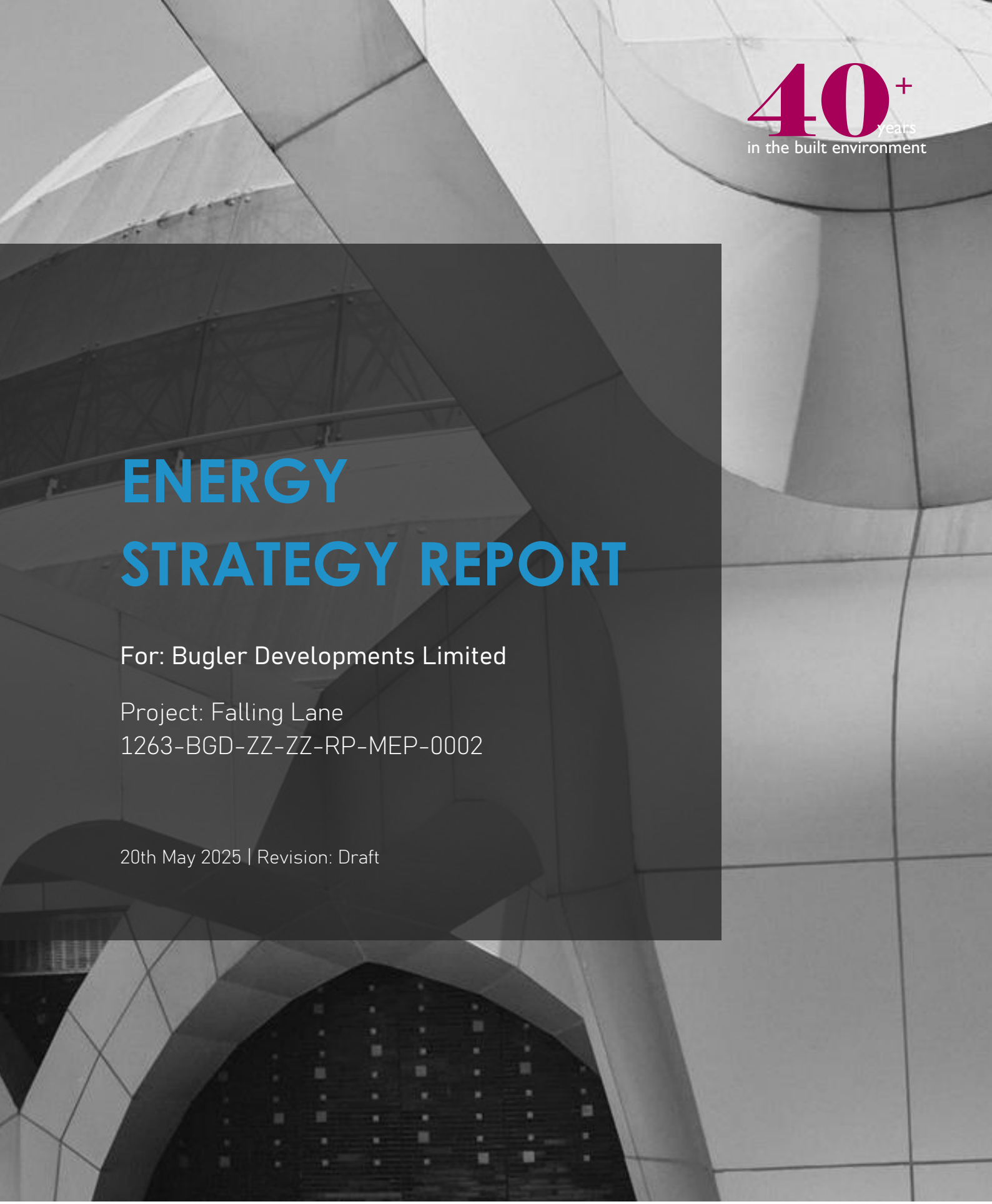

40+ years in the built environment

# ENERGY STRATEGY REPORT

For: Bugler Developments Limited

Project: Falling Lane
1263-BGD-ZZ-ZZ-RP-MEP-0002

20th May 2025 | Revision: Draft

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# CONTENTS


| | |
|---|---|
| DOCUMENT CONTROL | 3 |
| 1.0 EXECUTIVE SUMMARY | 4 |
| 2.0 INTRODUCTION | 5 |
| 3.0 DEVELOPMENT EMISSIONS | 8 |
| 4.0 DISTRICT HEATING – BE CLEAN | 11 |
| 5.0 LOW OR ZERO CARBON ENERGY TECHNOLOGIES | 12 |
| 6.0 CONCLUSION | 16 |
| 7.0 APPENDICES | 18 |

# DOCUMENT CONTROL

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# 1.0 EXECUTIVE SUMMARY

This report assesses the energy efficiency, and low carbon and renewable energy technologies that have been considered to reduce the carbon footprint of the planned development at Falling Lane (former Library site), West Drayton. In addition, the energy consumption and associated carbon emission of a 'base case' scheme have been assessed by the application of minimum Building Regulations.

The development is a new 5 storey building consisting of 50 apartments and supporting facilities.

Regional planning policy requires the site to be net zero carbon with a minimum on-site reduction of 35% beyond Building Regulations. This target must also be proven using 'new' SAP10 carbon factors which take account of the decarbonisation of the grid.

The building fabric and its services have firstly been made as efficient as possible to ensure the building uses as little energy as possible before renewables are introduced. This includes the following measures:

- High levels of insulation
- Low energy lighting and controls
- Low U-Value glazing
- High efficiency heat recovery ventilation

These measures produced a $CO_2$ saving of 12.9 tonnes compared to a Building Regulations compliance building representing an 24% saving.

Finally, renewables were introduced to further improve the $CO_2$ emissions from the building. Following a review of a wide range of technologies the following have been chosen:

- High efficiency air source heat pumps
- Solar thermal panels for hot water production

Using the above, the building achieves a further $CO_2$ saving of 19.4 tonnes or 36% over the measures mentioned above.

The cumulative measures mentioned above produce a $CO_2$ saving of 32 tonnes and a 60% saving compared to a Building Regulations Compliant Building.

This translates to an offset payment of £62,292 at a cost of £95/tonne $CO_2$ over 30 years.

# 2.0 INTRODUCTION

## 2.1 BACKGROUND TO THE SCHEME

The project involves the development of the Site for the construction of a single 5 storey block to create 50 apartments including the provision of cycle spaces, undercroft car parking, and other associated works.

SAP 10.2 calculations have been performed to ensure that the baseline site emissions and the proposed energy-efficiency measures are modelled in the most accurate and relevant method available.

This report presents the findings of a preliminary energy demand and carbon reduction assessment for the proposed development. Several energy efficient, low carbon and renewable energy technologies have been explored by which the carbon footprint will be significantly reduced compared to that of a building designed to be compliant with current Building Regulations.

## 2.2 PLANNING POLICY

The Hillingdon Local Plan: Part 1 – Strategic Policies covers aspects of energy & sustainability under the following policies:

Policy BE1: Built Environment.

The Council will require all new development to improve and maintain the quality of the built environment in order to create successful and sustainable neighbourhoods, where people enjoy living and working and that serve the long-term needs of all residents. All new developments should:

1. Achieve a high quality of design in all new buildings, alterations, extensions and the public realm which enhances the local distinctiveness of the area, contributes to community cohesion and a sense of place.

2. Improve the quality of the public realm and provide for public and private spaces that are attractive, safe, functional, diverse, sustainable, accessible to all, respect the local character and landscape, integrate with the development, enhance and protect biodiversity through the inclusion of living walls, roofs and areas for wildlife, encourage physical activity and where appropriate introduce public art.

3. Maximise the opportunities for all new homes to contribute to tackling and adapting to climate change and reducing emissions of local air quality pollutants. The Council will require all new development to achieve reductions in carbon dioxide emission in line with the London Plan targets through energy efficient design and effective use of low and zero carbon technologies. Where the required reduction from on-site renewable energy is not feasible within major developments, contributions off-site will be sought. The Council will seek to merge a suite of sustainable design goals, such as the use of SUDS, water efficiency, lifetime homes, and energy efficiency into a requirement measured against the Code for Sustainable Homes and BREEAM.

Policy EM1: Climate Change Adaptation and Mitigation

1. Working with developers of major schemes to identify the opportunities to help provide efficiency initiatives that can benefit the existing building stock. 5. Promoting the use of decentralised energy within large scale development whilst improving local air quality levels.

2. Targeting areas with high carbon emissions for additional reductions through low carbon strategies. These strategies will also have an objective to minimise other pollutants that impact on local air quality. Targeting areas of poor air quality for additional emissions reductions.

3. In addition, minor and major non-residential development will be required to achieve a minimum of Building Research Establishment Environmental Assessment Method (BREEAM) 'Excellent' standard, or any future national equivalent.

4. Encouraging the installation of renewable energy for all new development in meeting the carbon reduction targets savings set out in the London Plan. Identify opportunities for new sources of electricity generation including anaerobic digestion, hydroelectricty and a greater use of waste as a resource.

In accordance with the above policies, the relevant GLA policies are as follows.

Policy SI 1 Improving air quality where all developments must be at least air quality neutral, and proposals should use design solutions to prevent or minimise increased exposure to existing air pollution and make provision to address local problems of air quality in preference to post-design or retro-fitted mitigation measures. A separate air quality report will satisfy this this policy, however, in order to assist the assessment of air quality impacts we will list the total fuel consumption for each energy source as requested by the GLA Energy Assessment Guidance.

Policy SI 2 of The London Plan 2021 details the mitigation measures for Climate Change within the district. This report will satisfy the requirements of Parts A, B & C of the policy. Part F of the policy will be provided separately.

Part A of the policy requires all major developments to be net zero-carbon. To achieve this, the following energy hierarchy must be used when minimising carbon emissions from new developments:

1) **Be lean** – use less energy and manage demand during operation.
2) **Be clean** – exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly.
3) **Be green** – maximise opportunities for renewable energy by producing, storing and using renewable energy on-site.
4) **Be seen** – monitor, verify and report on energy performance.

This approach ensures the building fabric and energy efficiency of fittings is improved before energy reductions are sought from renewables. This prevents renewables being used to simply offset carbon emission with no thought given to the building energy usage.

Part B of the policy requires an energy strategy to be produced outlining the how the zero-carbon target will be met within the framework of the energy hierarchy.

Part C expands further on the energy reduction required with a minimum on-site reduction of at least 35% beyond Building Regulations. As a portion of this saving, non-residential developments should achieve a 15% reduction through energy efficiency measure alone (be lean). Where it's clear the zero caron target cannot be met on site any shortfall should be provided, in agreement with the borough, either:

1. Through cash in lieu contribution to the borough's carbon offset fund, or
2. Off-sire provided that an alternative proposal is identified, and delivery is certain.

Part D of the policy then requires boroughs to establish and administer a carbon offset fund where funds are ringfenced to implement projects that deliver carbon reductions.

We have used the new carbon factors from SAP10 in this report. These factors consider the decarbonisation of the grid and should be used for all $CO_2$ calculations that fall under the Greater London Authority. Decarbonisation of the grid now means the carbon emissions from electricity are similar to those of gas when taking into account the efficiency of a gas boiler.

Policy SI 3 of The London Plan 2021 details the requirements for Energy infrastructure for large-scale developments. Where small scale developments are proposed, they should connect to local existing or planned heat networks. The 'Be Clean' section of this report details the investigations into local heat networks.

Policy SI 4 Managing heat risk regulates overheating risk within buildings. A separate overheating report has been provided to satisfy this Policy.

The 'be seen' policy establishes post-construction monitoring as good practice, enabling developers and building owners to better understand their buildings and identify methods for improving energy performance from the project inception stage and throughout the buildings lifetime.

The 'be seen' stage requires monitoring and reporting of the actual operational energy performance of major developments for at least five years via the Mayor's 'be seen' monitoring portal.

# 3.0 DEVELOPMENT EMISSIONS

## 3.1 BASE BUILDING EMISSIONS

To demonstrate the savings of the energy efficiency measures employed a base building is automatically created within the carbon modelling software. The base building is a Building Regulations compliant building and is referred to as the Notional Building. From this a Target Emission Rate or TER is given, which must be met or exceeded by the Building Emission Rate (BER).

The methodology for calculating the TER for non-domestic properties can be found in National Calculation Methodology modelling guide 2013 Edition. The Target Emission Rate for the development is as follows:

Total: 15.91 $kgCO_2/m^2$/year or 54.1 tonnes $CO_2$ / year

## 3.2 LEAN BUILDING EMISSIONS

The thermal envelope and Mechanical and Electrical services within the building have been designed to produce a highly efficient building. Details of the measures employed are listed below.

### 3.2.1 Building Fabric

The building has improved fabric U-Values, as below, by means of high levels of insulation.

| Table 2 | Building Regulations limits (Part L1A 2021) | Proposed Building |
|---|---|---|
| | [$W/m^2K$] | [$W/m^2K$] |
| Walls | 0.26 | 0.15 |
| Roof | 0.16 | 0.10 |
| Floors | 0.18 | 0.10 |
| Doors | 1.6 | 1.4 |
| Glazed Doors | 1.6 | 1.4 |
| Windows | 1.6 | 1.1 |
| *g-value* | - | 0.45 |
| | $m^3/hr/m^2$ | $m^3/hr/m^2$ |
| Air permeability | 8 | 3 |

### 3.2.2 Lighting

Low energy LEDs are specified throughout project.

### 3.2.3 Ventilation

High efficiency heat recovery units will be fitted to every bedroom. These will extract from the bathroom and bedroom and supply make-up air into the bedroom.

### 3.2.4 Heating

Standalone high efficiency gas fired condensing boilers will be used to provide the heating for the site. Dedicated gas fired condensing water heaters will provide hot water for bedrooms.

### 3.2.5 Wastewater Heat Recovery

While not being incorporated into this project, the use of wastewater heat recovery units installed in the vertical stacks can provide a recovery efficiency of at least 67%.

### 3.2.6 Low Flow Water Fittings

To reduce water use, and the energy consumption associated with hot water, low flow showers and taps are specified for all bathrooms and kitchen areas. In accordance with Part G of the Building Regulations the following maximum water consumption per fitting will be used to achieve an average water usage of less than 105 litres/person/day excluding an allowance for 5 litres/person/day for external water usage.

| Water Fitting | Maximum Consumption | M4(3) |
|---|---|---|
| WC | 4/2.6 litres dual flush | 4 litres single flush |
| Shower | 8 litres/min | 7 litres/min |
| Bath | 170 litres | N/A |
| Basin taps | 5 litres/min | 3.5 litres/min |
| Sink Taps | 8 litre/min | 19.2 litres/min |
| Dishwasher | 1.25 litres/place setting | 1.25 litres/place setting |
| Washing Machine | 8.17 litres/kilogram | 8.17 litres/kilogram |

### 3.2.7 Lean Building Carbon Emissions

The SAP 10.2 calculations was amended with the energy improvements listed above; the table below shows the results:

Total: 12.87 $kgCO_2/m^2$ or 41.2 tonnes $CO_2$ / year

*Improvement BER/TER: 24%*

The revised calculations showed a significant saving over the emissions of a Building Regulations compliant building with a 24% saving in $CO_2$.

The next step is to investigate the 'Be Clean' and 'Be Green' energy efficiency measures to explore the further reduction in carbon emissions.

## Thermal Bridging

The thermal bridging junction that has been incorporated into the SAP calculation are listed in the following table.

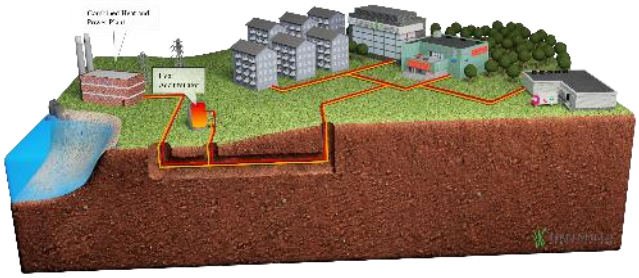
The thermal bridging junction details for the proposed project should be assessed by a suitably qualified professional and provided to the SAP assessor upon completion.

| Ref | Junction Details Description | Ψ (W/m.K) |
|---|---|---|
| E1 | Steel lintel with perforated steel base plate | 0.05 |
| E3 | Sill | 0.05 |
| E4 | Jamb | 0.05 |
| E5 | Ground floor (normal) | 0.16 |
| E20 | Exposed floor (normal) | 0.32 |
| E21 | Exposed floor (inverted) | 0.32 |
| E7 | Party floor between dwellings (in block of flats) | 0.07 |
| E23 | Balcony within or between dwellings, balcony support penetrates wall insulation | 0.02 |
| E24 | Eaves (insulation at ceiling level – inverted) | 0.24 |
| E15 | Flat roof with parapet | 0.56 |
| E16 | Corner (normal) | 0.09 |
| E17 | Corner (inverted) | -0.09 |
| E18 | Party wall between dwellings | 0.06 |
| E25 | Staggered party wall between dwellings | 0.06 |
| P1 | Ground floor | 0.08 |
| P7 | Exposed floor (normal) | 0.16 |
| P8 | Exposed floor (inverted) | 0.24 |
| P5 | Roof (insulation at rafter level) | 0.08 |

# 4.0 DISTRICT HEATING – BE CLEAN

### 4.1.1 Introduction to The Technology

District Heating is the production of heat in a central plant room and then the distribution of this heat via insulated pipes to consumers. This can be quite large areas such as whole cities or small applications such as several blocks of flats.



It is important to try and achieve a wide mix of building types to present a diversity of heat demands. The reason for this is that by using central plant there will be a constant base load.

This then lends itself to the use of CHP to generate the heat and produce electricity or even large biomass boilers to offer greater carbon savings.

### 4.1.2 Energy Storage

Heat energy can be stored in large buffer vessels to meet short term peak demands. This strategy is normally employed where local heating equipment is used to reduce the size of the plant. In a district heating system, the diversity would be so great that buffer vessel would serve no benefit in reducing heating plant sizes. A small buffer would normally be used in a district heating system to maintain flow temperatures on start up.

### 4.1.3 Life Cycle Costs/Maintenance Issues

Maintenance at a site level would be minimal as the plant required is basic. The maintenance at the heat source could be extensive if a CHP is used so there may be risks due to maintenance down time.

Electrical power is used to pump liquid through the heat exchanger, so there are also electrical energy costs associated with district heating.

### 4.1.4 Conclusion

This development is only 50 units with a relatively small heating demand. A large system to serve this development and to allow expansion of the network to other buildings would not be feasible on the site. We would look to bring in an existing district heating main to serve the site.

According to The Association for Decentralised Energy's National Heat Map there are no District Heating systems in the immediate vicinity to connect in to. The site is also not within the Heat Network Priority Area.

Whilst there are no opportunities at present for a district heating system is recommended a space in the plantroom is allocated for the future provision of a heat exchanger to connect to a wider district heating network. The heating and hot water system shall also be designed with reference to CIBSE CP1 with particular reference to low flow temperatures.

# 5.0 LOW OR ZERO CARBON ENERGY TECHNOLOGIES

An assessment of the renewable and low carbon technologies has been carried out.

The following technologies listed below were not feasible and their assessments can be found in the appendices:

CHP, Biomass, Wind Power, Photovoltaics, and ground source heat pumps.

We have found Solar Water Heating and Air Source Heat Pumps to be the most feasible options and their assessment is outline below.

## 5.1 AIR SOURCE HEAT PUMP

### 5.1.1 Introduction to the Technology

Located externally an Air Source Heat Pump (ASHP) uses outside air to provide a heat sink for the evaporative circuit in a reverse cycle refrigeration system. The energy extracted is then magnified up to 4 times and released by the condensing coil, as low-grade heat. This heat can be used to heat hot water or is ideal for underfloor heating.

There can be a large fluctuation in efficiency, as the external air temperature will change throughout the year.

ASHP are low carbon technologies (not zero carbon), as power is used to pump liquid through the ground and also to power the compressor in the refrigerant system.

### 5.1.2 Operation / Sizing

Commercial sized ASHPs can provide all the heating and hot water needed for a building. Reverse cycle heat pumps can also be used in commercial properties to provide cooling as well as heating, but these are not considered a low carbon technology.

It is anticipated that ASHP will provide all of the annual heating and hot water demand for the site. As the units can modulate well there would be no need for a backup gas heating system.

Pipework from these ASHPs to serve the heating shall distribute around the building to provide heating via radiators. The flow temperature will be limited to 45°C and return to 40°C. All radiators will be sized to suit these temperatures so will be around 3 times the size of normal radiators from a conventional boiler system.

Hot water to the student ensuites will be generated centrally within the lower ground floor plantroom and distributed throughout the building. Close coupled plate heat exchangers will be used for hot water generation to allow a flow temperature of 62°C to be used.

### 5.1.3 Energy Storage

Heat energy can be stored in buffer vessels to meet short term peak demands and reduce plant sizes. Air source heat pumps produce low grade heat, due to this, the use of a storage system is not economical for heating as the system cannot afford to lose temperature before being used within the building.

Typically, a high recovery hot water system would be used for student accommodation to lower the standing heat losses. However, to allow the size of heat pumps to be reduced, a 2 hour reheat time will be used for hot water generation. This allows one of the heat pumps to be used for heating and hot water.

### 5.1.4 Noise

Noise associated with ASHP can be an issue as they are located externally and close to the building to ensure minimal energy loss. Noise is generated from the compressor as well as the fan drawing air through the unit. The noise level of the ASHPs has been assessed by the acoustic consultant and no attenuation is required.

### 5.1.5 Heating & Hot Water Cost

To reduce the required heat pump installed capacity we have used larger than normal hot water cylinders that only need to be fully charged once a day. This will allow the building operator to schedule the time of recharge during to day to make use of any low-rate energy tariffs available.

The occupants of the building will be protected from high energy prices as their energy bills will be included in their weekly rental costs and set for the year.

To ensure the heat network is designed as efficiency as possible the detailed design of the system shall use CIBSE CP1: Heat networks: Code of Practice for the UK. Particular attention shall be given to the following broad themes throughout the project:

- Correct sizing of plant and networks
- Achieving low network heat losses
- Achieving consistently low return temperatures and optimising flow temperatures
- Use of variable flow principles
- Optimising the use of low-carbon heat sources to supply the network
- Delivery of a safe, high-quality scheme where risks are managed, and environmental impacts controlled

### 5.1.6 Conclusion

This form of low carbon technology is well suited to the site and offers a high $CO_2$ saving. However, the energy cost is higher than a gas boiler so financial payback is not possible.

Due to the above points this technology should be used for this project.

## 5.2 PHOTOVOLTAICS

### 5.2.1 Introduction to The Technology

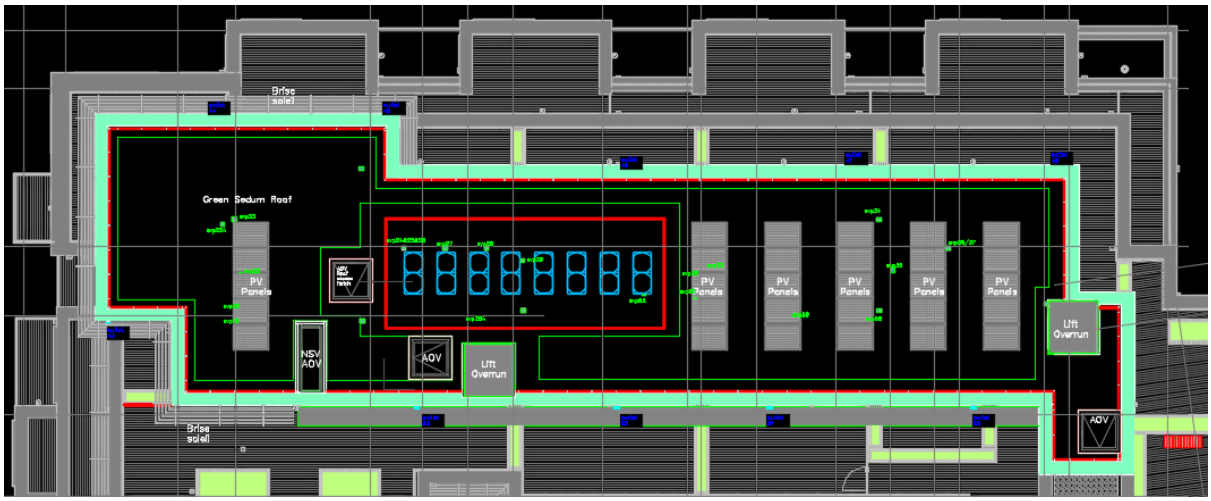
Photovoltaic (PV) cells convert energy from the sun into electricity, which can be used within the building or exported to the grid. The panels can be mounted on roofs, walls or integrated into the building fabric.

Dependent on planning restrictions, the flat roof mounted systems can be kept flat or tilted to obtain better performance and less cleaning.

With façade-mounted panels, although less efficient than the flat roofed mounted option, some cost is offset by the reduction in building façade elements.

### 5.2.2 Potential Energy Generation

The total free roof area for the proposed building is approx. 289.1m². Allowing access for maintenance, 57m² of PV could be installed. A PV panel is 1.9m² and produces 420Wp of electricity, therefore 30 panels could be installed with a peak capacity of 12.5kW.




### 5.2.3 Energy Storage

Electrical energy generated by photovoltaics can be stored in batteries. This can allow a greater proportion of the electricity to be used on site, reducing the payback period. Energy storage is not normally feasible for photovoltaic farms as the space and cost associated with the batteries would be cost prohibitive, however, roof top systems are normally small enough to make the use of energy storage beneficial.

### 5.2.4 Noise & Land Use

There are no noise issues associated with the use of PVs. The installation of the panels does require a large area, as maintenance access is required. These are usually mounted on the roof, so the size of the installation is limited by the available roof areas that are accessible.

### 5.2.5 Feasibility of Exporting Energy

Solar PV system installations include a connection to the grid, whereby any surplus electricity can be exported. Currently the Smart Export Guarantee provides a tariff or exported energy. This is set by energy companies and ranges from 0.5 p/kWh to 5.5 p/kWh.

### 5.2.6 Life Cycle Costs/Maintenance Issues

There is very little routine maintenance required for PV systems.  Maintenance may involve occasional cleaning, or more specialised electrical integrity testing.

### 5.2.7 Grants

There are currently no grants available for PV systems.

### 5.2.8 Conclusion

This form of sustainable energy will adapt extremely easily to this site, has low maintenance, good $CO_2$ reduction in relation to other options. They also offer a short payback which will improve as the cost of electricity rises.

Due to the above points this technology should be used for this project.

# 6.0 CONCLUSION

The planning policy requires the site to achieve a $CO_2$ emission reduction target of 35% using SAP10 carbon factors when compared to Building Regulations compliant building.

We have shown an improvement over the requirements of the Building Regulations $CO_2$ emissions by 17.47%, equivalent to an annual saving of 9.453 tonnes $CO_2$ per year by using an efficient building construction and high efficiency gas boilers, ventilation, lighting and wastewater heat recovery.

Unfortunately, there are no local district heating networks to connect to the site so no savings can be made under the 'be clean' heading.

Further savings are then realised using and air source heat pump for heating and hot water and PV panels. Both of these technologies contribute to the 'be green' heading and allow the development to achieve a further 22.775 reduction in $CO_2$ emissions giving a total 59.58% reduction in $CO_2$ emissions over a Building Regulations compliant building.

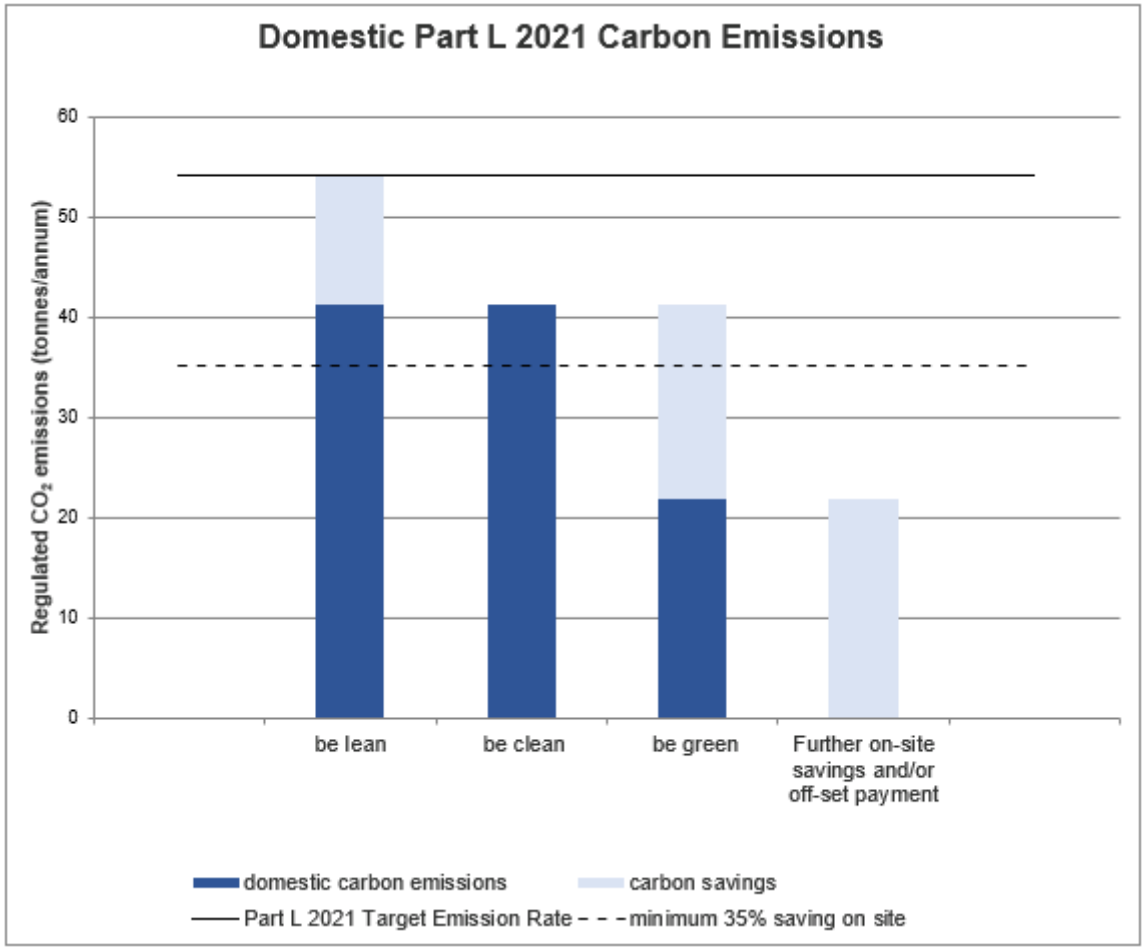
A summary of all the figures is shown below taken from the GLA carbon emission reporting spreadsheet.

| Regulated domestic carbon dioxide savings | | | |
|---|---|---|---|
| | Emissions per Annum (Tonnes $CO_2$) | Savings (Tonnes $CO_2$) | Savings (%) |
| Baseline $CO_2$ emissions | 54.1 | - | - |
| Be lean: savings from energy demand reduction | 41.2 | 12.9 | 24 |
| Be clean: savings from heat network | 41.2 | 0 | 0 |
| Be green: savings from renewable energy | 21.9 | 19.4 | 36 |
| Total Cumulative Savings | - | 32.2 | 60 |
| Annual savings require from off-set payment to reach zero carbon | - | 21.9 | - |
| | | | |
| Cumulative savings for off-set payment over 30 years | - | 656 | |
| Cash in-lieu contribution (£) | - | 62,292 | - |

The carbon reductions achieved plus the carbon offset payment satisfy the requirements of the GLA and Hillingdon policies.

The overall development dwelling fabric energy efficiency improvement over the target is listed as shown below.

| | Target Fabric Energy Efficiency (MWh/year) | Design Fabric Energy Efficiency (MWh/year) | Improvement (%) |
|---|---|---|---|
| Development Total | 45.69 | 42.08 | 8% |



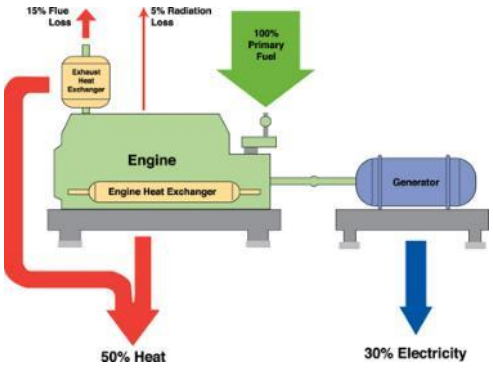
# 7.0 APPENDICES

## 7.1 UNFEASIBLE RENEWABLE ENERGY OPTIONS

### 7.1.1 COMBINED HEAT AND POWER

#### 7.1.1 Introduction to The Technology

Combined Heat & Power (CHP) also known as cogeneration is when an engine is used mechanically produce electricity and then the waste heat from the engine is used to heat water for heating and hot water production. The waste heat can also be used in conjunction with an absorption chiller for tri-generation.




Overall efficiencies of 90% can be achieved with contributions of 30% from the electricity generation and 60% from the waste heat.

CHP engines are normally driven by natural gas although biomass options are available in larger sizes (above 100kW$_{th}$)

#### 7.1.2 Potential Energy Generation

A CHP engine should be sized to meet the base heat load. It is particularly important to achieve a running time of at least 4,000-5,000 hours to ensure the system is cost effective. To achieve this running time the whole site would need to be served from a central CHP.

There are a number of products available for CHP applications and units can be installed in parallel to achieve various outputs.

#### 7.1.3 Energy Storage

As mentioned above a CHP needs to run for as many hours as possible. To achieve this, they are normally coupled to an energy storage buffer vessel to provide a heat sink for the CHP and to meet the peak loads of the building.

#### 7.1.4 Noise & Land Use

As CHP is normally a reciprocating engine there is some inherent noise generation associated with the units especially within the exhaust. It is important silencers are used at the chimney outlet however care must be taken not to introduce excessive pressure drop as this can affect the CHP unit's efficiency.

The engines are usually coupled with larger buffer vessel to smooth out the on/off nature of the energy delivery. This buffer combined with the engine and will mean a significant reduction of useable space to accommodate the required plant.

### 7.1.5 Feasibility of Exporting Energy

High-grade heat energy is produced by CHP units. It is possible to export the heat energy although the payback can be extended if the excess energy is not used as the operating hours of the engine will be reduced.

### 7.1.6 Life Cycle Costs/Maintenance Issues

CHP units require daily visual maintenance checks for fluid leaks and fluid levels plus routine servicing, typically every 1000 hours, to change engine oil and filters in addition to further visual checks. Maintenance costs equate to 1p/kWh of thermal output.

Remote monitoring is usual employed to ensure maintenance is carried out before issues arise.

### 7.1.7 Grants

CHP is currently not eligible for any grants.

### 7.1.9 Conclusion

This form of low carbon technology has a reasonable financial payback but would increase the carbon emissions of the site because of SAP10. Due to this, the technology is not recommended for the site.

### 7.2.1 BIOMASS

#### 7.2.1 Introduction to the Technology

Biomass is the solid form of 'bio energy'; energy is released by burning any plant derived from organic material such as trees, crops or animal dung. The material is burned in special boilers to provide heat energy, to replace the energy used from conventional fossil fuels, e.g. gas or oil. The most common form of biomass is wood, whether in a treated pellet form or of the natural wood chip variety.

The organic material will release $CO_2$ when burnt; this will be equivalent to the $CO_2$ which is absorbed during its growth. This makes biomass technology carbon neutral because, unlike fossil fuels, biomass crops can renew themselves over a relatively short period of time.

#### 7.2.2 Potential Energy Generation

Biomass boilers are usually sized as replacement to standard gas-fired boilers.

If required, the heat energy generation can be sized to meet the site demand or individual properties, depending on the arrangement of the site.

Due to the communal arrangement of the site a central biomass system would be installed.

#### 7.2.3 Energy Storage

Heat energy storage is usually used for biomass systems to allow the peak loads to be met without over sizing the heating plant. This allows the system to operate more efficiently and used less fuel.

#### 7.2.4 Noise & Land Use

With any form of biomass there is a considerable requirement for storage, together with access for delivery.

The bulk storage will take up considerable space and its size will largely be dependent on the product being burnt. Some product storage will need to be properly stirred and ventilated to prevent the formation of moulds, the spores of which can become a health hazard.

The operation of biomass boilers causes no more noise than conventional gas boilers but the associated activities, such as deliveries and ash removal, may cause annoyance to neighbours and residents within the local area.

#### 7.2.5 Feasibility of Exporting Energy

The energy produced from the use of Biomass would be available in the form of heat.

Any biomass installation would be sized to suit the proposed development but could be oversized to allow energy export. However, the cost of building the infrastructure to export compared with the available excess energy would deem export unfeasible.

### 7.2.6 Life Cycle Costs/Maintenance Issues

The cost of the biomass fuel will be continuous. Chipped fuel is comparatively cheaper than natural gas by 11% and wood pellets are 28% more expensive than gas.

A higher maintenance requirement applies to Biomass boilers, primarily to ensure that ash is removed and cleared from the boilers at the required intervals. This results in a potential downtime over a fossil fuel boiler plant.

The availability of the product must also be considered, together with the consequences of lack of supply.

### 7.2.7 Grants

RHI is only applicable for biomass systems which replace an existing fossil fuel boiler. This site would not be eligible.

### 7.2.9 Conclusion

There would be a potential for high carbon saving, but a biomass boiler installation would be expensive, and would not be practical for the site when considering the disturbance of deliveries with the proximity of the neighbours. The space required for fuel storage would also reduce the viability of the development.

We do not recommend this technology.

### 7.3.1 WIND POWER

#### 7.3.1 Introduction to the Technology

Wind turbines harness the energy in the wind and convert it to electricity. This can then be fed into the building or exported to the grid. Wind turbines are available in different sizes and designs, typically small turbines will be roof mounted and large turbines will be free standing. Horizontal axis turbines are the most common, although vertical axis turbines are also available.

Wind turbines are a renewable source of energy; although for them to be viable there needs to be an average wind speed of more than 5-6m/s, and a good prevailing wind without obstacles.

#### 7.3.2 Potential Energy Generation

Small/medium sized wind turbines mounted on the roof of the building would appear to be the most practical application for the site due to the proximity of neighbouring dwellings. Typical turbines might be rated at 2.5-6 kW.

The wind speeds given from Numerical Objective Analysis Boundary Layer wind speed database at the site in Falling Lane are 4.8m/s @ 10m, 5.6m/s @ 25m and 5.1m/s @ 45m. To reach 45m, where the turbine would be most efficient, the site would need a standalone turbine.

Electricity generated is highly dependent on the speed of the wind at the site of the turbine. Ideally an assessment of the local wind speed should be undertaken for a full year at the exact location where the turbine is to be installed.

#### 7.3.3 Energy Storage

Electrical energy generated by wind turbines can be stored in batteries. Dependant on the size of the turbine this can allow a greater proportion of the electricity to be used on site, reducing the payback period. Energy storage is not normally feasible for large turbines as the space and cost associated with the batteries would be cost prohibitive.

#### 7.3.4 Noise & Land Use

There is an issue of noise and visual impact from the wind turbines close to residential buildings. Noise and vibration result from the turbine's rotation. Their proximity to the buildings requires an assessment of the impact on resident's comfort.

Wind turbines can be roof-mounted, but this typically requires strengthening of the building structures, as well as careful design to avoid transmission through the buildings. Larger, freestanding turbines are possible, but they must be sited at some distance from the buildings, and they do then have considerable land take.

#### 7.3.5 Feasibility of Exporting Energy

Installing a wind turbine includes connection to the electricity grid. Permission from the local supplier is necessary, as well as an up-front agreement for power purchase. Most turbines operate continuously throughout the year and the generation and supply of electricity is fully automatic.

### 7.3.6 Life Cycle Costs/Maintenance Issues

Wind turbines are highly engineered products, which require specialist installation, commissioning and maintenance. Maintenance of horizontal axis wind turbines is usually on an annual basis and usually requires lowering the generator to the ground.

### 7.3.7 Grants

There are no grants available for wind turbines. The previously available Feed in Tarif scheme was closed to new applicants on the 1st April 2019.

### 7.3.9 Conclusion

Wind turbines could offer good energy and carbon saving but have an extended payback period. The use of a large wind turbine, or turbines within the site is considered impractical for the development due to the proximity of the neighbours.

We do not recommend this technology for the site.

### 7.4.1 GROUND SOURCE HEAT PUMPS

#### 7.4.1 Introduction to the Technology

At a depth of below around 10m, the ground is a constant temperature throughout the year. Ground Source Heat Pumps (GSHP) utilise this constant temperature by extracting heat from the ground at this depth.

This heat is used to provide a heat sink for the evaporative circuit in a reverse cycle refrigeration system. The energy extracted is then magnified by up to 4 times and released by the condensing coil, as low-grade heat. This heat can be used to pre-heat hot water or is ideal for underfloor heating.

The main factors affecting the performance of the heat transfer to the ground are the surface area of the collectors, i.e. pipe length, and the ground conditions. GSHP are low carbon technologies (not zero carbon), as power is used to pump liquid through the ground and also to power the compressor in the refrigerant system.

#### 7.4.2 Potential Energy Generation

For large applications the optimum application would be to size a heat pump in a similar way as CHP to cover the base load and to top the heat pump cycling on and off. For a domestic situation it can be sized to cover the entire load of the house.

Wet clay offers the best ground conditions for ground source heat pumps due to its high thermal conductivity. British Geological Survey records show the bedrock geology a mixture of clay and sand.

#### 7.4.3 Energy Storage

Heat energy can be stored in large buffer vessels to meet short term peak demands. This strategy is normally employed where local heating equipment is used to reduce the size of the plant. Ground source heat pumps produce low grade heat, due to this the size of the storage would be prohibitive for use in a heating system but can work in a hot water system.

#### 7.4.4 Noise & Land Use

There is very little noise associated with ground source heat pumps. The only source of noise is the compressor, and these are installed on vibration mountings to reduce nuisance. Heat pumps are ideally located at ground level.

Ground source heat pumps require ground collectors to act as external heat loops. There are two main alternative types with both requiring a considerable land area for their installation:

- Horizontal collectors require a large area of land. They are most appropriate for small installations. The pipes are buried in trenches 1–2m deep. Minimal separation distances should be maintained in order to allow for good thermal exchange.

- Vertical collectors are required where land is limited and are most suitable for hard rock types. Vertical boreholes have typical diameters of 0.2-0.3m and are between 15 to 180m depth. Boreholes should be at least 5m apart to prevent thermal interference.

### 7.4.5 Feasibility of Exporting Energy

Low-grade heat energy is produced by ground source heat pumps. It is not practical to export the heat energy that would be produced by ground source heating systems.

### 7.4.6 Life Cycle Costs/Maintenance Issues

Ground source heating systems have low maintenance requirements once installed. Electrical power is used to pump liquid through the ground and also to power the compressor in the refrigerant system, so there are electrical energy costs associated with GSHP. These costs offset the energy cost savings.

### 7.4.7 Grants

No grants are available for new building installations. The Renewable Heat Incentive is only applicable to technologies installed to replace exiting fossil fuel installations.

### 7.4.9 Conclusion

Extensive and complicate groundwork would be required throughout the site to install the ground loops. This technology is more suited to a large building where a single ground loop array can be installed more cost effectively.

The carbon savings are also low compared to the capital outlay.

This technology is not recommended for this project.

## 7.5.1 SOLAR WATER HEATING

### 7.5.1 Introduction to the Technology

Solar collectors are used to absorb the suns solar radiation. By passing liquid through these panels we can then harness this energy to heat water. This water is passed through a heat exchanger to heat water stored within a cylinder.

Solar water heating is a renewable technology; the only energy used is for a small pump to circulate the heated fluid. Typically, a solar thermal system can save over 50% of the energy needed for hot water.

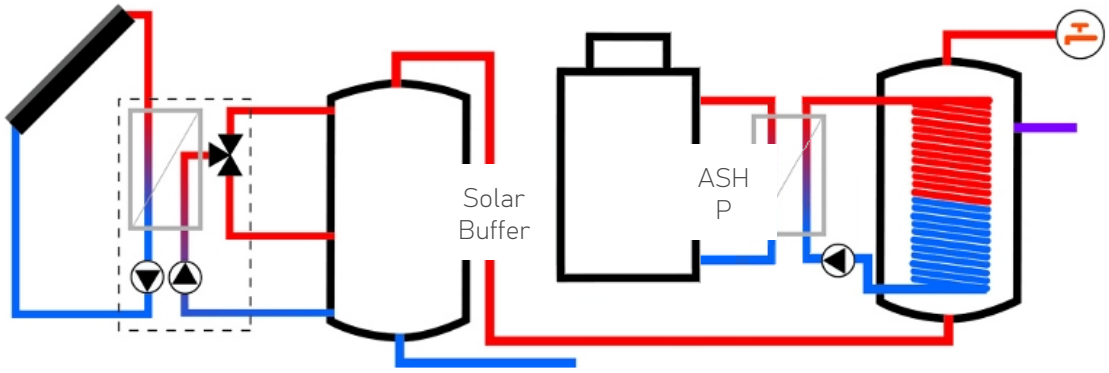
The optimum heat recovery is when the panels are inclined at around 30°.

Solar panels are a proven technology and have relatively low maintenance.

### 7.5.1 Energy Storage

Solar water heating is suited to using a storage system due to the asynchronous nature of the peak system outputs and peak demands. Hot water can be stored in a separate buffer used to pre heat water or in some instances providing the design temperature, dependant on the size of the system.

Due to the size of the solar thermal system a separate thermal store will be used to pre heat the hot water before it is fed into the hot water cylinders which are heated by the heat pump, as shown in the schematic below.




### 7.5.2 Conclusion

Solar thermal systems are considered a viable option to achieve $CO_2$ emissions reduction for the site, as they can provide an energy source for the domestic hot water systems, which is the largest energy demand for this type of accommodation.

Their payback is extremely long due to the low cost of gas, but this would decrease as the cost of fossil fuel rises. This technology is not recommended for this project.

## 7.2 Be Green SAP

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Property Reference** | Unit 1 | **Issued on Date** | 17/05/2025 |
| **Assessment Reference** | 00001 | **Prop Type Ref** | Unit 1 |
| **Property** | | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 73 C | **DER** | 7.26 | **TER** | 16.68 |
| **Environmental** | 94 A | **% DER < TER** | | | 56.47 |
| **$CO_2$ Emissions (t/year)** | 0.62 | **DFEE** | 54.09 | **TFEE** | 56.28 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 3.91 |
| **% DPER < TPER** | 14.75 | **DPER** | 75.72 | **TPER** | 88.82 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Robert Arnold | **Assessor ID** | BA04-0001 |
| **Client** | | | |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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## 1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 19.9800 (1b) | x | 2.9200 (2b) | = | 58.3416 | (1b) - (3b) |
| First floor | 78.3400 (1c) | x | 2.7400 (2c) | = | 214.6516 | (1c) - (3c) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 98.3200 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = | 272.9932 | (5) |

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## 2. Ventilation rate

---

| | | | | m3 per hour | |
|---|---|---|---|---|---|
| Number of open chimneys | | | 0 * 80 = | 0.0000 | (6a) |
| Number of open flues | | | 0 * 20 = | 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | | | 0 * 10 = | 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | | | 0 * 20 = | 0.0000 | (6d) |
| Number of flues attached to other heater | | | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | | | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | | | 0 * 10 = | 0.0000 | (7a) |
| Number of passive vents | | | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | | | 0 * 40 = | 0.0000 | (7c) |
| | | | | Air changes per hour | |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | | | 0.0000 / (5) = | 0.0000 | (8) |
| Pressure test | | | | Yes | |
| Pressure Test Method | | | | Blower Door | |
| Measured/design AP50 | | | | 3.0000 | (17) |
| Infiltration rate | | | | 0.1500 | (18) |
| Number of sides sheltered | | | | 0 | (19) |
| Shelter factor | | | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | | | (21) = (18) x (20) = | 0.1500 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.1912 | 0.1875 | 0.1837 | 0.1650 | 0.1612 | 0.1425 | 0.1425 | 0.1388 | 0.1500 | 0.1612 | 0.1687 | 0.1762 | (22b) |

Balanced mechanical ventilation with heat recovery

| | | |
|---|---|---|
| If mechanical ventilation | 0.5000 | (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | 0.5000 | (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | 80.1000 | (23c) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective ac | 0.2907 | 0.2870 | 0.2833 | 0.2645 | 0.2607 | 0.2420 | 0.2420 | 0.2382 | 0.2495 | 0.2607 | 0.2682 | 0.2757 | (25) |

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## 3. Heat losses and heat loss parameter

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| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| Window | | | 17.9000 | 1.0536 | 18.8602 | | | (27) |
| Door | | | 4.3500 | 1.4000 | 6.0900 | | | (26) |
| Glass Door | | | 4.8000 | 1.3258 | 6.3636 | | | (27) |
| Ground Floor | | | 19.9800 | 0.1000 | 1.9980 | 110.0000 | 2197.8000 | (28a) |
| Ground External Walls | 41.0200 | 7.4100 | 33.6100 | 0.1500 | 5.0415 | 150.0000 | 5041.5000 | (29a) |
| First External Walls | 88.4400 | 17.5100 | 70.9300 | 0.1500 | 10.6395 | 150.0000 | 10639.5000 | (29a) |
| Wall to Communal Corridor | 4.5700 | 2.1300 | 2.4400 | 0.1400 | 0.3416 | 150.0000 | 366.0000 | (29a) |
| Roof | 69.7500 | | 69.7500 | 0.1000 | 6.9750 | 9.0000 | 627.7500 | (30) |
| Total net area of external elements Aum(A, m2) | | | 223.7600 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | | (26)...(30) + (32) = | 56.3094 | | | (33) |
| Main dwelling | | | | | | | | |
| Grd to Unit 9 | | | 12.7600 | 0.0000 | 0.0000 | 70.0000 | 893.2000 | (32) |
| First to Unit 2 | | | 25.9700 | 0.0000 | 0.0000 | 70.0000 | 1817.9000 | (32) |
| First to Unit 11 | | | 20.1800 | 0.0000 | 0.0000 | 70.0000 | 1412.6000 | (32) |

| | | | | |
|---|---|---|---|---|
| Party Floor 1 | 55.3600 | 80.0000 | 4428.8000 | (32d) |
| Grd Internal Partitions | 42.8900 | 9.0000 | 386.0100 | (32c) |
| First Internal Partitions | 112.0600 | 9.0000 | 1008.5400 | (32c) |
| Internal Floor | 22.9900 | 18.0000 | 413.8200 | (32d) |
| Internal Ceiling | 19.9800 | 9.0000 | 179.8200 | (32e) |

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 29413.2400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 299.1583 (35)
List of Thermal Bridges

| K1 Element | Length | Psi-value | Total |
|---|---|---|---|
| E1 Steel lintel with perforated steel base plate | 12.1200 | 0.0500 | 0.6060 |
| E3 Sill | 1.8100 | 0.0500 | 0.0905 |
| E4 Jamb | 39.0200 | 0.0500 | 1.9510 |
| E5 Ground floor (normal) | 14.0100 | 0.1600 | 2.2416 |
| E6 Intermediate floor within a dwelling | 14.0150 | 0.0000 | 0.0000 |
| E16 Corner (normal) | 19.7200 | 0.0900 | 1.7748 |
| E18 Party wall between dwellings | 2.7400 | 0.0300 | 0.0822 |
| E25 Staggered party wall between dwellings | 8.5800 | 0.0300 | 0.2574 |
| E17 Corner (inverted - internal area greater than external area) | 11.1400 | -0.0900 | -1.0026 |
| E7 Party floor between dwellings (in blocks of flats) | 16.3200 | 0.0350 | 0.5712 |
| E15 Flat roof with parapet | 33.0000 | 0.5600 | 18.4800 |
| E23 Balcony within or between dwellings, balcony support penetrates wall insulation | 4.6200 | 0.0200 | 0.0924 |
| E24 Eaves (insulation at ceiling level - inverted) | 14.2850 | 0.1200 | 1.7142 |
| P1 Party wall - Ground floor | 4.3725 | 0.0400 | 0.1749 |
| E7 Party floor between dwellings (in blocks of flats) | 1.6700 | 0.0350 | 0.0585 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 27.0921 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 83.4014 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 26.1930 | 25.8552 | 25.5174 | 23.8282 | 23.4904 | 21.8012 | 21.8012 | 21.4634 | 22.4769 | 23.4904 | 24.1660 | 24.8417 | (38) |
| Heat transfer coeff | 109.5945 | 109.2566 | 108.9188 | 107.2297 | 106.8918 | 105.2027 | 105.2027 | 104.8648 | 105.8783 | 106.8918 | 107.5675 | 108.2431 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 107.1452 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.1147 | 1.1112 | 1.1078 | 1.0906 | 1.0872 | 1.0700 | 1.0700 | 1.0666 | 1.0769 | 1.0872 | 1.0941 | 1.1009 | (40) |
| HLP (average) | | | | | | | | | | | | 1.0898 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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4. Water heating energy requirements (kWh/year)

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Assumed occupancy 2.7234 (42)
Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 68.1170 | 67.0741 | 65.5372 | 63.1730 | 61.0546 | 58.0911 | 55.7471 | 58.4874 | 59.8656 | 62.8008 | 65.8576 | 68.0556 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 29.5023 | 29.0570 | 28.4234 | 27.4746 | 26.6195 | 25.4424 | 24.5494 | 25.6414 | 26.2145 | 27.3809 | 28.5935 | 29.4789 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 42.5205 | 40.9743 | 39.4281 | 37.8819 | 36.3357 | 34.7895 | 34.7895 | 36.3357 | 37.8819 | 39.4281 | 40.9743 | 42.5205 | (42c) |

Average daily hot water use (litres/day) 128.8093 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 140.1399 | 137.1055 | 133.3888 | 128.5295 | 124.0099 | 118.3230 | 115.0860 | 120.4645 | 123.9620 | 129.6098 | 135.4255 | 140.0551 | (44) |
| Energy conte | 206.3101 | 181.4183 | 190.6099 | 167.8917 | 159.7993 | 136.8366 | 127.1734 | 141.7889 | 143.7898 | 167.0154 | 183.0321 | 205.6811 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 2011.3466 | |
| Distribution loss (46)m = 0.15 x (45)m | 30.9465 | 27.2127 | 28.5915 | 25.1838 | 23.9699 | 20.5255 | 19.0760 | 21.2683 | 21.5685 | 25.0523 | 27.4548 | 30.8522 | (46) |
| Water storage loss: | | | | | | | | | | | | | |
| Store volume | | | | | | | | | | | | 110.0000 | (47) |
| b) If manufacturer declared loss factor is not known : | | | | | | | | | | | | | |
| Hot water storage loss factor from Table 2 (kWh/litre/day) | | | | | | | | | | | | 0.0152 | (51) |
| Volume factor from Table 2a | | | | | | | | | | | | 1.0294 | (52) |
| Temperature factor from Table 2b | | | | | | | | | | | | 0.6000 | (53) |
| Enter (49) or (54) in (55) | | | | | | | | | | | | 1.0327 | (55) |
| Total storage loss | 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (56) |
| If cylinder contains dedicated solar storage | 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (57) |
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | 261.5869 | 231.3457 | 245.8867 | 221.3853 | 215.0761 | 190.3303 | 182.4502 | 197.0657 | 197.2834 | 222.2922 | 236.5257 | 260.9579 | (62) |
| WWHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | 261.5869 | 231.3457 | 245.8867 | 221.3853 | 215.0761 | 190.3303 | 182.4502 | 197.0657 | 197.2834 | 222.2922 | 236.5257 | 260.9579 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2662.1863 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2662 | (64) |
| Electric shower(s) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | 112.8196 | 100.2635 | 107.5992 | 98.6189 | 97.3547 | 88.2931 | 86.5066 | 91.3663 | 90.6050 | 99.7541 | 103.6531 | 112.6104 | (65) |

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5. Internal gains (see Table 5 and 5a)

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Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 136.1710 | 136.1710 | 136.1710 | 136.1710 | 136.1710 | 136.1710 | 136.1710 | 136.1710 | 136.1710 | 136.1710 | 136.1710 | 136.1710 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 127.9034 | 141.6074 | 127.9034 | 132.1669 | 127.9034 | 132.1669 | 127.9034 | 127.9034 | 132.1669 | 127.9034 | 132.1669 | 127.9034 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 253.5828 | 256.2142 | 249.5832 | 235.4665 | 217.6467 | 200.8987 | 189.7099 | 187.0785 | 193.7095 | 207.8262 | 225.6460 | 242.3941 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 36.6171 | 36.6171 | 36.6171 | 36.6171 | 36.6171 | 36.6171 | 36.6171 | 36.6171 | 36.6171 | 36.6171 | 36.6171 | 36.6171 | (69) |
| Pumps, fans | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | -108.9368 | -108.9368 | -108.9368 | -108.9368 | -108.9368 | -108.9368 | -108.9368 | -108.9368 | -108.9368 | -108.9368 | -108.9368 | -108.9368 | (71) |
| Water heating gains (Table 5) | 151.6392 | 149.2017 | 144.6226 | 136.9707 | 130.8531 | 122.6293 | 116.2723 | 122.8041 | 125.8403 | 134.0780 | 143.9626 | 151.3581 | (72) |
| Total internal gains | | | | | | | | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 596.9768 | 610.8746 | 585.9605 | 568.4554 | 540.2546 | 519.5462 | 497.7370 | 501.6373 | 515.5681 | 533.6590 | 565.6268 | 585.5069 (73) |

6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Northeast | 7.8500 | 11.2829 | 0.4500 | 0.7000 | 0.7700 | 19.3346 | (75) |
| Southeast | 2.5700 | 36.7938 | 0.4500 | 0.7000 | 0.7700 | 20.6420 | (77) |
| Southwest | 7.4800 | 36.7938 | 0.4500 | 0.7000 | 0.7700 | 60.0787 | (79) |
| Northeast | 2.4000 | 11.2829 | 0.4500 | 0.7000 | 0.7700 | 5.9112 | (75) |
| Southwest | 2.4000 | 36.7938 | 0.4500 | 0.7000 | 0.7700 | 19.2766 | (79) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 125.2431 | 221.7210 | 325.6422 | 440.8207 | 527.8329 | 539.0052 | 513.4207 | 446.2141 | 365.1680 | 251.0546 | 151.5395 | 106.1939 | (83) |
| Total gains | 722.2199 | 832.5956 | 911.6027 | 1009.2761 | 1068.0875 | 1058.5514 | 1011.1577 | 947.8514 | 880.7361 | 784.7135 | 717.1663 | 691.7008 | (84) |

7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, ni1,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 74.5507 | 74.7812 | 75.0132 | 76.1948 | 76.4356 | 77.6629 | 77.6629 | 77.9131 | 77.1673 | 76.4356 | 75.9555 | 75.4814 | |
| alpha | 5.9700 | 5.9854 | 6.0009 | 6.0797 | 6.0957 | 6.1775 | 6.1775 | 6.1942 | 6.1445 | 6.0957 | 6.0637 | 6.0321 | |
| util living area | 0.9976 | 0.9940 | 0.9840 | 0.9420 | 0.8264 | 0.6213 | 0.4558 | 0.5051 | 0.7686 | 0.9616 | 0.9939 | 0.9982 | (86) |
| MIT | 19.9470 | 20.1157 | 20.3519 | 20.6697 | 20.8938 | 20.9851 | 20.9981 | 20.9965 | 20.9488 | 20.6596 | 20.2552 | 19.9273 | (87) |
| Th 2 | 19.9889 | 19.9917 | 19.9945 | 20.0085 | 20.0113 | 20.0254 | 20.0254 | 20.0282 | 20.0198 | 20.0113 | 20.0057 | 20.0001 | (88) |
| util rest of house | 0.9967 | 0.9916 | 0.9776 | 0.9193 | 0.7694 | 0.5337 | 0.3560 | 0.4006 | 0.6838 | 0.9416 | 0.9911 | 0.9975 | (89) |
| MIT 2 | 18.7718 | 18.9888 | 19.2892 | 19.6866 | 19.9298 | 20.0182 | 20.0249 | 20.0272 | 19.9897 | 19.6847 | 19.1781 | 18.7550 | (90) |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.5294 | (91) |
| MIT | 19.3939 | 19.5853 | 19.8518 | 20.2070 | 20.4402 | 20.5301 | 20.5401 | 20.5404 | 20.4975 | 20.2008 | 19.7483 | 19.3756 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.3939 | 19.5853 | 19.8518 | 20.2070 | 20.4402 | 20.5301 | 20.5401 | 20.5404 | 20.4975 | 20.2008 | 19.7483 | 19.3756 | (93) |

8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9960 | 0.9904 | 0.9765 | 0.9244 | 0.7957 | 0.5799 | 0.4090 | 0.4561 | 0.7273 | 0.9461 | 0.9902 | 0.9969 | (94) |
| Useful gains | 719.3220 | 824.6178 | 890.1577 | 933.0012 | 849.8454 | 613.8627 | 413.5167 | 432.3053 | 640.5542 | 742.4384 | 710.1058 | 689.5246 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | 1654.2130 | 1604.4706 | 1454.2584 | 1212.4489 | 934.2508 | 623.8609 | 414.5091 | 434.1799 | 677.3551 | 1026.2478 | 1360.5465 | 1642.6557 | (97) |
| Space heating kWh | 695.5589 | 524.0611 | 419.6909 | 201.2023 | 62.7976 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 211.1542 | 468.3173 | 709.1296 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 3291.9120 | |
| Solar heating kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | 695.5589 | 524.0611 | 419.6909 | 201.2023 | 62.7976 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 211.1542 | 468.3173 | 709.1296 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 3291.9120 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 33.4816 | (99) |

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ext. temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | |
| Heat loss rate W | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 988.9052 | 778.4998 | 796.9728 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (100) |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.9226 | 0.9653 | 0.9491 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (101) |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 912.3202 | 751.4960 | 756.3934 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (102) |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 1172.7959 | 1120.7839 | 1048.6514 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 187.5425 | 274.7502 | 217.4400 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (104) |
| Cooled fraction | | | | | | | | | | fC = cooled area / (4) = | | 0.9967 | (105) |
| Intermittency factor (Table 10b) | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | (106) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 46.7330 | 68.4640 | 54.1831 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) |
| Space cooling requirement | | | | | | | | | | | | 169.3801 | (107) |

9b. Energy requirements

| | | |
|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | 0.0000 | (301) |
| Fraction of space heat from community system | 1.0000 | (302) |
| Fraction of heat from community Heat pump-Space and Water | 1.0000 | (303a) |
| Factor for control and charging method (Table 4c(3)) for space heating | 1.0000 | (305) |
| Factor for charging method (Table 4c(3)) for water heating | 1.0000 | (305a) |
| Distribution loss factor (Table 12c) for community heating system | 2.0000 | (306) |
| Efficiency of secondary/supplementary heating system, % | 0.0000 | (208) |
| Space heating: | | |
| Space heating requirement | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 695.5589 | 524.0611 | 419.6909 | 201.2023 | 62.7976 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 211.1542 | 468.3173 | 709.1296 (98) |
| Space heat from Heat pump = (98) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | |
| 307a | 1391.1179 | 1048.1222 | 839.3819 | 402.4047 | 125.5952 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 422.3084 | 936.6346 | 1418.2592 |
| Space heating requirement | | | | | | | | | | | | |
| | 1391.1179 | 1048.1222 | 839.3819 | 402.4047 | 125.5952 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 422.3084 | 936.6346 | 1418.2592 (307) |

| | | |
|---|---|---|
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000 | (308) |
| Space heating fuel for secondary/supplementary system | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (309) |

Water heating
Annual water heating requirement

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 261.5869 | 231.3457 | 245.8867 | 221.3853 | 215.0761 | 190.3303 | 182.4502 | 197.0657 | 197.2834 | 222.2922 | 236.5257 | 260.9579 (64) |

Water heat from Heat pump = (64) x 1.00 x 1.00 x 2.00

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 310a | 523.1739 | 462.6914 | 491.7733 | 442.7707 | 430.1522 | 380.6606 | 364.9005 | 394.1314 | 394.5669 | 444.5844 | 473.0515 | 521.9159 |

Water heating fuel

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 523.1739 | 462.6914 | 491.7733 | 442.7707 | 430.1522 | 380.6606 | 364.9005 | 394.1314 | 394.5669 | 444.5844 | 473.0515 | 521.9159 (310) |

Cooling System Energy Efficiency Ratio 2.6000 (314)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space coolin | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 17.9742 | 26.3323 | 20.8396 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (315) |
| Pumps and Fa | 24.1567 | 21.8190 | 24.1567 | 23.3775 | 24.1567 | 23.3775 | 24.1567 | 24.1567 | 23.3775 | 24.1567 | 23.3775 | 24.1567 (331) |
| Lighting | 29.8762 | 23.9678 | 21.5803 | 15.8107 | 12.2126 | 9.9778 | 11.1408 | 14.4812 | 18.8096 | 24.6792 | 27.8751 | 30.7065 (332) |

Electricity generated by PVs (Appendix M) (negative quantity)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (333a)m | -4.8751 | -7.9694 | -13.3656 | -17.4856 | -21.0549 | -20.4907 | -20.1966 | -17.8797 | -14.2533 | -10.0092 | -5.7090 | -4.0847 (333a) |

Electricity generated by wind turbines (Appendix M) (negative quantity)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (334a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (334a) |

Electricity generated by hydro-electric generators (Appendix M) (negative quantity)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (335a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (335a) |

Electricity generated by PVs (Appendix M) (negative quantity)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (333b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (333b) |

Electricity generated by wind turbines (Appendix M) (negative quantity)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (334b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (334b) |

Electricity generated by hydro-electric generators (Appendix M) (negative quantity)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (335b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (335b) |

Annual totals kWh/year

| | |
|---|---|
| Space heating fuel - community heating | 6583.8240 (307) |
| Space heating fuel - secondary | 0.0000 (309) |
| Water heating fuel - community heating | 5324.3727 (310) |
| Efficiency of water heater | 0.0000 (311) |
| Electricity used for heat distribution | 65.8382 (313) |
| Space cooling fuel | 65.1462 (321) |

Electricity for pumps and fans:
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8540)

| | |
|---|---|
| mechanical ventilation fans (SFP = 0.8540) | 284.4262 (330a) |
| Total electricity for the above, kWh/year | 284.4262 (331) |
| Electricity for lighting (calculated in Appendix L) | 241.1179 (332) |

Energy saving/generation technologies (Appendices M ,N and Q)

| | |
|---|---|
| PV generation | -157.3738 (333) |
| Wind generation | 0.0000 (334) |
| Hydro-electric generation (Appendix N) | 0.0000 (335a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 (335) |
| Appendix Q - special features | |
| Energy saved or generated | -0.0000 (336) |
| Energy used | 0.0000 (337) |
| Total delivered energy for all uses | 12341.5132 (338) |

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12b. Carbon dioxide emissions - Community heating scheme

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (367) |
| Space and Water heating from Heat pump | 4252.9274 | 0.1560 | 366.8006 | (367) |
| Electrical energy for heat distribution (space & water) | 65.8382 | 0.0000 | 17.7712 | (372) |
| Overall CO2 factor for heat network | | | 0.0548 | (386) |
| Total CO2 associated with community systems | | | 652.4558 | (373) |
| Space and water heating | | | 652.4558 | (376) |
| Space cooling | 65.1462 | 0.1138 | 7.4138 | (377) |
| Pumps, fans and electric keep-hot | 284.4262 | 0.1387 | 39.4534 | (378) |
| Energy for lighting | 241.1179 | 0.1443 | 34.8008 | (379) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -157.3738 | 0.1317 | -20.7256 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -20.7256 | (380) |
| Total CO2, kg/year | | | 713.3982 | (383) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 7.2600 | (384) |

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13b. Primary energy - Community heating scheme

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| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (467a) |
| Space and Water heating from Heat pump | 4252.9274 | 1.5775 | 3709.3342 | (467) |
| Electrical energy for heat distribution (space & water) | 65.8382 | 0.0000 | 184.8400 | (472) |
| Overall CO2 factor for heat network | | | 0.5699 | (486) |
| Total CO2 associated with community systems | | | 6786.2696 | (473) |
| Space and water heating | | | 6786.2696 | (476) |
| Space cooling | 65.1462 | 1.4195 | 92.4759 | (477) |
| Pumps, fans and electric keep-hot | 284.4262 | 1.5128 | 430.2799 | (478) |
| Energy for lighting | 241.1179 | 1.5338 | 369.8347 | (479) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -157.3738 | 1.4866 | -233.9457 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -233.9457 | (480) |
| Total Primary energy kWh/year | | | 7444.9143 | (483) |
| Dwelling Primary energy Rate (DPER) | | | 75.7200 | (484) |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 19.9800 (1b) | x | 2.9200 (2b) | = | 58.3416 | (1b) - (3b) |
| First floor | 78.3400 (1c) | x | 2.7400 (2c) | = | 214.6516 | (1c) - (3c) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 98.3200 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = | 272.9932 | (5) |

## 2. Ventilation rate

| | m3 per hour | |
|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 (6a) |
| Number of open flues | 0 * 20 = | 0.0000 (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 (6f) |
| Number of intermittent extract fans | 3 * 10 = | 30.0000 (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 (7c) |

| | Air changes per hour | |
|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 30.0000 / (5) = | 0.1099 (8) |
| Pressure test | | Yes |
| Pressure Test Method | | Blower Door |
| Measured/design AP50 | | 5.0000 (17) |
| Infiltration rate | | 0.3599 (18) |
| Number of sides sheltered | | 0 (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.3599 (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.4589 | 0.4499 | 0.4409 | 0.3959 | 0.3869 | 0.3419 | 0.3419 | 0.3329 | 0.3599 | 0.3869 | 0.4049 | 0.4229 | (22b) |
| Effective ac | 0.6053 | 0.6012 | 0.5972 | 0.5784 | 0.5748 | 0.5584 | 0.5584 | 0.5554 | 0.5648 | 0.5748 | 0.5820 | 0.5894 | (25) |

## 3. Heat losses and heat loss parameter

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| TER Opaque door | | | 4.3500 | 1.0000 | 4.3500 | | | (26) |
| TER Opening Type | | | 20.2300 | 1.1450 | 23.1641 | | | (27) |
| Ground Floor | | | 19.9800 | 0.1300 | 2.5974 | | | (28a) |
| Ground External Walls | 41.0200 | 6.8500 | 34.1700 | 0.1800 | 6.1506 | | | (29a) |
| First External Walls | 88.4400 | 15.6000 | 72.8400 | 0.1800 | 13.1112 | | | (29a) |
| Wall to Communal Corridor | 4.5700 | 2.1300 | 2.4400 | 0.1800 | 0.4392 | | | (29a) |
| Roof | 69.7500 | | 69.7500 | 0.1100 | 7.6725 | | | (30) |
| Total net area of external elements Aum(A, m2) | | | 223.7600 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 57.4850 | | | (33) |
| Main dwelling | | | | | | | | |
| Grd to Unit 9 | | | 12.7600 | 0.0000 | 0.0000 | | | (32) |
| First to Unit 2 | | | 25.9700 | 0.0000 | 0.0000 | | | (32) |
| First to Unit 11 | | | 20.1800 | 0.0000 | 0.0000 | | | (32) |

| | | |
|---|---|---|
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | 299.1583 | (35) |

List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E1 Steel lintel with perforated steel base plate | 12.1200 | 0.0500 | 0.6060 |
| E3 Sill | 1.8100 | 0.0500 | 0.0905 |
| E4 Jamb | 39.0200 | 0.0500 | 1.9510 |
| E5 Ground floor (normal) | 14.0100 | 0.1600 | 2.2416 |
| E6 Intermediate floor within a dwelling | 14.0150 | 0.0000 | 0.0000 |
| E16 Corner (normal) | 19.7200 | 0.0900 | 1.7748 |
| E18 Party wall between dwellings | 2.7400 | 0.0600 | 0.1644 |
| E25 Staggered party wall between dwellings | 8.5800 | 0.0600 | 0.5148 |
| E17 Corner (inverted - internal area greater than external area) | 11.1400 | -0.0900 | -1.0026 |
| E7 Party floor between dwellings (in blocks of flats) | 16.3200 | 0.0700 | 1.1424 |
| E15 Flat roof with parapet | 33.0000 | 0.5600 | 18.4800 |
| E23 Balcony within or between dwellings, balcony support penetrates wall insulation | 4.6200 | 0.0200 | 0.0924 |
| E24 Eaves (insulation at ceiling level - inverted) | 14.2850 | 0.2400 | 3.4284 |
| P1 Party wall - Ground floor | 4.3725 | 0.0800 | 0.3498 |
| E7 Party floor between dwellings (in blocks of flats) | 1.6700 | 0.0700 | 0.1169 |

| | | |
|---|---|---|
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | 29.9504 | (36) |
| Point Thermal bridges | (36a) = 0.0000 | |
| Total fabric heat loss | (33) + (36) + (36a) = 87.4354 | (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 54.5281 | 54.1598 | 53.7988 | 52.1033 | 51.7860 | 50.3093 | 50.3093 | 50.0358 | 50.8781 | 51.7860 | 52.4278 | 53.0987 | (38) |
| Heat transfer coeff | 141.9635 | 141.5953 | 141.2343 | 139.5387 | 139.2215 | 137.7447 | 137.7447 | 137.4712 | 138.3135 | 139.2215 | 139.8632 | 140.5342 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 139.5372 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.4439 | 1.4401 | 1.4365 | 1.4192 | 1.4160 | 1.4010 | 1.4010 | 1.3982 | 1.4068 | 1.4160 | 1.4225 | 1.4294 | (40) |
| HLP (average) | | | | | | | | | | | | 1.4192 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

## 4. Water heating energy requirements (kWh/year)

| | | |
|---|---|---|
| Assumed occupancy | 2.7234 | (42) |

Hot water usage for mixer showers

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 69.8826 | 68.8324 | 67.3020 | 64.3740 | 62.2132 | 59.8034 | 58.4338 | 59.9525 | 61.6174 | 64.2047 | 67.1956 | 69.6148 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 30.1750 | 29.7269 | 29.0958 | 27.9322 | 27.0609 | 26.0948 | 25.5730 | 26.1996 | 26.8819 | 27.9157 | 29.1033 | 30.0730 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 42.5205 | 40.9743 | 39.4281 | 37.8819 | 36.3357 | 34.7895 | 34.7895 | 36.3357 | 37.8819 | 39.4281 | 40.9743 | 42.5205 (42c) |

Average daily hot water use (litres/day) 131.0614 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 142.5781 | 139.5336 | 135.8260 | 130.1881 | 125.6098 | 120.6878 | 118.7962 | 122.4879 | 126.3812 | 131.5485 | 137.2732 | 142.2084 | (44) |
| Energy conte | 225.8089 | 198.6940 | 208.7595 | 178.2211 | 169.0950 | 148.3997 | 143.6738 | 151.6656 | 155.8407 | 178.5101 | 195.5709 | 222.6640 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 2176.9032 | |
| Distribution loss (46)m = 0.15 x (45)m | 33.8713 | 29.8041 | 31.3139 | 26.7332 | 25.3642 | 22.2600 | 21.5511 | 22.7498 | 23.3761 | 26.7765 | 29.3356 | 33.3996 | (46) |

Water storage loss:

| | | |
|---|---|---|
| Store volume | 150.0000 | (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | 1.3938 | (48) |
| Temperature factor from Table 2b | 0.5400 | (49) |
| Enter (49) or (54) in (55) | 0.7527 | (55) |

Total storage loss

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 (56) |

If cylinder contains dedicated solar storage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 (57) |
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (61) |

Total heat required for water heating calculated for each month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 272.4038 | 240.7797 | 255.3544 | 223.3129 | 215.6899 | 193.4916 | 190.2687 | 198.2605 | 200.9326 | 225.1050 | 240.6627 | 269.2589 (62) |
| WWHRS | -31.9474 | -28.2545 | -29.5865 | -24.4988 | -22.8320 | -19.5375 | -18.3133 | -19.4744 | -20.2143 | -23.8304 | -26.9969 | -31.3558 (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (63d) |

Output from w/h

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 240.4564 | 212.5252 | 225.7678 | 198.8141 | 192.8579 | 173.9540 | 171.9554 | 178.7861 | 180.7183 | 201.2746 | 213.6658 | 237.9031 (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2428.6787 (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2429 (64) |

Electric shower(s)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (64a) |
| | | | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | 0.0000 (64a) |

Heat gains from water heating, kWh/month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 112.3574 | 99.7343 | 106.6884 | 95.3320 | 93.5000 | 85.4164 | 85.0474 | 87.7047 | 87.8905 | 96.6305 | 101.1008 | 111.3117 (65) |

## 5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 136.1710 | 136.1710 | 136.1710 | 136.1710 | 136.1710 | 136.1710 | 136.1710 | 136.1710 | 136.1710 | 136.1710 | 136.1710 | 136.1710 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 128.4580 | 142.2213 | 128.4580 | 132.7399 | 128.4580 | 132.7399 | 128.4580 | 128.4580 | 132.7399 | 128.4580 | 132.7399 | 128.4580 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 253.5828 | 256.2142 | 249.5832 | 235.4665 | 217.6467 | 200.8987 | 189.7099 | 187.0785 | 193.7095 | 207.8262 | 225.6460 | 242.3941 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 36.6171 | 36.6171 | 36.6171 | 36.6171 | 36.6171 | 36.6171 | 36.6171 | 36.6171 | 36.6171 | 36.6171 | 36.6171 | 36.6171 | (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.0000 | 3.0000 | 3.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | -108.9368 | -108.9368 | -108.9368 | -108.9368 | -108.9368 | -108.9368 | -108.9368 | -108.9368 | -108.9368 | -108.9368 | -108.9368 | -108.9368 | (71) |
| Water heating gains (Table 5) | 151.0180 | 148.4142 | 143.3984 | 132.4055 | 125.6720 | 118.6339 | 114.3111 | 117.8827 | 122.0702 | 129.8798 | 140.4178 | 149.6125 | (72) |
| Total internal gains | 599.9101 | 613.7010 | 588.2909 | 567.4632 | 538.6280 | 516.1237 | 496.3302 | 497.2705 | 512.3709 | 533.0152 | 565.6550 | 587.3158 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Northeast | 9.1300 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 31.4822 | (75) |
| Southeast | 2.2900 | 36.7938 | 0.6300 | 0.7000 | 0.7700 | 25.7503 | (77) |
| Southwest | 8.8100 | 36.7938 | 0.6300 | 0.7000 | 0.7700 | 99.0656 | (79) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 156.2981 | 276.6905 | 406.3560 | 550.0516 | 658.5984 | 672.5279 | 640.6098 | 556.7713 | 455.6683 | 313.2911 | 189.1134 | 132.5263 | (83) |
| Total gains | 756.2082 | 890.3915 | 994.6469 | 1117.5148 | 1197.2265 | 1188.6516 | 1136.9401 | 1054.0418 | 968.0392 | 846.3063 | 754.7684 | 719.8422 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| tau | 57.5524 | 57.7021 | 57.8496 | 58.5525 | 58.6860 | 59.3151 | 59.3151 | 59.4331 | 59.0712 | 58.6860 | 58.4167 | 58.1378 | |
| alpha | 4.8368 | 4.8468 | 4.8566 | 4.9035 | 4.9124 | 4.9543 | 4.9543 | 4.9622 | 4.9381 | 4.9124 | 4.8944 | 4.8759 | |
| util living area | 0.9973 | 0.9936 | 0.9844 | 0.9510 | 0.8617 | 0.6892 | 0.5218 | 0.5800 | 0.8256 | 0.9690 | 0.9940 | 0.9979 | (86) |
| MIT | 19.5421 | 19.7412 | 20.0350 | 20.4337 | 20.7617 | 20.9434 | 20.9883 | 20.9809 | 20.8593 | 20.4314 | 19.9199 | 19.5154 | (87) |
| Th 2 | 19.7298 | 19.7327 | 19.7355 | 19.7486 | 19.7511 | 19.7626 | 19.7626 | 19.7647 | 19.7581 | 19.7511 | 19.7461 | 19.7409 | (88) |
| util rest of house | 0.9962 | 0.9909 | 0.9776 | 0.9291 | 0.8024 | 0.5785 | 0.3811 | 0.4347 | 0.7329 | 0.9506 | 0.9911 | 0.9970 | (89) |
| MIT 2 | 18.0667 | 18.3225 | 18.6964 | 19.1963 | 19.5648 | 19.7352 | 19.7599 | 19.7596 | 19.6730 | 19.2054 | 18.5611 | 18.0403 | (90) |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.5294 | (91) |
| MIT | 18.8478 | 19.0736 | 19.4051 | 19.8513 | 20.1984 | 20.3748 | 20.4102 | 20.4061 | 20.3010 | 19.8545 | 19.2804 | 18.8212 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 18.8478 | 19.0736 | 19.4051 | 19.8513 | 20.1984 | 20.3748 | 20.4102 | 20.4061 | 20.3010 | 19.8545 | 19.2804 | 18.8212 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9951 | 0.9891 | 0.9753 | 0.9312 | 0.8259 | 0.6359 | 0.4562 | 0.5123 | 0.7776 | 0.9525 | 0.9896 | 0.9961 | (94) |
| Useful gains | 752.4809 | 880.6636 | 970.0861 | 1040.6717 | 988.8112 | 755.8603 | 518.6391 | 540.0107 | 752.7674 | 806.1149 | 746.8837 | 717.0253 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | | | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2065.2535 | 2006.9105 | 1822.6356 | 1528.1365 | 1183.1652 | 795.4514 | 524.8371 | 550.7290 | 857.6875 | 1288.4195 | 1703.5956 | 2054.7760 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 976.7029 | 756.8379 | 634.2968 | 350.9747 | 144.5994 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 358.8346 | 688.8326 | 995.2866 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 4906.3654 | |
| Solar heating kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | | | | | | | | | | | | | |
| | 976.7029 | 756.8379 | 634.2968 | 350.9747 | 144.5994 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 358.8346 | 688.8326 | 995.2866 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 4906.3654 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 49.9020 | (99) |

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9a. Energy requirements - Individual heating systems, including micro-CHP

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | 0.0000 | (201) |
| Fraction of space heat from main system(s) | | | | | | | | | | | | 1.0000 | (202) |
| Efficiency of main space heating system 1 (in %) | | | | | | | | | | | | 92.3000 | (206) |
| Efficiency of main space heating system 2 (in %) | | | | | | | | | | | | 0.0000 | (207) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 | (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement | | | | | | | | | | | | | |
| | 976.7029 | 756.8379 | 634.2968 | 350.9747 | 144.5994 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 358.8346 | 688.8326 | 995.2866 | (98) |
| Space heating efficiency (main heating system 1) | | | | | | | | | | | | | |
| | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.3000 | 92.3000 | 92.3000 | (210) |
| Space heating fuel (main heating system) | | | | | | | | | | | | | |
| | 1058.1830 | 819.9761 | 687.2121 | 380.2543 | 156.6624 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 388.7699 | 746.2975 | 1078.3170 | (211) |
| Space heating efficiency (main heating system 2) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (212) |
| Space heating fuel (main heating system 2) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (213) |
| Space heating fuel (secondary) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (215) |
| Water heating | | | | | | | | | | | | | |
| Water heating requirement | | | | | | | | | | | | | |
| | 240.4564 | 212.5252 | 225.7678 | 198.8141 | 192.8579 | 173.9540 | 171.9554 | 178.7861 | 180.7183 | 201.2746 | 213.6658 | 237.9031 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 | (216) |
| (217)m | 86.8646 | 86.6573 | 86.2466 | 85.3203 | 83.4230 | 79.8000 | 79.8000 | 79.8000 | 79.8000 | 85.3413 | 86.4906 | 86.9091 | (217) |
| Fuel for water heating, kWh/month | | | | | | | | | | | | | |
| | 276.8175 | 245.2479 | 261.7700 | 233.0209 | 231.1808 | 217.9875 | 215.4829 | 224.0428 | 226.4640 | 235.8467 | 247.0393 | 273.7379 | (219) |
| Space cooling fuel requirement | | | | | | | | | | | | | |
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (221) |
| Pumps and Fa | 7.3041 | 6.5973 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | (231) |
| Lighting | 26.6910 | 21.4125 | 19.2796 | 14.1251 | 10.9106 | 8.9141 | 9.9530 | 12.9373 | 16.8043 | 22.0481 | 24.9033 | 27.4329 | (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233a)m | -21.4653 | -32.0164 | -48.6505 | -57.9179 | -65.2780 | -61.9455 | -61.1689 | -56.3280 | -48.3148 | -37.9822 | -24.2064 | -18.3576 | (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233b)m | -7.3267 | -15.7876 | -32.0976 | -49.2908 | -66.2613 | -66.9978 | -66.2319 | -55.5952 | -40.1061 | -22.9501 | -9.8980 | -5.7677 | (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235d) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - main system 1 | 5315.6722 | (211) |
| Space heating fuel - main system 2 | 0.0000 | (213) |
| Space heating fuel - secondary | 0.0000 | (215) |
| Efficiency of water heater | 79.8000 | |
| Water heating fuel used | 2888.6383 | (219) |
| Space cooling fuel | 0.0000 | (221) |
| | | |
| Electricity for pumps and fans: | | |
| Total electricity for the above, kWh/year | 86.0000 | (231) |
| Electricity for lighting (calculated in Appendix L) | 215.4119 | (232) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -971.9425 | (233) |
| Wind generation | 0.0000 | (234) |
| Hydro-electric generation (Appendix N) | 0.0000 | (235a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (235) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (236) |
| Energy used | 0.0000 | (237) |
| Total delivered energy for all uses | 7533.7799 | (238) |

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12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 5315.6722 | 0.2100 | 1116.2912 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2888.6383 | 0.2100 | 606.6141 | (264) |
| Space and water heating | | | 1722.9052 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 215.4119 | 0.1443 | 31.0906 | (268) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -533.6316 | 0.1334 | -71.2033 | |
| PV Unit electricity exported | -438.3109 | 0.1252 | -54.8952 | |
| Total | | | -126.0986 | (269) |
| Total CO2, kg/year | | | 1639.8265 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 16.6800 | (273) |

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13a. Primary energy - Individual heating systems including micro-CHP

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| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 5315.6722 | 1.1300 | 6006.7095 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2888.6383 | 1.1300 | 3264.1613 | (278) |
| Space and water heating | | | 9270.8709 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 215.4119 | 1.5338 | 330.4059 | (282) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -533.6316 | 1.4931 | -796.7520 | |
| PV Unit electricity exported | -438.3109 | 0.4597 | -201.4890 | |
| Total | | | -998.2411 | (283) |
| Total Primary energy kWh/year | | | 8733.1365 | (286) |
| Target Primary Energy Rate (TPER) | | | 88.8200 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Property Reference** | Unit 2 | **Issued on Date** | 17/05/2025 |
| **Assessment Reference** | 00001 | **Prop Type Ref** | Unit 2 |
| **Property** | | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 80 C | **DER** | 4.84 | **TER** | 11.55 |
| **Environmental** | 96 A | **% DER < TER** | | | 58.10 |
| **$CO_2$ Emissions (t/year)** | 0.4 | **DFEE** | 31.14 | **TFEE** | 31.92 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 2.46 |
| **% DPER < TPER** | 16.45 | **DPER** | 51.22 | **TPER** | 61.31 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Robert Arnold | **Assessor ID** | BA04-0001 |
| **Client** | | | |

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SAP 10 WORKSHEET FOR New Build (As Designed)  (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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## 1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 41.6000 (1b) | x | 2.9200 (2b) | = | 121.4720 | (1b) - (3b) |
| First floor | 51.7300 (1c) | x | 2.8700 (2c) | = | 148.4651 | (1c) - (3c) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 93.3300 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = | 269.9371 | (5) |

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## 2. Ventilation rate

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| | | m3 per hour | |
|---|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 | (6a) |
| Number of open flues | 0 * 20 = | 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | 0 * 10 = | 0.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |

| | | Air changes per hour | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 0.0000 / (5) = | 0.0000 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 3.0000 | (17) |
| Infiltration rate | | 0.1500 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.1500 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.1912 | 0.1875 | 0.1837 | 0.1650 | 0.1612 | 0.1425 | 0.1425 | 0.1388 | 0.1500 | 0.1612 | 0.1687 | 0.1762 | (22b) |

Balanced mechanical ventilation with heat recovery

| | | |
|---|---|---|
| If mechanical ventilation | | 0.5000 (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | | 0.5000 (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | | 80.1000 (23c) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective ac | 0.2907 | 0.2870 | 0.2833 | 0.2645 | 0.2607 | 0.2420 | 0.2420 | 0.2382 | 0.2495 | 0.2607 | 0.2682 | 0.2757 | (25) |

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## 3. Heat losses and heat loss parameter

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| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| Window | | | 12.4300 | 1.0536 | 13.0967 | | | (27) |
| Solid Door | | | 6.4800 | 1.4000 | 9.0720 | | | (26) |
| Glass Door | | | 2.4000 | 1.3258 | 3.1818 | | | (27) |
| Heatloss Floor 1 | | | 41.6000 | 0.1000 | 4.1600 | 110.0000 | 4576.0000 | (28a) |
| Ground External Walls | 30.5100 | 10.6500 | 19.8600 | 0.1500 | 2.9790 | 150.0000 | 2979.0000 | (29a) |
| First Floor External Wall | 30.5100 | 10.6600 | 19.8500 | 0.1500 | 2.9775 | 150.0000 | 2977.5000 | (29a) |
| Wall to Communal Corridor | 3.7800 | | 3.7800 | 0.1400 | 0.5292 | 150.0000 | 567.0000 | (29a) |
| Total net area of external elements Aum(A, m2) | | | 106.4000 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 35.9963 | | | (33) |
| Main dwelling | | | | | | | | |
| Grd to Unit 3 | | | 14.9800 | 0.0000 | 0.0000 | 70.0000 | 1048.6000 | (32) |
| Grd to Unit 9 | | | 31.8500 | 0.0000 | 0.0000 | 70.0000 | 2229.5000 | (32) |
| First to Unit 1 | | | 27.2000 | 0.0000 | 0.0000 | 70.0000 | 1904.0000 | (32) |
| First to Unit 3 | | | 20.7400 | 0.0000 | 0.0000 | 70.0000 | 1451.8000 | (32) |

| | | | | |
|---|---|---|---|---|
| Party Floor 1 | 8.4100 | 80.0000 | 672.8000 | (32d) |
| Party Ceiling 1 | 51.7300 | 100.0000 | 5173.0000 | (32b) |
| Grd Internal Partitions | 30.0100 | 9.0000 | 270.0900 | (32c) |
| First Internal Partitions | 111.1600 | 9.0000 | 1000.4400 | (32c) |
| Internal Floor 1 | 41.6000 | 18.0000 | 748.8000 | (32d) |

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 25598.5300 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 274.2798 (35)
List of Thermal Bridges

| K1 Element | Length | Psi-value | Total |
|---|---|---|---|
| E1 Steel lintel with perforated steel base plate | 8.7100 | 0.0500 | 0.4355 |
| E4 Jamb | 20.2000 | 0.0500 | 1.0100 |
| E5 Ground floor (normal) | 10.4500 | 0.1600 | 1.6720 |
| E6 Intermediate floor within a dwelling | 3.1600 | 0.0000 | 0.0000 |
| E18 Party wall between dwellings | 23.1600 | 0.0300 | 0.6948 |
| E7 Party floor between dwellings (in blocks of flats) | 3.1600 | 0.0350 | 0.1106 |
| E16 Corner (normal) | 11.5800 | 0.0900 | 1.0422 |
| E17 Corner (inverted - internal area greater than external area) | 11.5800 | -0.0900 | -1.0422 |
| E25 Staggered party wall between dwellings | 11.5800 | 0.0300 | 0.3474 |
| E23 Balcony within or between dwellings, balcony support penetrates wall insulation | 5.6000 | 0.0200 | 0.1120 |
| P1 Party wall - Ground floor | 15.6925 | 0.0800 | 1.2554 |
| P3 Party wall - Intermediate floor between dwellings (in blocks of flats) | 16.7075 | 0.0000 | 0.0000 |
| E7 Party floor between dwellings (in blocks of flats) | 4.8225 | 0.0350 | 0.1688 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 5.8065 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 41.8027 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 25.8998 | 25.5657 | 25.2317 | 23.5615 | 23.2274 | 21.5572 | 21.5572 | 21.2231 | 22.2253 | 23.2274 | 23.8955 | 24.5636 | (38) |

Heat transfer coeff

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 67.7025 | 67.3685 | 67.0344 | 65.3642 | 65.0302 | 63.3599 | 63.3599 | 63.0259 | 64.0280 | 65.0302 | 65.6983 | 66.3664 | (39) |

Average = Sum(39)m / 12 = 65.2807

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 0.7254 | 0.7218 | 0.7183 | 0.7004 | 0.6968 | 0.6789 | 0.6789 | 0.6753 | 0.6860 | 0.6968 | 0.7039 | 0.7111 | (40) |
| HLP (average) | | | | | | | | | | | | 0.6995 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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4. Water heating energy requirements (kWh/year)

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Assumed occupancy 2.6686 (42)
Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 67.2213 | 66.1921 | 64.6754 | 62.3422 | 60.2518 | 57.3272 | 55.0141 | 57.7183 | 59.0784 | 61.9750 | 64.9916 | 67.1607 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 29.1160 | 28.6765 | 28.0512 | 27.1148 | 26.2709 | 25.1092 | 24.2279 | 25.3056 | 25.8712 | 27.0223 | 28.2190 | 29.0929 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 41.9593 | 40.4335 | 38.9077 | 37.3819 | 35.8561 | 34.3303 | 34.3303 | 35.8561 | 37.3819 | 38.9077 | 40.4335 | 41.9593 | (42c) |

Average daily hot water use (litres/day) 127.1150 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | | | | | | | | | | | | | |
| | 138.2965 | 135.3020 | 131.6343 | 126.8389 | 122.3788 | 116.7667 | 113.5722 | 118.8799 | 122.3314 | 127.9050 | 133.6441 | 138.2128 | (44) |
| Energy conte | 203.5963 | 179.0320 | 188.1027 | 165.6833 | 157.6974 | 135.0368 | 125.5006 | 139.9239 | 141.8984 | 164.8185 | 180.6245 | 202.9756 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1984.8901 | |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | | |
| | 30.5395 | 26.8548 | 28.2154 | 24.8525 | 23.6546 | 20.2555 | 18.8251 | 20.9886 | 21.2848 | 24.7228 | 27.0937 | 30.4463 | (46) |
| Water storage loss: | | | | | | | | | | | | | |
| Store volume | | | | | | | | | | | | 110.0000 | (47) |
| b) If manufacturer declared loss factor is not known : | | | | | | | | | | | | | |
| Hot water storage loss factor from Table 2 (kWh/litre/day) | | | | | | | | | | | | 0.0152 | (51) |
| Volume factor from Table 2a | | | | | | | | | | | | 1.0294 | (52) |
| Temperature factor from Table 2b | | | | | | | | | | | | 0.6000 | (53) |
| Enter (49) or (54) in (55) | | | | | | | | | | | | 1.0327 | (55) |
| Total storage loss | | | | | | | | | | | | | |
| | 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (56) |
| If cylinder contains dedicated solar storage | | | | | | | | | | | | | |
| | 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (57) |
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | | | | | | | | | | | | | |
| | 258.8731 | 228.9594 | 243.3795 | 219.1770 | 212.9742 | 188.5305 | 180.7774 | 195.2007 | 195.3920 | 220.0953 | 234.1182 | 258.2524 | (62) |
| WWHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | | | | | | | | | | | | | |
| | 258.8731 | 228.9594 | 243.3795 | 219.1770 | 212.9742 | 188.5305 | 180.7774 | 195.2007 | 195.3920 | 220.0953 | 234.1182 | 258.2524 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2635.7298 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2636 | (64) |
| Electric shower(s) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | | | | | | | | | | | | | |
| | 111.9172 | 99.4701 | 106.7656 | 97.8847 | 96.6558 | 87.6947 | 85.9504 | 90.7461 | 89.9761 | 99.0236 | 102.8526 | 111.7108 | (65) |

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5. Internal gains (see Table 5 and 5a)

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Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 133.4306 | 133.4306 | 133.4306 | 133.4306 | 133.4306 | 133.4306 | 133.4306 | 133.4306 | 133.4306 | 133.4306 | 133.4306 | 133.4306 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 129.1374 | 142.9735 | 129.1374 | 133.4419 | 129.1374 | 133.4419 | 129.1374 | 129.1374 | 133.4419 | 129.1374 | 133.4419 | 129.1374 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 245.0725 | 247.6155 | 241.2070 | 227.5641 | 210.3424 | 194.1564 | 183.3431 | 180.8000 | 187.2085 | 200.8515 | 218.0732 | 234.2592 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 36.3431 | 36.3431 | 36.3431 | 36.3431 | 36.3431 | 36.3431 | 36.3431 | 36.3431 | 36.3431 | 36.3431 | 36.3431 | 36.3431 | (69) |
| Pumps, fans | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | | | | | | | | | | | | | |
| | -106.7445 | -106.7445 | -106.7445 | -106.7445 | -106.7445 | -106.7445 | -106.7445 | -106.7445 | -106.7445 | -106.7445 | -106.7445 | -106.7445 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 150.4264 | 148.0209 | 143.5021 | 135.9509 | 129.9138 | 121.7982 | 115.5247 | 121.9706 | 124.9669 | 133.0962 | 142.8508 | 150.1490 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 587.6654 | 601.6392 | 576.8757 | 559.9862 | 532.4227 | 512.4257 | 491.0344 | 494.9372 | 508.6465 | 526.1142 | 557.3951 | 576.5747 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Southwest | 12.4300 | 36.7938 | 0.4500 | 0.7000 | 0.7700 | 99.8366 | (79) |
| Southwest | 2.4000 | 36.7938 | 0.4500 | 0.7000 | 0.7700 | 19.2766 | (79) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 119.1132 | 202.8939 | 277.6083 | 343.9701 | 385.2752 | 382.4891 | 368.7603 | 337.9448 | 300.5910 | 224.2410 | 142.6702 | 101.9361 | (83) |
| Total gains | 706.7786 | 804.5331 | 854.4840 | 903.9563 | 917.6979 | 894.9147 | 859.7947 | 832.8820 | 809.2376 | 750.3552 | 700.0653 | 678.5108 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| tau | 105.0286 | 105.5494 | 106.0754 | 108.7859 | 109.3447 | 112.2271 | 112.2271 | 112.8220 | 111.0561 | 109.3447 | 108.2327 | 107.1432 | |
| alpha | 8.0019 | 8.0366 | 8.0717 | 8.2524 | 8.2896 | 8.4818 | 8.4818 | 8.5215 | 8.4037 | 8.2896 | 8.2155 | 8.1429 | |
| util living area | 0.9911 | 0.9749 | 0.9380 | 0.8237 | 0.6518 | 0.4528 | 0.3242 | 0.3481 | 0.5444 | 0.8406 | 0.9712 | 0.9931 | (86) |
| MIT | 20.5057 | 20.6547 | 20.8038 | 20.9466 | 20.9923 | 20.9997 | 21.0000 | 21.0000 | 20.9986 | 20.9474 | 20.7309 | 20.4917 | (87) |
| Th 2 | 20.3184 | 20.3216 | 20.3247 | 20.3405 | 20.3437 | 20.3595 | 20.3595 | 20.3627 | 20.3532 | 20.3437 | 20.3374 | 20.3310 | (88) |
| util rest of house | 0.9884 | 0.9679 | 0.9223 | 0.7911 | 0.6084 | 0.4077 | 0.2770 | 0.2999 | 0.4941 | 0.8036 | 0.9620 | 0.9909 | (89) |
| MIT 2 | 19.7494 | 19.9376 | 20.1200 | 20.2921 | 20.3381 | 20.3594 | 20.3595 | 20.3627 | 20.3524 | 20.2983 | 20.0469 | 19.7423 | (90) |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.4226 | (91) |
| MIT | 20.0690 | 20.2406 | 20.4090 | 20.5687 | 20.6146 | 20.6300 | 20.6302 | 20.6320 | 20.6254 | 20.5726 | 20.3359 | 20.0590 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 20.0690 | 20.2406 | 20.4090 | 20.5687 | 20.6146 | 20.6300 | 20.6302 | 20.6320 | 20.6254 | 20.5726 | 20.3359 | 20.0590 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9872 | 0.9670 | 0.9244 | 0.8028 | 0.6265 | 0.4267 | 0.2970 | 0.3202 | 0.5153 | 0.8171 | 0.9620 | 0.9899 | (94) |
| Useful gains | 697.7514 | 777.9473 | 789.9245 | 725.7020 | 574.9077 | 381.8973 | 255.3454 | 266.7143 | 417.0281 | 613.1158 | 673.4796 | 671.6316 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | 1067.6009 | 1033.4754 | 932.3813 | 762.7146 | 579.7148 | 382.0577 | 255.3514 | 266.7254 | 417.8110 | 648.5175 | 869.5785 | 1052.5026 | (97) |
| Space heating kWh | 275.1680 | 171.7149 | 105.9879 | 26.6490 | 3.5765 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 26.3389 | 141.1912 | 283.3680 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 1033.9942 | |
| Solar heating kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | 275.1680 | 171.7149 | 105.9879 | 26.6490 | 3.5765 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 26.3389 | 141.1912 | 283.3680 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 1033.9942 | |
| Space heating per m2 | | | | | | | | | | (98c) / (4) = | | 11.0789 | (99) |

## 8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ext. temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | |
| Heat loss rate W | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 595.5833 | 468.8635 | 478.9967 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (100) |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.9941 | 0.9986 | 0.9980 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (101) |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 592.0690 | 468.2183 | 478.0409 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (102) |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 977.4580 | 939.9456 | 910.3867 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 277.4800 | 350.9651 | 321.6652 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (104) |
| Cooled fraction | | | | | | | | | fC = cooled area / (4) = | | | 0.5464 | (105) |
| Intermittency factor (Table 10b) | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | (106) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 37.9071 | 47.9460 | 43.9433 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) |
| Space cooling requirement | | | | | | | | | | | | 129.7965 | (107) |

## 9b. Energy requirements

| | | |
|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | 0.0000 | (301) |
| Fraction of space heat from community system | 1.0000 | (302) |
| Fraction of heat from community Heat pump-Space and Water | 1.0000 | (303a) |
| Factor for control and charging method (Table 4c(3)) for space heating | 1.0000 | (305) |
| Factor for charging method (Table 4c(3)) for water heating | 1.0000 | (305a) |
| Distribution loss factor (Table 12c) for community heating system | 2.0000 | (306) |
| Efficiency of secondary/supplementary heating system, % | 0.0000 | (208) |
| Space heating: | | |

| Space heating requirement | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 275.1680 | 171.7149 | 105.9879 | 26.6490 | 3.5765 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 26.3389 | 141.1912 | 283.3680 | (98) |
| Space heat from Heat pump = (98) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 307a | 550.3360 | 343.4297 | 211.9758 | 53.2980 | 7.1529 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 52.6778 | 282.3823 | 566.7360 | |
| Space heating requirement | | | | | | | | | | | | | |
| | 550.3360 | 343.4297 | 211.9758 | 53.2980 | 7.1529 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 52.6778 | 282.3823 | 566.7360 | (307) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | | | | | | | | | | | 0.0000 | (308) |
| Space heating fuel for secondary/supplementary system | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (309) |

Water heating

Annual water heating requirement

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 258.8731 | 228.9594 | 243.3795 | 219.1770 | 212.9742 | 188.5305 | 180.7774 | 195.2007 | 195.3920 | 220.0953 | 234.1182 | 258.2524 | (64) |

Water heat from Heat pump = (64) x 1.00 x 1.00 x 2.00

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 310a | 517.7463 | 457.9188 | 486.7590 | 438.3540 | 425.9485 | 377.0610 | 361.5549 | 390.4013 | 390.7841 | 440.1906 | 468.2363 | 516.5049 | |
| Water heating fuel | | | | | | | | | | | | | |
| | 517.7463 | 457.9188 | 486.7590 | 438.3540 | 425.9485 | 377.0610 | 361.5549 | 390.4013 | 390.7841 | 440.1906 | 468.2363 | 516.5049 | (310) |
| Cooling System Energy Efficiency Ratio | | | | | | | | | | | | 2.6000 | (314) |
| Space coolin | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 14.5797 | 18.4408 | 16.9013 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (315) |
| Pumps and Fa | 23.8863 | 21.5747 | 23.8863 | 23.1158 | 23.8863 | 23.1158 | 23.8863 | 23.8863 | 23.1158 | 23.8863 | 23.1158 | 23.8863 | (331) |
| Lighting | 29.8182 | 23.9213 | 21.5384 | 15.7800 | 12.1889 | 9.9584 | 11.1191 | 14.4531 | 18.7731 | 24.6313 | 27.8210 | 30.6469 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333a)m | -4.8664 | -7.9494 | -13.3219 | -17.4144 | -20.9563 | -20.3905 | -20.0992 | -17.8008 | -14.1994 | -9.9804 | -5.6972 | -4.0780 | (333a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335a) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (333b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335b) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - community heating | 2067.9885 | (307) |
| Space heating fuel - secondary | 0.0000 | (309) |
| Water heating fuel - community heating | 5271.4597 | (310) |
| Efficiency of water heater | 0.0000 | (311) |
| Electricity used for heat distribution | 20.6799 | (313) |
| Space cooling fuel | 49.9217 | (321) |
| | | |
| Electricity for pumps and fans: | | |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8540) | | |
| mechanical ventilation fans (SFP = 0.8540) | 281.2421 | (330a) |
| Total electricity for the above, kWh/year | 281.2421 | (331) |
| Electricity for lighting (calculated in Appendix L) | 240.6498 | (332) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -156.7541 | (333) |
| Wind generation | 0.0000 | (334) |
| Hydro-electric generation (Appendix N) | 0.0000 | (335a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (335) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (336) |
| Energy used | 0.0000 | (337) |
| Total delivered energy for all uses | 7754.5077 | (338) |

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12b. Carbon dioxide emissions - Community heating scheme

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (367) |
| Space and Water heating from Heat pump | 2621.2315 | 0.1585 | 117.0834 | (367) |
| Electrical energy for heat distribution (space & water) | 20.6799 | 0.0000 | 10.7042 | (372) |
| Overall CO2 factor for heat network | | | 0.0535 | (386) |
| Total CO2 associated with community systems | | | 392.9961 | (373) |
| Space and water heating | | | 392.9961 | (376) |
| Space cooling | 49.9217 | 0.1140 | 5.6894 | (377) |
| Pumps, fans and electric keep-hot | 281.2421 | 0.1387 | 39.0117 | (378) |
| Energy for lighting | 240.6498 | 0.1443 | 34.7332 | (379) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -156.7541 | 0.1317 | -20.6461 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -20.6461 | (380) |
| Total CO2, kg/year | | | 451.7844 | (383) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 4.8400 | (384) |

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13b. Primary energy - Community heating scheme

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| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (467a) |
| Space and Water heating from Heat pump | 2621.2315 | 1.5868 | 1171.9663 | (467) |
| Electrical energy for heat distribution (space & water) | 20.6799 | 0.0000 | 112.9876 | (472) |
| Overall CO2 factor for heat network | | | 0.5652 | (486) |
| Total CO2 associated with community systems | | | 4148.2584 | (473) |
| Space and water heating | | | 4148.2584 | (476) |
| Space cooling | 49.9217 | 1.4201 | 70.8923 | (477) |
| Pumps, fans and electric keep-hot | 281.2421 | 1.5128 | 425.4630 | (478) |
| Energy for lighting | 240.6498 | 1.5338 | 369.1167 | (479) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -156.7541 | 1.4866 | -233.0323 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -233.0323 | (480) |
| Total Primary energy kWh/year | | | 4780.6980 | (483) |
| Dwelling Primary energy Rate (DPER) | | | 51.2200 | (484) |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 41.6000 | (1b) x | 2.9200 | (2b) = | 121.4720 | (1b) - (3b) |
| First floor | 51.7300 | (1c) x | 2.8700 | (2c) = | 148.4651 | (1c) - (3c) |

Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 93.3300 (4)
Dwelling volume (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 269.9371 (5)

---
2. Ventilation rate
---

| | | m3 per hour | |
|---|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 | (6a) |
| Number of open flues | 0 * 20 = | 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | 3 * 10 = | 30.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |

| | | Air changes per hour | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 30.0000 / (5) = | 0.1111 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3611 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.3611 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.4604 | 0.4514 | 0.4424 | 0.3973 | 0.3882 | 0.3431 | 0.3431 | 0.3341 | 0.3611 | 0.3882 | 0.4063 | 0.4243 | (22b) |
| Effective ac | 0.6060 | 0.6019 | 0.5979 | 0.5789 | 0.5754 | 0.5589 | 0.5589 | 0.5558 | 0.5652 | 0.5754 | 0.5825 | 0.5900 | (25) |

---
3. Heat losses and heat loss parameter
---

| Element | Gross | Openings | NetArea | U-value | A x U | K-value | A x K | |
|---|---|---|---|---|---|---|---|---|
| | m2 | m2 | m2 | W/m2K | W/K | kJ/m2K | kJ/K | |
| Main dwelling | | | | | | | | |
| TER Opaque door | | | 6.4800 | 1.0000 | 6.4800 | | | (26) |
| TER Opening Type | | | 14.8300 | 1.1450 | 16.9809 | | | (27) |
| Heatloss Floor 1 | | | 41.6000 | 0.1300 | 5.4080 | | | (28a) |
| Ground External Walls | 30.5100 | 10.6500 | 19.8600 | 0.1800 | 3.5748 | | | (29a) |
| First Floor External Wall | 30.5100 | 10.6600 | 19.8500 | 0.1800 | 3.5730 | | | (29a) |
| Wall to Communal Corridor | 3.7800 | | 3.7800 | 0.1800 | 0.6804 | | | (29a) |
| Total net area of external elements Aum(A, m2) | | | 106.4000 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 36.6971 | | | (33) |
| Main dwelling | | | | | | | | |
| Grd to Unit 3 | | | 14.9800 | 0.0000 | 0.0000 | | | (32) |
| Grd to Unit 9 | | | 31.8500 | 0.0000 | 0.0000 | | | (32) |
| First to Unit 1 | | | 27.2000 | 0.0000 | 0.0000 | | | (32) |
| First to Unit 3 | | | 20.7400 | 0.0000 | 0.0000 | | | (32) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 263.1944 (35)
List of Thermal Bridges

| K1 Element | Length | Psi-value | Total |
|---|---|---|---|
| E1 Steel lintel with perforated steel base plate | 8.7100 | 0.0500 | 0.4355 |
| E4 Jamb | 20.2000 | 0.0500 | 1.0100 |
| E5 Ground floor (normal) | 10.4500 | 0.1600 | 1.6720 |
| E6 Intermediate floor within a dwelling | 3.1600 | 0.0000 | 0.0000 |
| E18 Party wall between dwellings | 23.1600 | 0.0600 | 1.3896 |
| E7 Party floor between dwellings (in blocks of flats) | 3.1600 | 0.0700 | 0.2212 |
| E16 Corner (normal) | 11.5800 | 0.0900 | 1.0422 |
| E17 Corner (inverted - internal area greater than external area) | 11.5800 | -0.0900 | -1.0422 |
| E25 Staggered party wall between dwellings | 11.5800 | 0.0600 | 0.6948 |
| E23 Balcony within or between dwellings, balcony support penetrates wall insulation | 5.6000 | 0.0200 | 0.1120 |
| P1 Party wall - Ground floor | 15.6925 | 0.0800 | 1.2554 |
| P3 Party wall - Intermediate floor between dwellings (in blocks of flats) | 16.7075 | 0.0000 | 0.0000 |
| E7 Party floor between dwellings (in blocks of flats) | 4.8225 | 0.0700 | 0.3376 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 7.1281 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 43.8252 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 53.9826 | 53.6160 | 53.2565 | 51.5683 | 51.2525 | 49.7821 | 49.7821 | 49.5098 | 50.3485 | 51.2525 | 51.8915 | 52.5595 | (38) |
| Heat transfer coeff | 97.8078 | 97.4411 | 97.0817 | 95.3935 | 95.0777 | 93.6073 | 93.6073 | 93.3350 | 94.1737 | 95.0777 | 95.7166 | 96.3847 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 95.3920 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.0480 | 1.0440 | 1.0402 | 1.0221 | 1.0187 | 1.0030 | 1.0030 | 1.0001 | 1.0090 | 1.0187 | 1.0256 | 1.0327 | (40) |
| HLP (average) | | | | | | | | | | | | 1.0221 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

---
4. Water heating energy requirements (kWh/year)
---

Assumed occupancy 2.6686 (42)
Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 68.9636 | 67.9272 | 66.4170 | 63.5275 | 61.3951 | 59.0170 | 57.6654 | 59.1641 | 60.8071 | 63.3604 | 66.3120 | 68.6994 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 29.7798 | 29.3376 | 28.7148 | 27.5664 | 26.7065 | 25.7531 | 25.2380 | 25.8565 | 26.5299 | 27.5501 | 28.7221 | 29.6792 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 41.9593 | 40.4335 | 38.9077 | 37.3819 | 35.8561 | 34.3303 | 34.3303 | 35.8561 | 37.3819 | 38.9077 | 40.4335 | 41.9593 | (42c) |

Average daily hot water use (litres/day) 129.3375 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 140.7027 | 137.6983 | 134.0394 | 128.4758 | 123.9577 | 119.1004 | 117.2337 | 120.8767 | 124.7189 | 129.8182 | 135.4676 | 140.3378 | (44) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Energy conte | 222.8387 | 196.0805 | 206.0136 | 175.8769 | 166.8709 | 146.4478 | 141.7840 | 149.6707 | 153.7909 | 176.1621 | 192.9984 | 219.7351 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 2148.2696 | |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | | |
| | 33.4258 | 29.4121 | 30.9020 | 26.3815 | 25.0306 | 21.9672 | 21.2676 | 22.4506 | 23.0686 | 26.4243 | 28.9498 | 32.9603 | (46) |
| Water storage loss: | | | | | | | | | | | | | |
| Store volume | | | | | | | | | | | | 150.0000 | (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | | | | | | | | | | | | 1.3938 | (48) |
| Temperature factor from Table 2b | | | | | | | | | | | | 0.5400 | (49) |
| Enter (49) or (54) in (55) | | | | | | | | | | | | 0.7527 | (55) |
| Total storage loss | | | | | | | | | | | | | |
| | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (56) |
| If cylinder contains dedicated solar storage | | | | | | | | | | | | | |
| | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (57) |
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | | | | | | | | | | | | | |
| | 269.4336 | 238.1662 | 252.6085 | 220.9687 | 213.4658 | 191.5397 | 188.3789 | 196.2656 | 198.8827 | 222.7570 | 238.0903 | 266.3300 | (62) |
| WWHRS | -31.5273 | -27.8830 | -29.1975 | -24.1767 | -22.5318 | -19.2806 | -18.0725 | -19.2183 | -19.9485 | -23.5170 | -26.6419 | -30.9435 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | | | | | | | | | | | | | |
| | 237.9063 | 210.2832 | 223.4111 | 196.7921 | 190.9340 | 172.2591 | 170.3064 | 177.0473 | 178.9342 | 199.2400 | 211.4483 | 235.3866 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2403.9486 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2404 | (64) |
| Electric shower(s) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | | | | | | | | | | | | | |
| | 111.3698 | 98.8653 | 105.7755 | 94.5525 | 92.7605 | 84.7674 | 84.4191 | 87.0414 | 87.2089 | 95.8498 | 100.2455 | 110.3378 | (65) |

## 5. Internal gains (see Table 5 and 5a)

| Metabolic gains (Table 5), Watts | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 133.4306 | 133.4306 | 133.4306 | 133.4306 | 133.4306 | 133.4306 | 133.4306 | 133.4306 | 133.4306 | 133.4306 | 133.4306 | 133.4306 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 129.1374 | 142.9735 | 129.1374 | 133.4419 | 129.1374 | 133.4419 | 129.1374 | 129.1374 | 133.4419 | 129.1374 | 133.4419 | 129.1374 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 245.0725 | 247.6155 | 241.2070 | 227.5641 | 210.3424 | 194.1564 | 183.3431 | 180.8000 | 187.2085 | 200.8515 | 218.0732 | 234.2592 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 36.3431 | 36.3431 | 36.3431 | 36.3431 | 36.3431 | 36.3431 | 36.3431 | 36.3431 | 36.3431 | 36.3431 | 36.3431 | 36.3431 | (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.0000 | 3.0000 | 3.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | | | | | | | | | | | | | |
| | -106.7445 | -106.7445 | -106.7445 | -106.7445 | -106.7445 | -106.7445 | -106.7445 | -106.7445 | -106.7445 | -106.7445 | -106.7445 | -106.7445 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 149.6906 | 147.1210 | 142.1713 | 131.3230 | 124.6781 | 117.7325 | 113.4665 | 116.9912 | 121.1235 | 128.8304 | 139.2298 | 148.3036 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 589.9296 | 603.7393 | 578.5449 | 558.3582 | 530.1870 | 508.3600 | 488.9762 | 489.9578 | 504.8032 | 524.8484 | 556.7741 | 577.7293 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Southwest | 14.8300 | 36.7938 | 0.6300 | 0.7000 | 0.7700 | 166.7585 | (79) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 166.7585 | 284.0514 | 388.6516 | 481.5581 | 539.3852 | 535.4847 | 516.2644 | 473.1228 | 420.8274 | 313.9373 | 199.7383 | 142.7105 | (83) |
| Total gains | 756.6881 | 887.7907 | 967.1965 | 1039.9164 | 1069.5722 | 1043.8447 | 1005.2406 | 963.0805 | 925.6306 | 838.7858 | 756.5124 | 720.4399 | (84) |

## 7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, ni1,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 69.7624 | 70.0250 | 70.2842 | 71.5281 | 71.7657 | 72.8930 | 72.8930 | 73.1056 | 72.4546 | 71.7657 | 71.2866 | 70.7925 | |
| alpha | 5.6508 | 5.6683 | 5.6856 | 5.7685 | 5.7844 | 5.8595 | 5.8595 | 5.8737 | 5.8303 | 5.7844 | 5.7524 | 5.7195 | |
| util living area | | | | | | | | | | | | | |
| | 0.9930 | 0.9824 | 0.9597 | 0.8928 | 0.7610 | 0.5643 | 0.4084 | 0.4436 | 0.6728 | 0.9129 | 0.9829 | 0.9946 | (86) |
| MIT | 20.0099 | 20.2174 | 20.4610 | 20.7454 | 20.9207 | 20.9886 | 20.9985 | 20.9976 | 20.9695 | 20.7483 | 20.3385 | 19.9838 | (87) |
| Th 2 | 20.0435 | 20.0468 | 20.0500 | 20.0649 | 20.0678 | 20.0809 | 20.0809 | 20.0833 | 20.0758 | 20.0678 | 20.0621 | 20.0561 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9907 | 0.9769 | 0.9472 | 0.8622 | 0.7041 | 0.4876 | 0.3238 | 0.3564 | 0.5944 | 0.8810 | 0.9765 | 0.9928 | (89) |
| MIT 2 | 18.9053 | 19.1694 | 19.4739 | 19.8212 | 20.0062 | 20.0749 | 20.0804 | 20.0825 | 20.0576 | 19.8343 | 19.3361 | 18.8818 | (90) |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.4226 | (91) |
| MIT | 19.3721 | 19.6123 | 19.8910 | 20.2118 | 20.3927 | 20.4610 | 20.4684 | 20.4692 | 20.4429 | 20.2205 | 19.7597 | 19.3475 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.3721 | 19.6123 | 19.8910 | 20.2118 | 20.3927 | 20.4610 | 20.4684 | 20.4692 | 20.4429 | 20.2205 | 19.7597 | 19.3475 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9886 | 0.9738 | 0.9447 | 0.8675 | 0.7249 | 0.5198 | 0.3596 | 0.3934 | 0.6266 | 0.8869 | 0.9739 | 0.9910 | (94) |
| Useful gains | 748.0840 | 864.4869 | 913.7073 | 902.1631 | 775.3052 | 542.5547 | 361.5257 | 378.8285 | 579.9848 | 743.8954 | 736.7816 | 713.9604 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | | | | | | | | | | | | | |
| | 1474.1680 | 1433.5800 | 1300.0234 | 1079.0688 | 826.4771 | 548.6341 | 362.1104 | 379.8033 | 597.3384 | 914.6960 | 1211.7441 | 1459.9850 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 540.2065 | 382.4306 | 287.4192 | 127.3721 | 38.0719 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 127.0757 | 341.9730 | 555.0423 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 2399.5913 | |
| Solar heating kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | | | | | | | | | | | | | |
| | 540.2065 | 382.4306 | 287.4192 | 127.3721 | 38.0719 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 127.0757 | 341.9730 | 555.0423 | (98c) |

Space heating requirement after solar contribution - total per year (kWh/year) 2399.5913
Space heating per m2 (98c) / (4) = 25.7108 (99)

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9a. Energy requirements - Individual heating systems, including micro-CHP

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Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 92.3000 (206)
Efficiency of main space heating system 2 (in %) 0.0000 (207)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement | | | | | | | | | | | | | |
| | 540.2065 | 382.4306 | 287.4192 | 127.3721 | 38.0719 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 127.0757 | 341.9730 | 555.0423 | (98) |
| Space heating efficiency (main heating system 1) | | | | | | | | | | | | | |
| | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.3000 | 92.3000 | 92.3000 | (210) |
| Space heating fuel (main heating system) | | | | | | | | | | | | | |
| | 585.2725 | 414.3343 | 311.3967 | 137.9980 | 41.2480 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 137.6768 | 370.5016 | 601.3460 | (211) |
| Space heating efficiency (main heating system 2) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (212) |
| Space heating fuel (main heating system 2) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (213) |
| Space heating fuel (secondary) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (215) |
| Water heating | | | | | | | | | | | | | |
| Water heating requirement | | | | | | | | | | | | | |
| | 237.9063 | 210.2832 | 223.4111 | 196.7921 | 190.9340 | 172.2591 | 170.3064 | 177.0473 | 178.9342 | 199.2400 | 211.4483 | 235.3866 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 | (216) |
| (217)m | 85.8400 | 85.3836 | 84.6258 | 83.1097 | 81.1676 | 79.8000 | 79.8000 | 79.8000 | 79.8000 | 83.0790 | 85.1316 | 85.9145 | (217) |
| Fuel for water heating, kWh/month | | | | | | | | | | | | | |
| | 277.1509 | 246.2807 | 263.9987 | 236.7859 | 235.2342 | 215.8635 | 213.4166 | 221.8638 | 224.2284 | 239.8198 | 248.3783 | 273.9778 | (219) |
| Space cooling fuel requirement | | | | | | | | | | | | | |
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (221) |
| Pumps and Fa | 7.3041 | 6.5973 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | (231) |
| Lighting | 26.8322 | 21.5258 | 19.3816 | 14.1998 | 10.9683 | 8.9612 | 10.0057 | 13.0057 | 16.8932 | 22.1648 | 25.0350 | 27.5779 | (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233a)m | -20.4471 | -30.5344 | -46.4517 | -55.3646 | -62.4570 | -59.2919 | -58.5560 | -53.9017 | -46.1954 | -36.2612 | -23.0734 | -17.4833 | (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233b)m | -6.8836 | -14.8434 | -30.1982 | -46.4030 | -62.4063 | -63.1073 | -62.3790 | -52.3410 | -37.7378 | -21.5787 | -9.3000 | -5.4176 | (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235d) |

Annual totals kWh/year
Space heating fuel - main system 1 2599.7739 (211)
Space heating fuel - main system 2 0.0000 (213)
Space heating fuel - secondary 0.0000 (215)
Efficiency of water heater 79.8000
Water heating fuel used 2896.9984 (219)
Space cooling fuel 0.0000 (221)

Electricity for pumps and fans:
Total electricity for the above, kWh/year 86.0000 (231)
Electricity for lighting (calculated in Appendix L) 216.5512 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV generation -922.6138 (233)
Wind generation 0.0000 (234)
Hydro-electric generation (Appendix N) 0.0000 (235a)
Electricity generated - Micro CHP (Appendix N) 0.0000 (235)
Appendix Q - special features
Energy saved or generated -0.0000 (236)
Energy used 0.0000 (237)
Total delivered energy for all uses 4876.7097 (238)

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12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

---

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 2599.7739 | 0.2100 | 545.9525 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2896.9984 | 0.2100 | 608.3697 | (264) |
| Space and water heating | | | 1154.3222 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 216.5512 | 0.1443 | 31.2550 | (268) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -510.0178 | 0.1334 | -68.0399 | |
| PV Unit electricity exported | -412.5960 | 0.1252 | -51.6681 | |
| Total | | | -119.7081 | (269) |
| Total CO2, kg/year | | | 1077.7984 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 11.5500 | (273) |

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13a. Primary energy - Individual heating systems including micro-CHP

---

| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 2599.7739 | 1.1300 | 2937.7445 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2896.9984 | 1.1300 | 3273.6082 | (278) |
| Space and water heating | | | 6211.3528 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 216.5512 | 1.5338 | 332.1534 | (282) |

| | | | | |
|---|---|---|---|---|
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | | -510.0178 | 1.4930 | -761.4477 |
| PV Unit electricity exported | | -412.5960 | 0.4596 | -189.6440 |
| Total | | | | -951.0917 (283) |
| Total Primary energy kWh/year | | | | 5722.5153 (286) |
| Target Primary Energy Rate (TPER) | | | | 61.3100 (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Property Reference** | Unit 3 | **Issued on Date** | 17/05/2025 |
| **Assessment Reference** | 00001 | **Prop Type Ref** | Unit 2 |
| **Property** | | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 79 C | **DER** | 5.07 | **TER** | 12.51 |
| **Environmental** | 95 A | **% DER < TER** | | | 59.47 |
| **$CO_2$ Emissions (t/year)** | 0.45 | **DFEE** | 35.98 | **TFEE** | 37.99 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 5.27 |
| **% DPER < TPER** | 19.72 | **DPER** | 53.34 | **TPER** | 66.44 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Robert Arnold | **Assessor ID** | BA04-0001 |
| **Client** | | | |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 44.7200 (1b) | x | 2.9200 (2b) | = | 130.5824 | (1b) - (3b) |
| First floor | 57.2200 (1c) | x | 2.8700 (2c) | = | 164.2214 | (1c) - (3c) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 101.9400 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = | 294.8038 | (5) |

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2. Ventilation rate

---

| | | m3 per hour | |
|---|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 | (6a) |
| Number of open flues | 0 * 20 = | 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | 0 * 10 = | 0.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |

| | | Air changes per hour | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 0.0000 / (5) = | 0.0000 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 3.0000 | (17) |
| Infiltration rate | | 0.1500 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.1500 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.1912 | 0.1875 | 0.1837 | 0.1650 | 0.1612 | 0.1425 | 0.1425 | 0.1388 | 0.1500 | 0.1612 | 0.1687 | 0.1762 | (22b) |

Balanced mechanical ventilation with heat recovery

| | | |
|---|---|---|
| If mechanical ventilation | 0.5000 | (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | 0.5000 | (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | 80.1000 | (23c) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective ac | 0.2907 | 0.2870 | 0.2833 | 0.2645 | 0.2607 | 0.2420 | 0.2420 | 0.2382 | 0.2495 | 0.2607 | 0.2682 | 0.2757 | (25) |

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3. Heat losses and heat loss parameter

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| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| Window | | | 12.4300 | 1.0536 | 13.0967 | | | (27) |
| Solid Door | | | 6.4800 | 1.4000 | 9.0720 | | | (26) |
| Glass Door | | | 2.4000 | 1.3258 | 3.1818 | | | (27) |
| Ground Floor | | | 44.7200 | 0.1000 | 4.4720 | 110.0000 | 4919.2000 | (28a) |
| Ground External Walls | 30.5100 | 10.6500 | 19.8600 | 0.1500 | 2.9790 | 150.0000 | 2979.0000 | (29a) |
| First Floor External Wall | 30.5100 | 10.6600 | 19.8500 | 0.1500 | 2.9775 | 150.0000 | 2977.5000 | (29a) |
| Wall to Communal Corridor FF | 21.3400 | | 21.3400 | 0.1400 | 2.9876 | 150.0000 | 3201.0000 | (29a) |
| Wall To Communal Corridor GF | 42.8200 | | 42.8200 | 0.1400 | 5.9948 | 150.0000 | 6423.0000 | (29a) |
| Total net area of external elements Aum(A, m2) | | | 169.9000 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | | (26)...(30) + (32) = | 44.7615 | | | (33) |
| Main dwelling | | | | | | | | |
| Grd to Unit 3 | | | 14.9800 | 0.0000 | 0.0000 | 70.0000 | 1048.6000 | (32) |
| Grd to Unit 9 | | | 31.8500 | 0.0000 | 0.0000 | 70.0000 | 2229.5000 | (32) |
| First to Unit 10 | | | 14.4900 | 0.0000 | 0.0000 | 70.0000 | 1014.3000 | (32) |

| | | | | | |
|---|---|---|---|---|---|
| First to Unit 2 | 20.7400 | 0.0000 | 0.0000 | 70.0000 | 1451.8000 (32) |
| Party Floor 1 | 12.4900 | | | 80.0000 | 999.2000 (32d) |
| Party Ceiling 1 | 57.2200 | | | 100.0000 | 5722.0000 (32b) |
| Grd Internal Partitions | 30.0100 | | | 9.0000 | 270.0900 (32c) |
| First Internal Partitions | 111.1600 | | | 9.0000 | 1000.4400 (32c) |
| Internal Floor 1 | 44.7200 | | | 18.0000 | 804.9600 (32d) |

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 35040.5900 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 343.7374 (35)
List of Thermal Bridges

| K1 Element | Length | Psi-value | Total |
|---|---|---|---|
| E1 Steel lintel with perforated steel base plate | 8.7100 | 0.0500 | 0.4355 |
| E3 Sill | 8.7100 | 0.0500 | 0.4355 |
| E4 Jamb | 20.2000 | 0.0500 | 1.0100 |
| E5 Ground floor (normal) | 11.2290 | 0.1600 | 1.7966 |
| E6 Intermediate floor within a dwelling | 3.1350 | 0.0000 | 0.0000 |
| E18 Party wall between dwellings | 8.6600 | 0.0300 | 0.2598 |
| E7 Party floor between dwellings (in blocks of flats) | 3.1350 | 0.0350 | 0.1097 |
| E16 Corner (normal) | 17.3700 | 0.0900 | 1.5633 |
| E17 Corner (inverted - internal area greater than external area) | 5.7900 | -0.0900 | -0.5211 |
| E25 Staggered party wall between dwellings | 11.5800 | 0.0300 | 0.3474 |
| E23 Balcony within or between dwellings, balcony support penetrates wall insulation | 6.8600 | 0.0200 | 0.1372 |
| P1 Party wall - Ground floor | 5.1320 | 0.0400 | 0.2053 |
| P3 Party wall - Intermediate floor between dwellings (in blocks of flats) | 18.0000 | 0.0000 | 0.0000 |
| E7 Party floor between dwellings (in blocks of flats) | 7.1850 | 0.0350 | 0.2515 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 6.0307 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 50.7922 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 28.2857 | 27.9209 | 27.5560 | 25.7319 | 25.3671 | 23.5430 | 23.5430 | 23.1782 | 24.2727 | 25.3671 | 26.0968 | 26.8264 | (38) |
| Heat transfer coeff | 79.0779 | 78.7130 | 78.3482 | 76.5241 | 76.1593 | 74.3352 | 74.3352 | 73.9704 | 75.0649 | 76.1593 | 76.8890 | 77.6186 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 76.4329 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 0.7757 | 0.7722 | 0.7686 | 0.7507 | 0.7471 | 0.7292 | 0.7292 | 0.7256 | 0.7364 | 0.7471 | 0.7543 | 0.7614 | (40) |
| HLP (average) | | | | | | | | | | | | 0.7498 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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4. Water heating energy requirements (kWh/year)

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Assumed occupancy 2.7568 (42)
Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 68.6621 | 67.6109 | 66.0617 | 63.6785 | 61.5432 | 58.5560 | 56.1932 | 58.9554 | 60.3447 | 63.3034 | 66.3847 | 68.6002 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 29.7375 | 29.2886 | 28.6500 | 27.6936 | 26.8317 | 25.6452 | 24.7450 | 25.8458 | 26.4234 | 27.5991 | 28.8214 | 29.7139 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 42.8621 | 41.3035 | 39.7449 | 38.1863 | 36.6276 | 35.0690 | 35.0690 | 36.6276 | 38.1863 | 39.7449 | 41.3035 | 42.8621 | (42c) |

Average daily hot water use (litres/day) 129.8404 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 141.2617 | 138.2030 | 134.4565 | 129.5583 | 125.0025 | 119.2702 | 116.0073 | 121.4288 | 124.9544 | 130.6474 | 136.5096 | 141.1762 | (44) |
| Energy conte | 207.9616 | 182.8705 | 192.1356 | 169.2356 | 161.0784 | 137.9320 | 128.1915 | 142.9239 | 144.9408 | 168.3523 | 184.4972 | 207.3276 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 2027.4471 | |
| Distribution loss (46)m = 0.15 x (45)m | 31.1942 | 27.4306 | 28.8203 | 25.3853 | 24.1618 | 20.6898 | 19.2287 | 21.4386 | 21.7411 | 25.2529 | 27.6746 | 31.0991 | (46) |
| Water storage loss: | | | | | | | | | | | | | |
| Store volume | | | | | | | | | | | | 110.0000 | (47) |
| b) If manufacturer declared loss factor is not known : | | | | | | | | | | | | | |
| Hot water storage loss factor from Table 2 (kWh/litre/day) | | | | | | | | | | | | 0.0152 | (51) |
| Volume factor from Table 2a | | | | | | | | | | | | 1.0294 | (52) |
| Temperature factor from Table 2b | | | | | | | | | | | | 0.6000 | (53) |
| Enter (49) or (54) in (55) | | | | | | | | | | | | 1.0327 | (55) |
| Total storage loss | 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (56) |
| If cylinder contains dedicated solar storage | 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (57) |
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | 263.2384 | 232.7979 | 247.4124 | 222.7293 | 216.3552 | 191.4256 | 183.4683 | 198.2007 | 198.4345 | 223.6291 | 237.9909 | 262.6044 | (62) |
| WWHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | 263.2384 | 232.7979 | 247.4124 | 222.7293 | 216.3552 | 191.4256 | 183.4683 | 198.2007 | 198.4345 | 223.6291 | 237.9909 | 262.6044 | (64) |
| | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | | 2678.2868 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2678 | (64) |
| Electric shower(s) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | 113.3687 | 100.7464 | 108.1065 | 99.0658 | 97.7800 | 88.6573 | 86.8451 | 91.7436 | 90.9878 | 100.1986 | 104.1403 | 113.1579 | (65) |

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5. Internal gains (see Table 5 and 5a)

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Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 137.8387 | 137.8387 | 137.8387 | 137.8387 | 137.8387 | 137.8387 | 137.8387 | 137.8387 | 137.8387 | 137.8387 | 137.8387 | 137.8387 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 139.2213 | 154.1379 | 139.2213 | 143.8620 | 139.2213 | 143.8620 | 139.2213 | 139.2213 | 143.8620 | 139.2213 | 143.8620 | 139.2213 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 259.4264 | 262.1185 | 255.3346 | 240.8926 | 222.6622 | 205.5282 | 194.0816 | 191.3896 | 198.1734 | 212.6154 | 230.8458 | 247.9798 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 36.7839 | 36.7839 | 36.7839 | 36.7839 | 36.7839 | 36.7839 | 36.7839 | 36.7839 | 36.7839 | 36.7839 | 36.7839 | 36.7839 | (69) |
| Pumps, fans | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | -110.2709 | -110.2709 | -110.2709 | -110.2709 | -110.2709 | -110.2709 | -110.2709 | -110.2709 | -110.2709 | -110.2709 | -110.2709 | -110.2709 | (71) |
| Water heating gains (Table 5) | 152.3773 | 149.9202 | 145.3045 | 137.5914 | 131.4248 | 123.1352 | 116.7273 | 123.3114 | 126.3719 | 134.6755 | 144.6393 | 152.0939 | (72) |
| Total internal gains | | | | | | | | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 615.3766 | 630.5281 | 604.2120 | 586.6976 | 557.6599 | 536.8770 | 514.3818 | 518.2738 | 532.7589 | 550.8638 | 583.6987 | 603.6467 (73) |

6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Southwest | 12.4300 | 36.7938 | 0.4500 | 0.7000 | 0.7700 | 99.8366 | (79) |
| Southwest | 2.4000 | 36.7938 | 0.4500 | 0.7000 | 0.7700 | 19.2766 | (79) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 119.1132 | 202.8939 | 277.6083 | 343.9701 | 385.2752 | 382.4891 | 368.7603 | 337.9448 | 300.5910 | 224.2410 | 142.6702 | 101.9361 | (83) |
| Total gains | 734.4898 | 833.4220 | 881.8203 | 930.6677 | 942.9350 | 919.3660 | 883.1421 | 856.2187 | 833.3499 | 775.1048 | 726.3689 | 705.5828 | (84) |

7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 123.0875 | 123.6580 | 124.2338 | 127.1951 | 127.8044 | 130.9406 | 130.9406 | 131.5864 | 129.6678 | 127.8044 | 126.5916 | 125.4016 | |
| alpha | 9.2058 | 9.2439 | 9.2823 | 9.4797 | 9.5203 | 9.7294 | 9.7294 | 9.7724 | 9.6445 | 9.5203 | 9.4394 | 9.3601 | |
| util living area | | | | | | | | | | | | | |
| | 0.9980 | 0.9928 | 0.9770 | 0.9023 | 0.7382 | 0.5171 | 0.3703 | 0.3974 | 0.6191 | 0.9144 | 0.9915 | 0.9985 | (86) |
| MIT | 20.4969 | 20.6232 | 20.7647 | 20.9259 | 20.9895 | 20.9997 | 21.0000 | 21.0000 | 20.9983 | 20.9284 | 20.7006 | 20.4857 | (87) |
| Th 2 | 20.2744 | 20.2775 | 20.2807 | 20.2963 | 20.2994 | 20.3151 | 20.3151 | 20.3183 | 20.3088 | 20.2994 | 20.2932 | 20.2869 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9971 | 0.9899 | 0.9680 | 0.8726 | 0.6878 | 0.4620 | 0.3127 | 0.3385 | 0.5584 | 0.8817 | 0.9875 | 0.9979 | (89) |
| MIT 2 | 19.6912 | 19.8539 | 20.0320 | 20.2301 | 20.2924 | 20.3150 | 20.3151 | 20.3182 | 20.3080 | 20.2384 | 19.9657 | 19.6874 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.3869 | (91) |
| MIT | 20.0030 | 20.1515 | 20.3155 | 20.4993 | 20.5621 | 20.5799 | 20.5801 | 20.5820 | 20.5751 | 20.5054 | 20.2500 | 19.9963 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 20.0030 | 20.1515 | 20.3155 | 20.4993 | 20.5621 | 20.5799 | 20.5801 | 20.5820 | 20.5751 | 20.5054 | 20.2500 | 19.9963 | (93) |

8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9967 | 0.9893 | 0.9685 | 0.8818 | 0.7071 | 0.4833 | 0.3350 | 0.3613 | 0.5819 | 0.8922 | 0.9872 | 0.9976 | (94) |
| Useful gains | 732.0919 | 824.4765 | 854.0662 | 820.6378 | 666.7397 | 444.3202 | 295.8555 | 309.3351 | 484.9276 | 691.5666 | 717.0590 | 703.8778 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | | | | | | | | | | | | | |
| | 1241.7566 | 1200.4944 | 1082.4200 | 887.6274 | 674.9328 | 444.5154 | 295.8602 | 309.3445 | 486.0489 | 754.3872 | 1011.0913 | 1226.0828 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 379.1905 | 252.6840 | 169.8952 | 48.2325 | 6.0956 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 46.7386 | 211.7032 | 388.5205 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 1503.0602 | |
| Solar heating kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | | | | | | | | | | | | | |
| | 379.1905 | 252.6840 | 169.8952 | 48.2325 | 6.0956 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 46.7386 | 211.7032 | 388.5205 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 1503.0602 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 14.7446 | (99) |

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ext. temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | |
| Heat loss rate W | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 698.7510 | 550.0806 | 562.1750 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (100) |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.9905 | 0.9981 | 0.9971 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (101) |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 692.1400 | 549.0434 | 560.5658 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (102) |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 999.3111 | 960.8126 | 931.5464 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103) |
| Space cooling kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 221.1632 | 306.3563 | 276.0095 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (104) |
| Cooled fraction | | | | | | | | | | fC = cooled area / (4) = | | 0.5592 | (105) |
| Intermittency factor (Table 10b) | | | | | | | | | | | | | |
| | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | (106) |
| Space cooling kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 30.9160 | 42.8250 | 38.5829 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) |
| Space cooling requirement | | | | | | | | | | | | 112.3238 | (107) |

9b. Energy requirements

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | 0.0000 | (301) |
| Fraction of space heat from community system | | | | | | | | | | | | 1.0000 | (302) |
| Fraction of heat from community Heat pump-Space and Water | | | | | | | | | | | | 1.0000 | (303a) |
| Factor for control and charging method (Table 4c(3)) for space heating | | | | | | | | | | | | 1.0000 | (305) |
| Factor for charging method (Table 4c(3)) for water heating | | | | | | | | | | | | 1.0000 | (305a) |
| Distribution loss factor (Table 12c) for community heating system | | | | | | | | | | | | 2.0000 | (306) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 | (208) |
| Space heating: | | | | | | | | | | | | | |
| Space heating requirement | | | | | | | | | | | | | |
| | 379.1905 | 252.6840 | 169.8952 | 48.2325 | 6.0956 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 46.7386 | 211.7032 | 388.5205 | (98) |
| Space heat from Heat pump = (98) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 307a | 758.3810 | 505.3680 | 339.7904 | 96.4650 | 12.1913 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 93.4771 | 423.4065 | 777.0410 | |
| Space heating requirement | | | | | | | | | | | | | |
| | 758.3810 | 505.3680 | 339.7904 | 96.4650 | 12.1913 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 93.4771 | 423.4065 | 777.0410 | (307) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | | | | | | | | | | | 0.0000 | (308) |
| Space heating fuel for secondary/supplementary system | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (309) |

Water heating

Annual water heating requirement

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 263.2384 | 232.7979 | 247.4124 | 222.7293 | 216.3552 | 191.4256 | 183.4683 | 198.2007 | 198.4345 | 223.6291 | 237.9909 | 262.6044 | (64) |
| Water heat from Heat pump = (64) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 310a | 526.4769 | 465.5958 | 494.8249 | 445.4585 | 432.7104 | 382.8513 | 366.9365 | 396.4014 | 396.8690 | 447.2583 | 475.9818 | 525.2088 | |
| Water heating fuel | | | | | | | | | | | | | |
| | 526.4769 | 465.5958 | 494.8249 | 445.4585 | 432.7104 | 382.8513 | 366.9365 | 396.4014 | 396.8690 | 447.2583 | 475.9818 | 525.2088 | (310) |
| Cooling System Energy Efficiency Ratio | | | | | | | | | | | | 2.6000 | (314) |
| Space coolin | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 11.8908 | 16.4711 | 14.8396 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (315) |
| Pumps and Fa | 26.0867 | 23.5622 | 26.0867 | 25.2452 | 26.0867 | 25.2452 | 26.0867 | 26.0867 | 25.2452 | 26.0867 | 25.2452 | 26.0867 | (331) |
| Lighting | 32.7678 | 26.2875 | 23.6690 | 17.3409 | 13.3946 | 10.9435 | 12.2190 | 15.8828 | 20.6301 | 27.0678 | 30.5731 | 33.6785 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333a)m | -4.8847 | -7.9908 | -13.4107 | -17.5571 | -21.1522 | -20.5899 | -20.2958 | -17.9636 | -14.3130 | -10.0420 | -5.7224 | -4.0922 | (333a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335a) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (333b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335b) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - community heating | 3006.1204 | (307) |
| Space heating fuel - secondary | 0.0000 | (309) |
| Water heating fuel - community heating | 5356.5737 | (310) |
| Efficiency of water heater | 0.0000 | (311) |
| Electricity used for heat distribution | 30.0612 | (313) |
| Space cooling fuel | 43.2015 | (321) |
| | | |
| Electricity for pumps and fans: | | |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8540) | | |
| mechanical ventilation fans (SFP = 0.8540) | 307.1502 | (330a) |
| Total electricity for the above, kWh/year | 307.1502 | (331) |
| Electricity for lighting (calculated in Appendix L) | 264.4546 | (332) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -158.0144 | (333) |
| Wind generation | 0.0000 | (334) |
| Hydro-electric generation (Appendix N) | 0.0000 | (335a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (335) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (336) |
| Energy used | 0.0000 | (337) |
| Total delivered energy for all uses | 8819.4859 | (338) |

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12b. Carbon dioxide emissions - Community heating scheme

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (367) |
| Space and Water heating from Heat pump | 2986.6764 | 0.1581 | 169.7042 | (367) |
| Electrical energy for heat distribution (space & water) | 30.0612 | 0.0000 | 12.2981 | (372) |
| Overall CO2 factor for heat network | | | 0.0540 | (386) |
| Total CO2 associated with community systems | | | 451.5144 | (373) |
| Space and water heating | | | 451.5144 | (376) |
| Space cooling | 43.2015 | 0.1138 | 4.9172 | (377) |
| Pumps, fans and electric keep-hot | 307.1502 | 0.1387 | 42.6055 | (378) |
| Energy for lighting | 264.4546 | 0.1443 | 38.1690 | (379) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -158.0144 | 0.1317 | -20.8079 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -20.8079 | (380) |
| Total CO2, kg/year | | | 516.3982 | (383) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 5.0700 | (384) |

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13b. Primary energy - Community heating scheme

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| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (467a) |
| Space and Water heating from Heat pump | 2986.6764 | 1.5851 | 1701.8284 | (467) |
| Electrical energy for heat distribution (space & water) | 30.0612 | 0.0000 | 129.1205 | (472) |
| Overall CO2 factor for heat network | | | 0.5669 | (486) |
| Total CO2 associated with community systems | | | 4740.5654 | (473) |
| Space and water heating | | | 4740.5654 | (476) |
| Space cooling | 43.2015 | 1.4196 | 61.3272 | (477) |
| Pumps, fans and electric keep-hot | 307.1502 | 1.5128 | 464.6568 | (478) |
| Energy for lighting | 264.4546 | 1.5338 | 405.6293 | (479) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -158.0144 | 1.4865 | -234.8901 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -234.8901 | (480) |
| Total Primary energy kWh/year | | | 5437.2886 | (483) |
| Dwelling Primary energy Rate (DPER) | | | 53.3400 | (484) |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

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| | Area (m2) | Storey height (m) | Volume (m3) |
|---|---|---|---|
| Main dwelling | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Ground floor | 44.7200 (1b) | x | 2.9200 (2b) | = | 130.5824 | (1b) - (3b) |
| First floor | 57.2200 (1c) | x | 2.8700 (2c) | = | 164.2214 | (1c) - (3c) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 101.9400 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = | 294.8038 | (5) |

## 2. Ventilation rate

| | m3 per hour | | |
|---|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 | (6a) |
| Number of open flues | 0 * 20 = | 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | 4 * 10 = | 40.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |

| | Air changes per hour | | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 40.0000 / (5) = | 0.1357 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3857 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.3857 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.4917 | 0.4821 | 0.4725 | 0.4243 | 0.4146 | 0.3664 | 0.3664 | 0.3568 | 0.3857 | 0.4146 | 0.4339 | 0.4532 | (22b) |
| Effective ac | 0.6209 | 0.6162 | 0.6116 | 0.5900 | 0.5860 | 0.5671 | 0.5671 | 0.5636 | 0.5744 | 0.5860 | 0.5941 | 0.6027 | (25) |

## 3. Heat losses and heat loss parameter

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| TER Opaque door | | | 6.4800 | 1.0000 | 6.4800 | | | (26) |
| TER Opening Type | | | 14.8300 | 1.1450 | 16.9809 | | | (27) |
| Ground Floor | | | 44.7200 | 0.1300 | 5.8136 | | | (28a) |
| Ground External Walls | 30.5100 | 10.6500 | 19.8600 | 0.1800 | 3.5748 | | | (29a) |
| First Floor External Wall | 30.5100 | 10.6600 | 19.8500 | 0.1800 | 3.5730 | | | (29a) |
| Wall to Communal Corridor FF | 21.3400 | | 21.3400 | 0.1800 | 3.8412 | | | (29a) |
| Wall To Communal Corridor GF | 42.8200 | | 42.8200 | 0.1800 | 7.7076 | | | (29a) |
| Total net area of external elements Aum(A, m2) | | | 169.9000 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 47.9711 | | | (33) |
| Main dwelling | | | | | | | | |
| Grd to Unit 3 | | | 14.9800 | 0.0000 | 0.0000 | | | (32) |
| Grd to Unit 9 | | | 31.8500 | 0.0000 | 0.0000 | | | (32) |
| First to Unit 10 | | | 14.4900 | 0.0000 | 0.0000 | | | (32) |
| First to Unit 2 | | | 20.7400 | 0.0000 | 0.0000 | | | (32) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 332.5112 (35)

List of Thermal Bridges

| | K1 Element | Length | Psi-value | Total |
|---|---|---|---|---|
| E1 | Steel lintel with perforated steel base plate | 8.7100 | 0.0500 | 0.4355 |
| E3 | Sill | 8.7100 | 0.0500 | 0.4355 |
| E4 | Jamb | 20.2000 | 0.0500 | 1.0100 |
| E5 | Ground floor (normal) | 11.2290 | 0.1600 | 1.7966 |
| E6 | Intermediate floor within a dwelling | 3.1350 | 0.0000 | 0.0000 |
| E18 | Party wall between dwellings | 8.6600 | 0.0600 | 0.5196 |
| E7 | Party floor between dwellings (in blocks of flats) | 3.1350 | 0.0700 | 0.2195 |
| E16 | Corner (normal) | 17.3700 | 0.0900 | 1.5633 |
| E17 | Corner (inverted - internal area greater than external area) | 5.7900 | -0.0900 | -0.5211 |
| E25 | Staggered party wall between dwellings | 11.5800 | 0.0600 | 0.6948 |
| E23 | Balcony within or between dwellings, balcony support penetrates wall insulation | 6.8600 | 0.0200 | 0.1372 |
| P1 | Party wall - Ground floor | 5.1320 | 0.0800 | 0.4106 |
| P3 | Party wall - Intermediate floor between dwellings (in blocks of flats) | 18.0000 | 0.0000 | 0.0000 |
| E7 | Party floor between dwellings (in blocks of flats) | 7.1850 | 0.0700 | 0.5030 |

| | | |
|---|---|---|
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | 7.2044 | (36) |
| Point Thermal bridges | (36a) = 0.0000 | |
| Total fabric heat loss | (33) + (36) + (36a) = 55.1755 | (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 60.4051 | 59.9484 | 59.5007 | 57.3978 | 57.0044 | 55.1728 | 55.1728 | 54.8337 | 55.8783 | 57.0044 | 57.8003 | 58.6324 | (38) |
| Heat transfer coeff | 115.5806 | 115.1239 | 114.6762 | 112.5733 | 112.1799 | 110.3483 | 110.3483 | 110.0092 | 111.0538 | 112.1799 | 112.9758 | 113.8079 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 112.5714 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.1338 | 1.1293 | 1.1249 | 1.1043 | 1.1004 | 1.0825 | 1.0825 | 1.0792 | 1.0894 | 1.1004 | 1.1083 | 1.1164 | (40) |
| HLP (average) | | | | | | | | | | | | 1.1043 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

## 4. Water heating energy requirements (kWh/year)

| | | |
|---|---|---|
| Assumed occupancy | 2.7568 | (42) |

Hot water usage for mixer showers

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 70.4418 | 69.3832 | 67.8406 | 64.8892 | 62.7110 | 60.2820 | 58.9014 | 60.4323 | 62.1105 | 64.7185 | 67.7334 | 70.1719 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 30.4155 | 29.9638 | 29.3277 | 28.1548 | 27.2766 | 26.3028 | 25.7768 | 26.4084 | 27.0962 | 28.1382 | 29.3352 | 30.3127 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 42.8621 | 41.3035 | 39.7449 | 38.1863 | 36.6276 | 35.0690 | 35.0690 | 36.6276 | 38.1863 | 39.7449 | 41.3035 | 42.8621 | (42c) |

| | | |
|---|---|---|
| Average daily hot water use (litres/day) | 132.1105 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 143.7195 | 140.6505 | 136.9132 | 131.2302 | 126.6153 | 121.6538 | 119.7472 | 123.4684 | 127.3929 | 132.6016 | 138.3721 | 143.3467 | (44) |
| Energy conte | 227.6165 | 200.2845 | 210.4305 | 179.6476 | 170.4485 | 149.5876 | 144.8238 | 152.8796 | 157.0882 | 179.9391 | 197.1364 | 224.4463 | (45) |
| Energy content (annual) | | | | | | | | | | | Total = Sum(45)m = | 2194.3285 | |
| Distribution loss (46)m = 0.15 x (45)m | 34.1425 | 30.0427 | 31.5646 | 26.9471 | 25.5673 | 22.4381 | 21.7236 | 22.9319 | 23.5632 | 26.9909 | 29.5705 | 33.6670 | (46) |
| Water storage loss: | | | | | | | | | | | | | |
| Store volume | | | | | | | | | | | | 150.0000 | (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | | | | | | | | | | | | 1.3938 | (48) |
| Temperature factor from Table 2b | | | | | | | | | | | | 0.5400 | (49) |
| Enter (49) or (54) in (55) | | | | | | | | | | | | 0.7527 | (55) |
| Total storage loss | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (56) |
| If cylinder contains dedicated solar storage | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (57) |
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | 274.2114 | 242.3702 | 257.0254 | 224.7395 | 217.0434 | 194.6794 | 191.4187 | 199.4745 | 202.1800 | 226.5340 | 242.2282 | 271.0412 | (62) |
| WWHRS | -32.2031 | -28.4807 | -29.8233 | -24.6949 | -23.0147 | -19.6939 | -18.4599 | -19.6302 | -20.3760 | -24.0211 | -27.2130 | -31.6067 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | 242.0083 | 213.8895 | 227.2021 | 200.0446 | 194.0287 | 174.9855 | 172.9588 | 179.8443 | 181.8040 | 202.5129 | 215.0152 | 239.4345 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2443.7285 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2444 | (64) |
| Electric shower(s) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | 112.9584 | 100.2632 | 107.2441 | 95.8063 | 93.9500 | 85.8113 | 85.4298 | 88.1084 | 88.3053 | 97.1057 | 101.6213 | 111.9043 | (65) |

## 5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 137.8387 | 137.8387 | 137.8387 | 137.8387 | 137.8387 | 137.8387 | 137.8387 | 137.8387 | 137.8387 | 137.8387 | 137.8387 | 137.8387 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 139.2213 | 154.1379 | 139.2213 | 143.8620 | 139.2213 | 143.8620 | 139.2213 | 139.2213 | 143.8620 | 139.2213 | 143.8620 | 139.2213 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 259.4264 | 262.1185 | 255.3346 | 240.8926 | 222.6622 | 205.5282 | 194.0816 | 191.3896 | 198.1734 | 212.6154 | 230.8458 | 247.9798 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 36.7839 | 36.7839 | 36.7839 | 36.7839 | 36.7839 | 36.7839 | 36.7839 | 36.7839 | 36.7839 | 36.7839 | 36.7839 | 36.7839 | (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.0000 | 3.0000 | 3.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | -110.2709 | -110.2709 | -110.2709 | -110.2709 | -110.2709 | -110.2709 | -110.2709 | -110.2709 | -110.2709 | -110.2709 | -110.2709 | -110.2709 | (71) |
| Water heating gains (Table 5) | 151.8258 | 149.2011 | 144.1452 | 133.0643 | 126.2769 | 119.1824 | 114.8251 | 118.4253 | 122.6462 | 130.5184 | 141.1407 | 150.4090 | (72) |
| Total internal gains | 617.8251 | 632.8091 | 606.0528 | 585.1706 | 555.5120 | 532.9242 | 512.4796 | 513.3877 | 529.0333 | 549.7067 | 583.2002 | 604.9618 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Southwest | 14.8300 | 36.7938 | 0.6300 | 0.7000 | 0.7700 | 166.7585 | (79) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 166.7585 | 284.0514 | 388.6516 | 481.5581 | 539.3852 | 535.4847 | 516.2644 | 473.1228 | 420.8274 | 313.9373 | 199.7383 | 142.7105 | (83) |
| Total gains | 784.5836 | 916.8605 | 994.7043 | 1066.7287 | 1094.8973 | 1068.4089 | 1028.7439 | 986.5105 | 949.8607 | 863.6440 | 782.9384 | 747.6723 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| tau | 81.4635 | 81.7867 | 82.1061 | 83.6398 | 83.9331 | 85.3262 | 85.3262 | 85.5893 | 84.7842 | 83.9331 | 83.3418 | 82.7325 | |
| alpha | 6.4309 | 6.4524 | 6.4737 | 6.5760 | 6.5955 | 6.6884 | 6.6884 | 6.7060 | 6.6523 | 6.5955 | 6.5561 | 6.5155 | |
| util living area | 0.9982 | 0.9946 | 0.9852 | 0.9485 | 0.8465 | 0.6463 | 0.4703 | 0.5101 | 0.7604 | 0.9602 | 0.9947 | 0.9987 | (86) |
| MIT | 20.0412 | 20.2124 | 20.4285 | 20.7058 | 20.9022 | 20.9868 | 20.9986 | 20.9976 | 20.9630 | 20.7166 | 20.3359 | 20.0234 | (87) |
| Th 2 | 19.9733 | 19.9770 | 19.9805 | 19.9973 | 20.0005 | 20.0152 | 20.0152 | 20.0179 | 20.0095 | 20.0005 | 19.9941 | 19.9874 | (88) |
| util rest of house | 0.9974 | 0.9923 | 0.9787 | 0.9259 | 0.7887 | 0.5542 | 0.3660 | 0.4029 | 0.6715 | 0.9379 | 0.9920 | 0.9981 | (89) |
| MIT 2 | 18.8696 | 19.0904 | 19.3657 | 19.7155 | 19.9276 | 20.0093 | 20.0149 | 20.0173 | 19.9896 | 19.7369 | 19.2620 | 18.8578 | (90) |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.3869 | (91) |
| MIT | 19.3228 | 19.5245 | 19.7769 | 20.0987 | 20.3047 | 20.3875 | 20.3954 | 20.3966 | 20.3662 | 20.1159 | 19.6775 | 19.3088 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.3228 | 19.5245 | 19.7769 | 20.0987 | 20.3047 | 20.3875 | 20.3954 | 20.3966 | 20.3662 | 20.1159 | 19.6775 | 19.3088 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9967 | 0.9909 | 0.9770 | 0.9286 | 0.8078 | 0.5899 | 0.4065 | 0.4446 | 0.7054 | 0.9410 | 0.9909 | 0.9975 | (94) |
| Useful gains | 781.9771 | 908.4977 | 971.8376 | 990.5248 | 884.4613 | 630.2542 | 418.2117 | 438.5796 | 670.0072 | 812.6894 | 775.7975 | 745.8096 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | 1736.3496 | 1683.6286 | 1522.5466 | 1260.6715 | 965.2696 | 638.6372 | 418.8213 | 439.6612 | 695.8857 | 1067.4949 | 1420.9474 | 1719.4958 | (97) |
| Space heating kWh | 710.0532 | 520.8880 | 409.7275 | 194.5057 | 60.1214 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 189.5752 | 464.5080 | 724.4225 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 3273.8013 | |
| Solar heating kWh | | | | | | | | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | 0.0000 | |
| Space heating kWh | | | | | | | | | | | | |
| | 710.0532 | 520.8880 | 409.7275 | 194.5057 | 60.1214 | 0.0000 | 0.0000 | 0.0000 | 189.5752 | 464.5080 | 724.4225 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | 3273.8013 | |
| Space heating per m2 | | | | | | | | | | (98c) / (4) = | 32.1150 | (99) |

---

9a. Energy requirements - Individual heating systems, including micro-CHP

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| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | 0.0000 | (201) |
| Fraction of space heat from main system(s) | | | | | | | | | | | 1.0000 | (202) |
| Efficiency of main space heating system 1 (in %) | | | | | | | | | | | 92.3000 | (206) |
| Efficiency of main space heating system 2 (in %) | | | | | | | | | | | 0.0000 | (207) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | 0.0000 | (208) |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| Space heating requirement | | | | | | | | | | | | | |
| | 710.0532 | 520.8880 | 409.7275 | 194.5057 | 60.1214 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 189.5752 | 464.5080 | 724.4225 | (98) |
| Space heating efficiency (main heating system 1) | | | | | | | | | | | | | |
| | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.3000 | 92.3000 | 92.3000 | (210) |
| Space heating fuel (main heating system) | | | | | | | | | | | | | |
| | 769.2884 | 564.3423 | 443.9084 | 210.7321 | 65.1369 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 205.3903 | 503.2589 | 784.8564 | (211) |
| Space heating efficiency (main heating system 2) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (212) |
| Space heating fuel (main heating system 2) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (213) |
| Space heating fuel (secondary) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (215) |
| Water heating | | | | | | | | | | | | | |
| Water heating requirement | | | | | | | | | | | | | |
| | 242.0083 | 213.8895 | 227.2021 | 200.0446 | 194.0287 | 174.9855 | 172.9588 | 179.8443 | 181.8040 | 202.5129 | 215.0152 | 239.4345 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 | (216) |
| (217)m | 86.3252 | 85.9773 | 85.3657 | 83.9968 | 81.7602 | 79.8000 | 79.8000 | 79.8000 | 79.8000 | 83.9120 | 85.7402 | 86.3799 | (217) |
| Fuel for water heating, kWh/month | | | | | | | | | | | | | |
| | 280.3450 | 248.7743 | 266.1516 | 238.1573 | 237.3142 | 219.2801 | 216.7404 | 225.3688 | 227.8246 | 241.3396 | 250.7752 | 277.1877 | (219) |
| Space cooling fuel requirement | | | | | | | | | | | | | |
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (221) |
| Pumps and Fa | 7.3041 | 6.5973 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | (231) |
| Lighting | 28.9274 | 23.2067 | 20.8950 | 15.3086 | 11.8248 | 9.6610 | 10.7870 | 14.0213 | 18.2123 | 23.8955 | 26.9899 | 29.7314 | (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233a)m | -22.2217 | -33.1227 | -50.2931 | -59.8205 | -67.3702 | -63.9089 | -63.1119 | -58.1502 | -49.9186 | -39.2811 | -25.0537 | -19.0073 | (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233b)m | -7.6303 | -16.4414 | -33.4280 | -51.3355 | -69.0122 | -69.7820 | -68.9797 | -57.8938 | -41.7578 | -23.8948 | -10.3063 | -6.0064 | (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235d) |
| Annual totals kWh/year | | | | | | | | | | | | | |
| Space heating fuel - main system 1 | | | | | | | | | | | | 3546.9137 | (211) |
| Space heating fuel - main system 2 | | | | | | | | | | | | 0.0000 | (213) |
| Space heating fuel - secondary | | | | | | | | | | | | 0.0000 | (215) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 | |
| Water heating fuel used | | | | | | | | | | | | 2929.2588 | (219) |
| Space cooling fuel | | | | | | | | | | | | 0.0000 | (221) |
| Electricity for pumps and fans: | | | | | | | | | | | | | |
| Total electricity for the above, kWh/year | | | | | | | | | | | | 86.0000 | (231) |
| Electricity for lighting (calculated in Appendix L) | | | | | | | | | | | | 233.4610 | (232) |
| Energy saving/generation technologies (Appendices M ,N and Q) | | | | | | | | | | | | | |
| PV generation | | | | | | | | | | | | -1007.7280 | (233) |
| Wind generation | | | | | | | | | | | | 0.0000 | (234) |
| Hydro-electric generation (Appendix N) | | | | | | | | | | | | 0.0000 | (235a) |
| Electricity generated - Micro CHP (Appendix N) | | | | | | | | | | | | 0.0000 | (235) |
| Appendix Q - special features | | | | | | | | | | | | | |
| Energy saved or generated | | | | | | | | | | | | -0.0000 | (236) |
| Energy used | | | | | | | | | | | | 0.0000 | (237) |
| Total delivered energy for all uses | | | | | | | | | | | | 5787.9054 | (238) |

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12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

---

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 3546.9137 | 0.2100 | 744.8519 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2929.2588 | 0.2100 | 615.1443 | (264) |
| Space and water heating | | | 1359.9962 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 233.4610 | 0.1443 | 33.6956 | (268) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -551.2598 | 0.1334 | -73.5647 | |
| PV Unit electricity exported | -456.4682 | 0.1252 | -57.1692 | |
| Total | | | -130.7339 | (269) |
| Total CO2, kg/year | | | 1274.8872 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 12.5100 | (273) |

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13a. Primary energy - Individual heating systems including micro-CHP

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| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 3546.9137 | 1.1300 | 4008.0125 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2929.2588 | 1.1300 | 3310.0624 | (278) |

| | | | | |
|---|---|---|---|---|
| Space and water heating | | | 7318.0749 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 233.4610 | 1.5338 | 358.0902 | (282) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -551.2598 | 1.4931 | -823.1069 | |
| PV Unit electricity exported | -456.4682 | 0.4597 | -209.8356 | |
| Total | | | -1032.9425 | (283) |
| Total Primary energy kWh/year | | | 6773.3234 | (286) |
| Target Primary Energy Rate (TPER) | | | 66.4400 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Property Reference** | Unit 4 | **Issued on Date** | 17/05/2025 |
| **Assessment Reference** | 00001 | **Prop Type Ref** | Unit 4 |
| **Property** | | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 75 C | **DER** | 6.72 | **TER** | 16.74 |
| **Environmental** | 94 A | **% DER < TER** | | | 59.86 |
| **$CO_2$ Emissions (t/year)** | 0.47 | **DFEE** | 48.55 | **TFEE** | 52.80 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 8.04 |
| **% DPER < TPER** | 21.06 | **DPER** | 70.48 | **TPER** | 89.28 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Robert Arnold | **Assessor ID** | BA04-0001 |
| **Client** | | | |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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## 1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 10.0800 (1b) | x | 2.9300 (2b) | = | 29.5344 | (1b) - (3b) |
| First floor | 71.4700 (1c) | x | 3.0800 (2c) | = | 220.1276 | (1c) - (3c) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 81.5500 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = | 249.6620 | (5) |

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## 2. Ventilation rate

---

| | | | | m3 per hour | |
|---|---|---|---|---|---|
| Number of open chimneys | | | 0 * 80 = | 0.0000 | (6a) |
| Number of open flues | | | 0 * 20 = | 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | | | 0 * 10 = | 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | | | 0 * 20 = | 0.0000 | (6d) |
| Number of flues attached to other heater | | | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | | | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | | | 0 * 10 = | 0.0000 | (7a) |
| Number of passive vents | | | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | | | 0 * 40 = | 0.0000 | (7c) |
| | | | | Air changes per hour | |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | | | 0.0000 / (5) = | 0.0000 | (8) |
| Pressure test | | | | Yes | |
| Pressure Test Method | | | | Blower Door | |
| Measured/design AP50 | | | | 3.0000 | (17) |
| Infiltration rate | | | | 0.1500 | (18) |
| Number of sides sheltered | | | | 0 | (19) |
| Shelter factor | | | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | | | (21) = (18) x (20) = | 0.1500 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.1912 | 0.1875 | 0.1837 | 0.1650 | 0.1612 | 0.1425 | 0.1425 | 0.1388 | 0.1500 | 0.1612 | 0.1687 | 0.1762 | (22b) |

| | | |
|---|---|---|
| Balanced mechanical ventilation with heat recovery | | |
| If mechanical ventilation | 0.5000 | (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | 0.5000 | (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | 81.0000 | (23c) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective ac | 0.2862 | 0.2825 | 0.2787 | 0.2600 | 0.2562 | 0.2375 | 0.2375 | 0.2337 | 0.2450 | 0.2562 | 0.2637 | 0.2712 | (25) |

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## 3. Heat losses and heat loss parameter

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| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| Window | | | 10.4700 | 1.0536 | 11.0316 | | | (27) |
| Solid Door | | | 2.0200 | 1.4000 | 2.8280 | | | (26) |
| Glass Door | | | 4.6200 | 1.3258 | 6.1250 | | | (27) |
| Ground Floor | | | 10.0800 | 0.1000 | 1.0080 | 110.0000 | 1108.8000 | (28a) |
| First Floor over Cycle Store | | | 59.2800 | 0.1000 | 5.9280 | 110.0000 | 6520.8000 | (28b) |
| GF External | 26.6500 | 3.8200 | 22.8300 | 0.1500 | 3.4245 | 150.0000 | 3424.5000 | (29a) |
| GF Wall to Cycle Store | 8.2000 | | 8.2000 | 0.1400 | 1.1480 | 150.0000 | 1230.0000 | (29a) |
| FF External Walls | 40.5300 | 11.2700 | 29.2600 | 0.1500 | 4.3890 | 150.0000 | 4389.0000 | (29a) |
| FF Wall to Communal Corridor | 31.0100 | 2.0200 | 28.9900 | 0.1300 | 3.7687 | 150.0000 | 4348.5000 | (29a) |
| External Roof 1 | 4.8000 | | 4.8000 | 0.1000 | 0.4800 | 9.0000 | 43.2000 | (30) |
| Total net area of external elements Aum(A, m2) | | | 180.5500 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 40.1308 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall To Unit 10 FF | | | 20.1200 | 0.0000 | 0.0000 | 70.0000 | 1408.4000 | (32) |

| | | | | | |
|---|---|---|---|---|---|
| Party Wall to Unit 5 | 20.1300 | 0.0000 | 0.0000 | 70.0000 | 1409.1000 (32) |
| Party Ceiling 1 | 64.6000 | | | 100.0000 | 6460.0000 (32b) |
| Partitions | 157.0200 | | | 9.0000 | 1413.1800 (32c) |
| First Floor Internal | 10.0800 | | | 18.0000 | 181.4400 (32d) |
| Internal Ceiling 1 | 10.0800 | | | 9.0000 | 90.7200 (32e) |

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 32027.6400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 392.7362 (35)
List of Thermal Bridges

| K1 Element | Length | Psi-value | Total |
|---|---|---|---|
| E1 Steel lintel with perforated steel base plate | 6.7900 | 0.0500 | 0.3395 |
| E4 Jamb | 17.7800 | 0.0500 | 0.8890 |
| E5 Ground floor (normal) | 14.3700 | 0.1600 | 2.2992 |
| E6 Intermediate floor within a dwelling | 9.0970 | 0.0000 | 0.0000 |
| E7 Party floor between dwellings (in blocks of flats) | 4.1450 | 0.0700 | 0.2902 |
| E15 Flat roof with parapet | 4.4450 | 0.5600 | 2.4892 |
| E16 Corner (normal) | 12.0400 | 0.0900 | 1.0836 |
| E17 Corner (inverted - internal area greater than external area) | 6.0200 | -0.0900 | -0.5418 |
| E20 Exposed floor (normal) | 3.3850 | 0.3200 | 1.0832 |
| E21 Exposed floor (inverted) | 5.7250 | 0.3200 | 1.8320 |
| E25 Staggered party wall between dwellings | 6.0200 | 0.0600 | 0.3612 |
| P7 Party Wall - Exposed floor (normal) | 13.0740 | 0.1600 | 2.0918 |
| E7 Party floor between dwellings (in blocks of flats) | 10.0720 | 0.0350 | 0.3525 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 12.5696 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 52.7004 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 23.5837 | 23.2747 | 22.9658 | 21.4210 | 21.1120 | 19.5673 | 19.5673 | 19.2583 | 20.1852 | 21.1120 | 21.7300 | 22.3479 | (38) |

Heat transfer coeff

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 76.2841 | 75.9752 | 75.6662 | 74.1214 | 73.8125 | 72.2677 | 72.2677 | 71.9587 | 72.8856 | 73.8125 | 74.4304 | 75.0483 | (39) |

Average = Sum(39)m / 12 = 74.0442

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 0.9354 | 0.9316 | 0.9279 | 0.9089 | 0.9051 | 0.8862 | 0.8862 | 0.8824 | 0.8938 | 0.9051 | 0.9127 | 0.9203 | (40) |
| HLP (average) | | | | | | | | | | | | 0.9080 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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4. Water heating energy requirements (kWh/year)

---

Assumed occupancy 2.4916 (42)
Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 64.3285 | 63.3436 | 61.8922 | 59.6594 | 57.6589 | 54.8602 | 52.6466 | 55.2344 | 56.5360 | 59.3080 | 62.1948 | 64.2705 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 27.8682 | 27.4475 | 26.8490 | 25.9528 | 25.1451 | 24.0331 | 23.1896 | 24.2211 | 24.7625 | 25.8642 | 27.0097 | 27.8461 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 40.1466 | 38.6867 | 37.2269 | 35.7670 | 34.3071 | 32.8472 | 32.8472 | 34.3071 | 35.7670 | 37.2269 | 38.6867 | 40.1466 | (42c) |

Average daily hot water use (litres/day) 121.6432 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 132.3433 | 129.4779 | 125.9681 | 121.3792 | 117.1111 | 111.7406 | 108.6834 | 113.7626 | 117.0655 | 122.3991 | 127.8912 | 132.2632 | (44) |
| Energy conte | 194.8322 | 171.3254 | 180.0058 | 158.5516 | 150.9095 | 129.2242 | 120.0983 | 133.9007 | 135.7901 | 157.7236 | 172.8493 | 194.2382 | (45) |

Energy content (annual) Total = Sum(45)m = 1899.4489

Distribution loss (46)m = 0.15 x (45)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 29.2248 | 25.6988 | 27.0009 | 23.7827 | 22.6364 | 19.3836 | 18.0148 | 20.0851 | 20.3685 | 23.6585 | 25.9274 | 29.1357 | (46) |

Water storage loss:
Store volume 110.0000 (47)
b) If manufacturer declared loss factor is not known :
Hot water storage loss factor from Table 2 (kWh/litre/day) 0.0152 (51)
Volume factor from Table 2a 1.0294 (52)
Temperature factor from Table 2b 0.6000 (53)
Enter (49) or (54) in (55) 1.0327 (55)
Total storage loss

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (56) |

If cylinder contains dedicated solar storage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (57) |
| Primary loss 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |

Total heat required for water heating calculated for each month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 250.1090 | 221.2529 | 235.2826 | 212.0452 | 206.1863 | 182.7179 | 175.3751 | 189.1775 | 189.2838 | 213.0004 | 226.3429 | 249.5150 | (62) |
| WWHRS 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63a) |
| PV diverter -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |

Output from w/h

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 250.1090 | 221.2529 | 235.2826 | 212.0452 | 206.1863 | 182.7179 | 175.3751 | 189.1775 | 189.2838 | 213.0004 | 226.3429 | 249.5150 | (64) |

Total per year (kWh/year) = Sum(64)m = 2550.2887 (64)
12Total per year (kWh/year) 2550 (64)
Electric shower(s)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)
Heat gains from water heating, kWh/month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 109.0031 | 96.9076 | 104.0734 | 95.5133 | 94.3988 | 85.7620 | 84.1541 | 88.7434 | 87.9451 | 96.6645 | 100.2673 | 108.8056 | (65) |

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5. Internal gains (see Table 5 and 5a)

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Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 124.5807 | 124.5807 | 124.5807 | 124.5807 | 124.5807 | 124.5807 | 124.5807 | 124.5807 | 124.5807 | 124.5807 | 124.5807 | 124.5807 | (66) |

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 114.2138 | 126.4510 | 114.2138 | 118.0209 | 114.2138 | 118.0209 | 114.2138 | 114.2138 | 118.0209 | 114.2138 | 118.0209 | 114.2138 | (67) |

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 222.6495 | 224.9599 | 219.1377 | 206.7431 | 191.0970 | 176.3920 | 166.5681 | 164.2577 | 170.0798 | 182.4745 | 198.1205 | 212.8256 | (68) |

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 35.4581 | 35.4581 | 35.4581 | 35.4581 | 35.4581 | 35.4581 | 35.4581 | 35.4581 | 35.4581 | 35.4581 | 35.4581 | 35.4581 | (69) |
| Pumps, fans 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (70) |

Losses e.g. evaporation (negative values) (Table 5)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| -99.6645 | -99.6645 | -99.6645 | -99.6645 | -99.6645 | -99.6645 | -99.6645 | -99.6645 | -99.6645 | -99.6645 | -99.6645 | -99.6645 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 146.5096 | 144.2078 | 139.8836 | 132.6574 | 126.8802 | 119.1139 | 113.1104 | 119.2788 | 122.1460 | 129.9255 | 139.2602 | 146.2441 | (72) |

Total internal gains

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 543.7471 | 555.9929 | 533.6093 | 517.7956 | 492.5652 | 473.9010 | 454.2665 | 458.1245 | 470.6210 | 486.9880 | 515.7758 | 533.6577 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Northwest | 10.4700 | 11.2829 | 0.4500 | 0.7000 | 0.7700 | 25.7877 | (81) |
| Northwest | 4.6200 | 11.2829 | 0.4500 | 0.7000 | 0.7700 | 11.3791 | (81) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 37.1668 | 75.6541 | 136.3047 | 223.8514 | 300.9003 | 320.7915 | 300.0939 | 239.2383 | 166.0894 | 92.4553 | 46.7655 | 30.3523 | (83) |
| Total gains | 580.9139 | 631.6470 | 669.9140 | 741.6471 | 793.4655 | 794.6925 | 754.3604 | 697.3628 | 636.7104 | 579.4433 | 562.5413 | 564.0100 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| tau | 116.6241 | 117.0984 | 117.5765 | 120.0269 | 120.5293 | 123.1057 | 123.1057 | 123.6343 | 122.0621 | 120.5293 | 119.5287 | 118.5446 | |
| alpha | 8.7749 | 8.8066 | 8.8384 | 9.0018 | 9.0353 | 9.2070 | 9.2070 | 9.2423 | 9.1375 | 9.0353 | 8.9686 | 8.9030 | |
| util living area | 0.9994 | 0.9986 | 0.9950 | 0.9632 | 0.8240 | 0.5803 | 0.4214 | 0.4744 | 0.7687 | 0.9795 | 0.9981 | 0.9996 | (86) |
| MIT | 20.3547 | 20.4483 | 20.5988 | 20.8296 | 20.9695 | 20.9988 | 20.9999 | 20.9998 | 20.9874 | 20.8130 | 20.5583 | 20.3499 | (87) |
| Th 2 | 20.1375 | 20.1407 | 20.1439 | 20.1599 | 20.1632 | 20.1793 | 20.1793 | 20.1825 | 20.1728 | 20.1632 | 20.1567 | 20.1503 | (88) |
| util rest of house | 0.9992 | 0.9978 | 0.9922 | 0.9445 | 0.7661 | 0.5069 | 0.3429 | 0.3903 | 0.6873 | 0.9651 | 0.9969 | 0.9993 | (89) |
| MIT 2 | 19.3878 | 19.5102 | 19.7043 | 19.9992 | 20.1430 | 20.1788 | 20.1793 | 20.1825 | 20.1668 | 19.9873 | 19.6644 | 19.3923 | (90) |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.3654 | (91) |
| MIT | 19.7411 | 19.8530 | 20.0312 | 20.3026 | 20.4450 | 20.4784 | 20.4791 | 20.4811 | 20.4667 | 20.2890 | 19.9910 | 19.7423 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.7411 | 19.8530 | 20.0312 | 20.3026 | 20.4450 | 20.4784 | 20.4791 | 20.4811 | 20.4667 | 20.2890 | 19.9910 | 19.7423 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9990 | 0.9975 | 0.9917 | 0.9482 | 0.7866 | 0.5338 | 0.3716 | 0.4210 | 0.7174 | 0.9678 | 0.9965 | 0.9992 | (94) |
| Useful gains | 580.3176 | 630.0467 | 664.3774 | 703.2308 | 624.1525 | 424.2003 | 280.3177 | 293.6166 | 456.7541 | 560.7595 | 560.5946 | 563.5580 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | 1177.9098 | 1136.0555 | 1023.8534 | 845.1785 | 645.4899 | 424.8205 | 280.3371 | 293.6741 | 464.0387 | 715.1708 | 959.4842 | 1166.4197 | (97) |
| Space heating kWh | 444.6086 | 340.0379 | 267.4501 | 102.2023 | 15.8750 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 114.8820 | 287.2005 | 448.5291 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 2020.7857 | |
| Solar heating kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | 444.6086 | 340.0379 | 267.4501 | 102.2023 | 15.8750 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 114.8820 | 287.2005 | 448.5291 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 2020.7857 | |
| Space heating per m2 | | | | | | | | | | (98c) / (4) = | | 24.7797 | (99) |

## 8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ext. temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | |
| Heat loss rate W | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 679.3162 | 534.7808 | 546.8863 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (100) |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.9755 | 0.9935 | 0.9862 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (101) |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 662.6852 | 531.2833 | 539.3329 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (102) |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 869.6644 | 825.6161 | 760.4637 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 149.0250 | 218.9837 | 164.5214 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (104) |
| Cooled fraction | | | | | | | | | fC = cooled area / (4) = | | | 0.8706 | (105) |
| Intermittency factor (Table 10b) | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | (106) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 32.4365 | 47.6635 | 35.8094 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) |
| Space cooling requirement | | | | | | | | | | | | 115.9094 | (107) |

## 9b. Energy requirements

| | | |
|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | 0.0000 | (301) |
| Fraction of space heat from community system | 1.0000 | (302) |
| Fraction of heat from community Heat pump-Space and Water | 1.0000 | (303a) |
| Factor for control and charging method (Table 4c(3)) for space heating | 1.0000 | (305) |
| Factor for charging method (Table 4c(3)) for water heating | 1.0000 | (305a) |
| Distribution loss factor (Table 12c) for community heating system | 2.0000 | (306) |
| Efficiency of secondary/supplementary heating system, % | 0.0000 | (208) |

Space heating:

Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 444.6086 | 340.0379 | 267.4501 | 102.2023 | 15.8750 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 114.8820 | 287.2005 | 448.5291 | (98) |

Space heat from Heat pump = (98) x 1.00 x 1.00 x 2.00

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 307a | 889.2172 | 680.0759 | 534.9003 | 204.4047 | 31.7500 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 229.7641 | 574.4011 | 897.0583 | |
| Space heating requirement | 889.2172 | 680.0759 | 534.9003 | 204.4047 | 31.7500 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 229.7641 | 574.4011 | 897.0583 | (307) |

| | | |
|---|---|---|
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000 | (308) |

Space heating fuel for secondary/supplementary system

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (309) |

Water heating

Annual water heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 250.1090 | 221.2529 | 235.2826 | 212.0452 | 206.1863 | 182.7179 | 175.3751 | 189.1775 | 189.2838 | 213.0004 | 226.3429 | 249.5150 | (64) |

Water heat from Heat pump = (64) x 1.00 x 1.00 x 2.00

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 310a | 500.2180 | 442.5057 | 470.5653 | 424.0905 | 412.3726 | 365.4358 | 350.7503 | 378.3550 | 378.5675 | 426.0008 | 452.6859 | 499.0300 | |
| Water heating fuel | | | | | | | | | | | | | |
| | 500.2180 | 442.5057 | 470.5653 | 424.0905 | 412.3726 | 365.4358 | 350.7503 | 378.3550 | 378.5675 | 426.0008 | 452.6859 | 499.0300 | (310) |
| Cooling System Energy Efficiency Ratio | | | | | | | | | | | | 2.6000 | (314) |
| Space coolin | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 12.4756 | 18.3321 | 13.7728 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (315) |
| Pumps and Fa | 22.8165 | 20.6085 | 22.8165 | 22.0805 | 22.8165 | 22.0805 | 22.8165 | 22.8165 | 22.0805 | 22.8165 | 22.0805 | 22.8165 | (331) |
| Lighting | 25.5007 | 20.4576 | 18.4198 | 13.4952 | 10.4241 | 8.5165 | 9.5092 | 12.3604 | 16.0549 | 21.0649 | 23.7928 | 26.2095 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333a)m | -4.8369 | -7.8830 | -13.1798 | -17.1881 | -20.6481 | -20.0795 | -19.7940 | -17.5477 | -14.0215 | -9.8829 | -5.6570 | -4.0551 | (333a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335a) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (333b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335b) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - community heating | 4041.5715 | (307) |
| Space heating fuel - secondary | 0.0000 | (309) |
| Water heating fuel - community heating | 5100.5774 | (310) |
| Efficiency of water heater | 0.0000 | (311) |
| Electricity used for heat distribution | 40.4157 | (313) |
| Space cooling fuel | 44.5805 | (321) |
| | | |
| Electricity for pumps and fans: | | |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8820) | | |
| mechanical ventilation fans (SFP = 0.8820) | 268.6463 | (330a) |
| Total electricity for the above, kWh/year | 268.6463 | (331) |
| Electricity for lighting (calculated in Appendix L) | 205.8056 | (332) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -154.7736 | (333) |
| Wind generation | 0.0000 | (334) |
| Hydro-electric generation (Appendix N) | 0.0000 | (335a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (335) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (336) |
| Energy used | 0.0000 | (337) |
| Total delivered energy for all uses | 9506.4077 | (338) |

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12b. Carbon dioxide emissions - Community heating scheme

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (367) |
| Space and Water heating from Heat pump | 3265.0532 | 0.1567 | 226.1493 | (367) |
| Electrical energy for heat distribution (space & water) | 40.4157 | 0.0000 | 13.5161 | (372) |
| Overall CO2 factor for heat network | | | 0.0543 | (386) |
| Total CO2 associated with community systems | | | 496.2337 | (373) |
| Space and water heating | | | 496.2337 | (376) |
| Space cooling | 44.5805 | 0.1138 | 5.0745 | (377) |
| Pumps, fans and electric keep-hot | 268.6463 | 0.1387 | 37.2646 | (378) |
| Energy for lighting | 205.8056 | 0.1443 | 29.7041 | (379) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -154.7736 | 0.1318 | -20.3916 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -20.3916 | (380) |
| Total CO2, kg/year | | | 547.8853 | (383) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 6.7200 | (384) |

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13b. Primary energy - Community heating scheme

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| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (467a) |
| Space and Water heating from Heat pump | 3265.0532 | 1.5801 | 2280.6876 | (467) |
| Electrical energy for heat distribution (space & water) | 40.4157 | 0.0000 | 141.4283 | (472) |
| Overall CO2 factor for heat network | | | 0.5680 | (486) |
| Total CO2 associated with community systems | | | 5192.4404 | (473) |
| Space and water heating | | | 5192.4404 | (476) |
| Space cooling | 44.5805 | 1.4196 | 63.2866 | (477) |
| Pumps, fans and electric keep-hot | 268.6463 | 1.5128 | 406.4081 | (478) |
| Energy for lighting | 205.8056 | 1.5338 | 315.6715 | (479) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -154.7736 | 1.4868 | -230.1118 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -230.1118 | (480) |
| Total Primary energy kWh/year | | | 5747.6948 | (483) |
| Dwelling Primary energy Rate (DPER) | | | 70.4800 | (484) |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 10.0800 | (1b) | x 2.9300 | (2b) | = 29.5344 | (1b) - (3b) |
| First floor | 71.4700 | (1c) | x 3.0800 | (2c) | = 220.1276 | (1c) - (3c) |

Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 81.5500 (4)
Dwelling volume (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 249.6620 (5)

---
2. Ventilation rate
---

| | | m3 per hour | |
|---|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 | (6a) |
| Number of open flues | 0 * 20 = | 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | 3 * 10 = | 30.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |

| | | Air changes per hour | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 30.0000 / (5) = | 0.1202 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3702 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.3702 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.4720 | 0.4627 | 0.4534 | 0.4072 | 0.3979 | 0.3517 | 0.3517 | 0.3424 | 0.3702 | 0.3979 | 0.4164 | 0.4349 | (22b) |
| Effective ac | 0.6114 | 0.6070 | 0.6028 | 0.5829 | 0.5792 | 0.5618 | 0.5618 | 0.5586 | 0.5685 | 0.5792 | 0.5867 | 0.5946 | (25) |

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3. Heat losses and heat loss parameter
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| Element | Gross | Openings | NetArea | U-value | A x U | K-value | A x K | |
|---|---|---|---|---|---|---|---|---|
| | m2 | m2 | m2 | W/m2K | W/K | kJ/m2K | kJ/K | |
| Main dwelling | | | | | | | | |
| TER Opaque door | | | 2.0200 | 1.0000 | 2.0200 | | | (26) |
| TER Opening Type | | | 15.0900 | 1.1450 | 17.2786 | | | (27) |
| Ground Floor | | | 10.0800 | 0.1300 | 1.3104 | | | (28a) |
| First Floor over Cycle Store | | | 59.2800 | 0.1300 | 7.7064 | | | (28b) |
| GF External | 26.6500 | 3.8200 | 22.8300 | 0.1800 | 4.1094 | | | (29a) |
| GF Wall to Cycle Store | 8.2000 | | 8.2000 | 0.1800 | 1.4760 | | | (29a) |
| FF External Walls | 40.5300 | 11.2700 | 29.2600 | 0.1800 | 5.2668 | | | (29a) |
| FF Wall to Communal Corridor | 31.0100 | 2.0200 | 28.9900 | 0.1800 | 5.2182 | | | (29a) |
| External Roof 1 | 4.8000 | | 4.8000 | 0.1100 | 0.5280 | | | (30) |
| Total net area of external elements Aum(A, m2) | | | 180.5500 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 44.9138 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall To Unit 10 FF | | | 20.1200 | 0.0000 | 0.0000 | | | (32) |
| Party Wall to Unit 5 | | | 20.1300 | 0.0000 | 0.0000 | | | (32) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 376.8932 (35)
List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E1 Steel lintel with perforated steel base plate | 6.7900 | 0.0500 | 0.3395 |
| E4 Jamb | 17.7800 | 0.0500 | 0.8890 |
| E5 Ground floor (normal) | 14.3700 | 0.1600 | 2.2992 |
| E6 Intermediate floor within a dwelling | 9.0970 | 0.0000 | 0.0000 |
| E7 Party floor between dwellings (in blocks of flats) | 4.1450 | 0.0700 | 0.2902 |
| E15 Flat roof with parapet | 4.4450 | 0.5600 | 2.4892 |
| E16 Corner (normal) | 12.0400 | 0.0900 | 1.0836 |
| E17 Corner (inverted - internal area greater than external area) | 6.0200 | -0.0900 | -0.5418 |
| E20 Exposed floor (normal) | 3.3850 | 0.3200 | 1.0832 |
| E21 Exposed floor (inverted) | 5.7250 | 0.3200 | 1.8320 |
| E25 Staggered party wall between dwellings | 6.0200 | 0.0600 | 0.3612 |
| P7 Party Wall - Exposed floor (normal) | 13.0740 | 0.1600 | 2.0918 |
| E7 Party floor between dwellings (in blocks of flats) | 10.0720 | 0.0700 | 0.7050 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 12.9221 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 57.8360 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 50.3700 | 50.0137 | 49.6644 | 48.0240 | 47.7171 | 46.2883 | 46.2883 | 46.0238 | 46.8387 | 47.7171 | 48.3380 | 48.9871 | (38) |
| Heat transfer coeff | 108.2059 | 107.8496 | 107.5004 | 105.8600 | 105.5530 | 104.1243 | 104.1243 | 103.8597 | 104.6746 | 105.5530 | 106.1739 | 106.8230 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 105.8585 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.3269 | 1.3225 | 1.3182 | 1.2981 | 1.2943 | 1.2768 | 1.2768 | 1.2736 | 1.2836 | 1.2943 | 1.3019 | 1.3099 | (40) |
| HLP (average) | | | | | | | | | | | | 1.2981 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

---
4. Water heating energy requirements (kWh/year)
---

Assumed occupancy 2.4916 (42)
Hot water usage for mixer showers

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 65.9959 | 65.0041 | 63.5589 | 60.7937 | 58.7530 | 56.4773 | 55.1838 | 56.6181 | 58.1904 | 60.6338 | 63.4584 | 65.7430 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 28.5036 | 28.0803 | 27.4842 | 26.3850 | 25.5620 | 24.6494 | 24.1565 | 24.7484 | 25.3929 | 26.3695 | 27.4912 | 28.4072 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 40.1466 | 38.6867 | 37.2269 | 35.7670 | 34.3071 | 32.8472 | 32.8472 | 34.3071 | 35.7670 | 37.2269 | 38.6867 | 40.1466 | (42c) |

Average daily hot water use (litres/day) 123.7702 (43)

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 134.6461 | 131.7711 | 128.2699 | 122.9457 | 118.6221 | 113.9739 | 112.1875 | 115.6736 | 119.3503 | 124.2301 | 129.6363 | 134.2969 | (44) |
| Energy conte | 213.2465 | 187.6403 | 197.1460 | 168.3065 | 159.6882 | 140.1443 | 135.6811 | 143.2281 | 147.1708 | 168.5790 | 184.6907 | 210.2765 | (45) |
| Energy content (annual) | | | | | | | | | | | Total = Sum(45)m = | 2055.7979 | |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | | |
| | 31.9870 | 28.1460 | 29.5719 | 25.2460 | 23.9532 | 21.0216 | 20.3522 | 21.4842 | 22.0756 | 25.2869 | 27.7036 | 31.5415 | (46) |
| Water storage loss: | | | | | | | | | | | | | |
| Store volume | | | | | | | | | | | | 150.0000 | (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | | | | | | | | | | | | 1.3938 | (48) |
| Temperature factor from Table 2b | | | | | | | | | | | | 0.5400 | (49) |
| Enter (49) or (54) in (55) | | | | | | | | | | | | 0.7527 | (55) |
| Total storage loss | | | | | | | | | | | | | |
| | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (56) |
| If cylinder contains dedicated solar storage | | | | | | | | | | | | | |
| | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (57) |
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | | | | | | | | | | | | | |
| | 259.8414 | 229.7260 | 243.7409 | 213.3983 | 206.2831 | 185.2361 | 182.2760 | 189.8230 | 192.2627 | 215.1739 | 229.7825 | 256.8714 | (62) |
| WWHRS | -30.1706 | -26.6831 | -27.9410 | -23.1362 | -21.5622 | -18.4509 | -17.2948 | -18.3912 | -19.0900 | -22.5050 | -25.4954 | -29.6118 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | | | | | | | | | | | | | |
| | 229.6708 | 203.0429 | 215.7999 | 190.2621 | 184.7209 | 166.7852 | 164.9812 | 171.4318 | 173.1727 | 192.6689 | 204.2871 | 227.2595 | (64) |
| | | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | 2324.0831 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2324 | (64) |
| Electric shower(s) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | | | | | | | | | | | | | |
| | 108.1804 | 96.0590 | 102.8270 | 92.0354 | 90.3722 | 82.6714 | 82.3899 | 84.8993 | 85.0078 | 93.3285 | 97.4831 | 107.1928 | (65) |

## 5. Internal gains (see Table 5 and 5a)

| Metabolic gains (Table 5), Watts | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 124.5807 | 124.5807 | 124.5807 | 124.5807 | 124.5807 | 124.5807 | 124.5807 | 124.5807 | 124.5807 | 124.5807 | 124.5807 | 124.5807 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 114.2138 | 126.4510 | 114.2138 | 118.0209 | 114.2138 | 118.0209 | 114.2138 | 114.2138 | 118.0209 | 114.2138 | 118.0209 | 114.2138 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 222.6495 | 224.9599 | 219.1377 | 206.7431 | 191.0970 | 176.3920 | 166.5681 | 164.2577 | 170.0798 | 182.4745 | 198.1205 | 212.8256 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 35.4581 | 35.4581 | 35.4581 | 35.4581 | 35.4581 | 35.4581 | 35.4581 | 35.4581 | 35.4581 | 35.4581 | 35.4581 | 35.4581 | (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.0000 | 3.0000 | 3.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | | | | | | | | | | | | | |
| | -99.6645 | -99.6645 | -99.6645 | -99.6645 | -99.6645 | -99.6645 | -99.6645 | -99.6645 | -99.6645 | -99.6645 | -99.6645 | -99.6645 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 145.4037 | 142.9449 | 138.2083 | 127.8269 | 121.4681 | 114.8214 | 110.7391 | 114.1119 | 118.0663 | 125.4415 | 135.3932 | 144.0764 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 545.6412 | 557.7300 | 534.9340 | 515.9651 | 490.1531 | 469.6086 | 451.8952 | 452.9576 | 466.5413 | 485.5040 | 514.9089 | 534.4900 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Northwest | 15.0900 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 52.0335 | (81) |
| Solar gains | 52.0335 | 105.9158 | 190.8266 | 313.3920 | 421.2604 | 449.1081 | 420.1314 | 334.9337 | 232.5251 | 129.4375 | 65.4717 | 42.4932 | (83) |
| Total gains | 597.6748 | 663.6458 | 725.7606 | 829.3571 | 911.4135 | 918.7167 | 872.0266 | 787.8913 | 699.0665 | 614.9415 | 580.3806 | 576.9832 | (84) |

## 7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 78.9021 | 79.1628 | 79.4200 | 80.6507 | 80.8852 | 81.9951 | 81.9951 | 82.2039 | 81.5640 | 80.8852 | 80.4122 | 79.9236 | |
| alpha | 6.2601 | 6.2775 | 6.2947 | 6.3767 | 6.3923 | 6.4663 | 6.4663 | 6.4803 | 6.4376 | 6.3923 | 6.3608 | 6.3282 | |
| util living area | | | | | | | | | | | | | |
| | 0.9993 | 0.9985 | 0.9956 | 0.9770 | 0.8946 | 0.6979 | 0.5215 | 0.5968 | 0.8792 | 0.9890 | 0.9984 | 0.9995 | (86) |
| MIT | 19.8907 | 20.0149 | 20.2324 | 20.5669 | 20.8469 | 20.9767 | 20.9968 | 20.9930 | 20.9008 | 20.5492 | 20.1754 | 19.8807 | (87) |
| Th 2 | 19.8198 | 19.8233 | 19.8266 | 19.8423 | 19.8453 | 19.8590 | 19.8590 | 19.8616 | 19.8537 | 19.8453 | 19.8393 | 19.8331 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9990 | 0.9977 | 0.9931 | 0.9631 | 0.8382 | 0.5874 | 0.3886 | 0.4548 | 0.7933 | 0.9800 | 0.9974 | 0.9992 | (89) |
| MIT 2 | 18.5464 | 18.7079 | 18.9881 | 19.4177 | 19.7321 | 19.8496 | 19.8585 | 19.8602 | 19.7973 | 19.4043 | 18.9260 | 18.5437 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.3654 | (91) |
| MIT | 19.0376 | 19.1855 | 19.4428 | 19.8376 | 20.1395 | 20.2615 | 20.2745 | 20.2741 | 20.2005 | 19.8227 | 19.3826 | 19.0323 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.0376 | 19.1855 | 19.4428 | 19.8376 | 20.1395 | 20.2615 | 20.2745 | 20.2741 | 20.2005 | 19.8227 | 19.3826 | 19.0323 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9987 | 0.9971 | 0.9920 | 0.9631 | 0.8546 | 0.6281 | 0.4376 | 0.5075 | 0.8234 | 0.9798 | 0.9968 | 0.9989 | (94) |
| Useful gains | 596.8718 | 661.7315 | 719.9369 | 798.7175 | 778.9292 | 577.0567 | 381.5561 | 399.8209 | 575.5880 | 602.5073 | 578.5070 | 576.3687 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | | | | | | | | | | | | | |
| | 1594.6952 | 1540.6869 | 1391.3520 | 1157.8545 | 890.8105 | 589.4970 | 382.6015 | 402.3668 | 638.5716 | 973.4812 | 1304.0867 | 1584.4268 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 742.3806 | 590.6581 | 499.5328 | 258.5786 | 83.2396 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 276.0046 | 522.4174 | 749.9952 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 3722.8070 | |
| Solar heating kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | | | | | | | | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 742.3806 | 590.6581 | 499.5328 | 258.5786 | 83.2396 | 0.0000 | 0.0000 | 0.0000 | 276.0046 | 522.4174 | 749.9952 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | 3722.8070 | |
| Space heating per m2 | | | | | | | | | | (98c) / (4) = | 45.6506 | (99) |

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9a. Energy requirements - Individual heating systems, including micro-CHP

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| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | 0.0000 | (201) |
| Fraction of space heat from main system(s) | | | | | | | | | | | 1.0000 | (202) |
| Efficiency of main space heating system 1 (in %) | | | | | | | | | | | 92.3000 | (206) |
| Efficiency of main space heating system 2 (in %) | | | | | | | | | | | 0.0000 | (207) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | 0.0000 | (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement | | | | | | | | | | | | | |
| | 742.3806 | 590.6581 | 499.5328 | 258.5786 | 83.2396 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 276.0046 | 522.4174 | 749.9952 | (98) |
| Space heating efficiency (main heating system 1) | | | | | | | | | | | | | |
| | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.3000 | 92.3000 | 92.3000 | (210) |
| Space heating fuel (main heating system) | | | | | | | | | | | | | |
| | 804.3127 | 639.9329 | 541.2057 | 280.1502 | 90.1838 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 299.0299 | 565.9993 | 812.5625 | (211) |
| Space heating efficiency (main heating system 2) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (212) |
| Space heating fuel (main heating system 2) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (213) |
| Space heating fuel (secondary) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (215) |
| Water heating | | | | | | | | | | | | | |
| Water heating requirement | | | | | | | | | | | | | |
| | 229.6708 | 203.0429 | 215.7999 | 190.2621 | 184.7209 | 166.7852 | 164.9812 | 171.4318 | 173.1727 | 192.6689 | 204.2871 | 227.2595 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 | (216) |
| (217)m | 86.4951 | 86.3098 | 85.8781 | 84.7484 | 82.3941 | 79.8000 | 79.8000 | 79.8000 | 79.8000 | 84.8653 | 86.0711 | 86.5305 | (217) |
| Fuel for water heating, kWh/month | | | | | | | | | | | | | |
| | 265.5304 | 235.2489 | 251.2863 | 224.5024 | 224.1920 | 209.0040 | 206.7433 | 214.8268 | 217.0084 | 227.0291 | 237.3468 | 262.6350 | (219) |
| Space cooling fuel requirement | | | | | | | | | | | | | |
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (221) |
| Pumps and Fa | 7.3041 | 6.5973 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | (231) |
| Lighting | 23.7314 | 19.0382 | 17.1418 | 12.5588 | 9.7008 | 7.9256 | 8.8494 | 11.5028 | 14.9409 | 19.6033 | 22.1419 | 24.3909 | (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233a)m | -17.9799 | -26.9136 | -41.0432 | -49.0472 | -55.4519 | -52.6940 | -52.0455 | -47.8507 | -40.9218 | -32.0189 | -20.3127 | -15.3671 | (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233b)m | -5.9012 | -12.7367 | -25.9320 | -39.8754 | -53.6513 | -54.2561 | -53.6251 | -44.9822 | -32.4175 | -18.5205 | -7.9747 | -4.6433 | (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235d) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - main system 1 | 4033.3770 | (211) |
| Space heating fuel - main system 2 | 0.0000 | (213) |
| Space heating fuel - secondary | 0.0000 | (215) |
| Efficiency of water heater | 79.8000 | |
| Water heating fuel used | 2775.3535 | (219) |
| Space cooling fuel | 0.0000 | (221) |
| | | |
| Electricity for pumps and fans: | | |
| Total electricity for the above, kWh/year | 86.0000 | (231) |
| Electricity for lighting (calculated in Appendix L) | 191.5258 | (232) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -806.1626 | (233) |
| Wind generation | 0.0000 | (234) |
| Hydro-electric generation (Appendix N) | 0.0000 | (235a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (235) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (236) |
| Energy used | 0.0000 | (237) |
| Total delivered energy for all uses | 6280.0936 | (238) |

---

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

---

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 4033.3770 | 0.2100 | 847.0092 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2775.3535 | 0.2100 | 582.8242 | (264) |
| Space and water heating | | | 1429.8334 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 191.5258 | 0.1443 | 27.6431 | (268) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -451.6466 | 0.1334 | -60.2286 | |
| PV Unit electricity exported | -354.5160 | 0.1252 | -44.3889 | |
| Total | | | -104.6175 | (269) |
| Total CO2, kg/year | | | 1364.7883 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 16.7400 | (273) |

---

13a. Primary energy - Individual heating systems including micro-CHP

---

| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 4033.3770 | 1.1300 | 4557.7160 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2775.3535 | 1.1300 | 3136.1494 | (278) |
| Space and water heating | | | 7693.8654 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 191.5258 | 1.5338 | 293.7686 | (282) |

| | | | |
|---|---|---|---|
| Energy saving/generation technologies | | | |
| PV Unit electricity used in dwelling | -451.6466 | 1.4928 | -674.2096 |
| PV Unit electricity exported | -354.5160 | 0.4596 | -162.9258 |
| Total | | | -837.1354 (283) |
| Total Primary energy kWh/year | | | 7280.5994 (286) |
| Target Primary Energy Rate (TPER) | | | 89.2800 (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Property Reference** | Unit 5 | **Issued on Date** | 17/05/2025 |
| **Assessment Reference** | 00001 | **Prop Type Ref** | Unit 4 |
| **Property** | | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 74 C | **DER** | 6.99 | **TER** | 17.49 |
| **Environmental** | 94 A | **% DER < TER** | | | 60.03 |
| **$CO_2$ Emissions (t/year)** | 0.49 | **DFEE** | 51.23 | **TFEE** | 56.01 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 8.54 |
| **% DPER < TPER** | 21.55 | **DPER** | 73.27 | **TPER** | 93.40 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Robert Arnold | **Assessor ID** | BA04-0001 |
| **Client** | | | |

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SAP 10 WORKSHEET FOR New Build (As Designed)  (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 10.0800 (1b) | x | 2.9300 (2b) | = | 29.5344 | (1b) - (3b) |
| First floor | 71.4700 (1c) | x | 3.0800 (2c) | = | 220.1276 | (1c) - (3c) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 81.5500 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = | 249.6620 | (5) |

---

2. Ventilation rate

---

| | | | |
|---|---|---|---|
| | | m3 per hour | |
| Number of open chimneys | 0 * 80 = | 0.0000 | (6a) |
| Number of open flues | 0 * 20 = | 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | 0 * 10 = | 0.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |
| | | Air changes per hour | |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 0.0000 / (5) = | 0.0000 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 3.0000 | (17) |
| Infiltration rate | | 0.1500 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.1500 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.1912 | 0.1875 | 0.1837 | 0.1650 | 0.1612 | 0.1425 | 0.1425 | 0.1388 | 0.1500 | 0.1612 | 0.1687 | 0.1762 | (22b) |

| | | |
|---|---|---|
| Balanced mechanical ventilation with heat recovery | | |
| If mechanical ventilation | | 0.5000 (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | | 0.5000 (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | | 81.0000 (23c) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective ac | 0.2862 | 0.2825 | 0.2787 | 0.2600 | 0.2562 | 0.2375 | 0.2375 | 0.2337 | 0.2450 | 0.2562 | 0.2637 | 0.2712 | (25) |

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3. Heat losses and heat loss parameter

---

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| Window | | | 10.4700 | 1.0536 | 11.0316 | | | (27) |
| Solid Door | | | 4.2400 | 1.4000 | 5.9360 | | | (26) |
| Glass Door | | | 2.4000 | 1.3258 | 3.1818 | | | (27) |
| Ground Floor | | | 10.0800 | 0.1000 | 1.0080 | 110.0000 | 1108.8000 | (28a) |
| First Floor | | | 59.0500 | 0.1000 | 5.9050 | 110.0000 | 6495.5000 | (28b) |
| GF External | 38.0200 | 3.8200 | 34.2000 | 0.1500 | 5.1300 | 150.0000 | 5130.0000 | (29a) |
| GF Wall to Comms | 4.9300 | | 4.9300 | 0.1400 | 0.6902 | 150.0000 | 739.5000 | (29a) |
| FF External Walls | 40.5300 | 11.2700 | 29.2600 | 0.1500 | 4.3890 | 150.0000 | 4389.0000 | (29a) |
| FF Wall to Communal Corridor | 31.0100 | 2.0200 | 28.9900 | 0.1300 | 3.7687 | 150.0000 | 4348.5000 | (29a) |
| External Roof 1 | 4.8000 | | 4.8000 | 0.1000 | 0.4800 | 9.0000 | 43.2000 | (30) |
| Total net area of external elements Aum(A, m2) | | | 188.4200 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 41.5203 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall To Unit 4 | | | 20.1200 | 0.0000 | 0.0000 | 70.0000 | 1408.4000 | (32) |

| | | | | | |
|---|---|---|---|---|---|
| Party Wall to Unit 6 | 20.1300 | 0.0000 | 0.0000 | 70.0000 | 1409.1000 (32) |
| Party Ceiling 1 | 64.6000 | | | 100.0000 | 6460.0000 (32b) |
| Partitions | 157.0200 | | | 9.0000 | 1413.1800 (32c) |
| First Floor Internal | 10.0800 | | | 18.0000 | 181.4400 (32d) |
| Internal Ceiling 1 | 10.0800 | | | 9.0000 | 90.7200 (32e) |

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 33217.3400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 407.3248 (35)
List of Thermal Bridges

| K1 Element | Length | Psi-value | Total |
|---|---|---|---|
| E1 Steel lintel with perforated steel base plate | 6.7900 | 0.0500 | 0.3395 |
| E4 Jamb | 17.7800 | 0.0500 | 0.8890 |
| E5 Ground floor (normal) | 14.3700 | 0.1600 | 2.2992 |
| E6 Intermediate floor within a dwelling | 9.0970 | 0.0000 | 0.0000 |
| E7 Party floor between dwellings (in blocks of flats) | 4.1450 | 0.0700 | 0.2902 |
| E15 Flat roof with parapet | 4.4450 | 0.5600 | 2.4892 |
| E16 Corner (normal) | 12.0400 | 0.0900 | 1.0836 |
| E17 Corner (inverted - internal area greater than external area) | 6.0200 | -0.0900 | -0.5418 |
| E20 Exposed floor (normal) | 3.3850 | 0.3200 | 1.0832 |
| E21 Exposed floor (inverted) | 10.2120 | 0.3200 | 3.2678 |
| E25 Staggered party wall between dwellings | 6.0200 | 0.0600 | 0.3612 |
| P7 Party Wall - Exposed floor (normal) | 6.5370 | 0.1600 | 1.0459 |
| P7 Party Wall - Exposed floor (normal) | 10.0720 | 0.0800 | 0.8058 |
| E7 Party floor between dwellings (in blocks of flats) | 10.0720 | 0.0350 | 0.3525 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 13.7653 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 55.2856 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 23.5837 | 23.2747 | 22.9658 | 21.4210 | 21.1120 | 19.5673 | 19.5673 | 19.2583 | 20.1852 | 21.1120 | 21.7300 | 22.3479 | (38) |
| Heat transfer coeff | 78.8693 | 78.5604 | 78.2514 | 76.7066 | 76.3977 | 74.8529 | 74.8529 | 74.5439 | 75.4708 | 76.3977 | 77.0156 | 77.6335 | (39) |

Average = Sum(39)m / 12 = 76.6294

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 0.9671 | 0.9633 | 0.9596 | 0.9406 | 0.9368 | 0.9179 | 0.9179 | 0.9141 | 0.9255 | 0.9368 | 0.9444 | 0.9520 | (40) |
| HLP (average) | | | | | | | | | | | | 0.9397 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

---
4. Water heating energy requirements (kWh/year)
---

Assumed occupancy 2.4916 (42)
Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 64.3285 | 63.3436 | 61.8922 | 59.6594 | 57.6589 | 54.8602 | 52.6466 | 55.2344 | 56.5360 | 59.3080 | 62.1948 | 64.2705 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 27.8682 | 27.4475 | 26.8490 | 25.9528 | 25.1451 | 24.0331 | 23.1896 | 24.2211 | 24.7625 | 25.8642 | 27.0097 | 27.8461 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 40.1466 | 38.6867 | 37.2269 | 35.7670 | 34.3071 | 32.8472 | 32.8472 | 34.3071 | 35.7670 | 37.2269 | 38.6867 | 40.1466 | (42c) |

Average daily hot water use (litres/day) 121.6432 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 132.3433 | 129.4779 | 125.9681 | 121.3792 | 117.1111 | 111.7406 | 108.6834 | 113.7626 | 117.0655 | 122.3991 | 127.8912 | 132.2632 | (44) |
| Energy conte | 194.8322 | 171.3254 | 180.0058 | 158.5516 | 150.9095 | 129.2242 | 120.0983 | 133.9007 | 135.7901 | 157.7236 | 172.8493 | 194.2382 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1899.4489 | |
| Distribution loss (46)m = 0.15 x (45)m | 29.2248 | 25.6988 | 27.0009 | 23.7827 | 22.6364 | 19.3836 | 18.0148 | 20.0851 | 20.3685 | 23.6585 | 25.9274 | 29.1357 | (46) |

Water storage loss:
Store volume 110.0000 (47)
b) If manufacturer declared loss factor is not known :
Hot water storage loss factor from Table 2 (kWh/litre/day) 0.0152 (51)
Volume factor from Table 2a 1.0294 (52)
Temperature factor from Table 2b 0.6000 (53)
Enter (49) or (54) in (55) 1.0327 (55)
Total storage loss

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (56) |

If cylinder contains dedicated solar storage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (57) |
| Primary loss 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |

Total heat required for water heating calculated for each month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 250.1090 | 221.2529 | 235.2826 | 212.0452 | 206.1863 | 182.7179 | 175.3751 | 189.1775 | 189.2838 | 213.0004 | 226.3429 | 249.5150 | (62) |
| WWHRS 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63a) |
| PV diverter -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |

Output from w/h

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 250.1090 | 221.2529 | 235.2826 | 212.0452 | 206.1863 | 182.7179 | 175.3751 | 189.1775 | 189.2838 | 213.0004 | 226.3429 | 249.5150 | (64) |

Total per year (kWh/year) = Sum(64)m = 2550.2887 (64)
12Total per year (kWh/year) 2550 (64)
Electric shower(s)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)
Heat gains from water heating, kWh/month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 109.0031 | 96.9076 | 104.0734 | 95.5133 | 94.3988 | 85.7620 | 84.1541 | 88.7434 | 87.9451 | 96.6645 | 100.2673 | 108.8056 | (65) |

---
5. Internal gains (see Table 5 and 5a)
---

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 124.5807 | 124.5807 | 124.5807 | 124.5807 | 124.5807 | 124.5807 | 124.5807 | 124.5807 | 124.5807 | 124.5807 | 124.5807 | 124.5807 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 117.4819 | 130.0693 | 117.4819 | 121.3980 | 117.4819 | 121.3980 | 117.4819 | 117.4819 | 121.3980 | 117.4819 | 121.3980 | 117.4819 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 222.6495 | 224.9599 | 219.1377 | 206.7431 | 191.0970 | 176.3920 | 166.5681 | 164.2577 | 170.0798 | 182.4745 | 198.1205 | 212.8256 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 35.4581 | 35.4581 | 35.4581 | 35.4581 | 35.4581 | 35.4581 | 35.4581 | 35.4581 | 35.4581 | 35.4581 | 35.4581 | 35.4581 | (69) |
| Pumps, fans 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (70) | |
| Losses e.g. evaporation (negative values) (Table 5) | -99.6645 | -99.6645 | -99.6645 | -99.6645 | -99.6645 | -99.6645 | -99.6645 | -99.6645 | -99.6645 | -99.6645 | -99.6645 | -99.6645 | (71) |
| Water heating gains (Table 5) | 146.5096 | 144.2078 | 139.8836 | 132.6574 | 126.8802 | 119.1139 | 113.1104 | 119.2788 | 122.1460 | 129.9255 | 139.2602 | 146.2441 | (72) |
| Total internal gains | 547.0152 | 559.6111 | 536.8774 | 521.1727 | 495.8333 | 477.2780 | 457.5346 | 461.3926 | 473.9980 | 490.2561 | 519.1529 | 536.9258 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Northwest | 10.4700 | 11.2829 | 0.4500 | 0.7000 | 0.7700 | 25.7877 | (81) |
| Northwest | 2.4000 | 11.2829 | 0.4500 | 0.7000 | 0.7700 | 5.9112 | (81) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 31.6989 | 64.5241 | 116.2519 | 190.9190 | 256.6326 | 273.5975 | 255.9449 | 204.0422 | 141.6548 | 78.8536 | 39.8855 | 25.8869 | (83) |
| Total gains | 578.7141 | 624.1352 | 653.1293 | 712.0917 | 752.4659 | 750.8756 | 713.4795 | 665.4348 | 615.6528 | 569.1096 | 559.0383 | 562.8128 | (84) |

## 7. Mean internal temperature (heating season)

| | | |
|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | 21.0000 | (85) |

| Utilisation factor for gains for living area, ni1,m (see Table 9a) | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| tau | 116.9915 | 117.4516 | 117.9153 | 120.2900 | 120.7765 | 123.2690 | 123.2690 | 123.7799 | 122.2597 | 120.7765 | 119.8074 | 118.8539 | |
| alpha | 8.7994 | 8.8301 | 8.8610 | 9.0193 | 9.0518 | 9.2179 | 9.2179 | 9.2520 | 9.1506 | 9.0518 | 8.9872 | 8.9236 | |
| util living area | 0.9996 | 0.9990 | 0.9968 | 0.9771 | 0.8728 | 0.6343 | 0.4614 | 0.5148 | 0.8114 | 0.9857 | 0.9986 | 0.9997 | (86) |
| MIT | 20.3369 | 20.4240 | 20.5654 | 20.7907 | 20.9515 | 20.9975 | 20.9999 | 20.9997 | 20.9808 | 20.7895 | 20.5388 | 20.3329 | (87) |
| Th 2 | 20.1108 | 20.1140 | 20.1172 | 20.1331 | 20.1363 | 20.1523 | 20.1523 | 20.1555 | 20.1459 | 20.1363 | 20.1299 | 20.1235 | (88) |
| util rest of house | 0.9994 | 0.9985 | 0.9949 | 0.9635 | 0.8182 | 0.5524 | 0.3727 | 0.4206 | 0.7282 | 0.9745 | 0.9977 | 0.9995 | (89) |
| MIT 2 | 19.3405 | 19.4547 | 19.6378 | 19.9302 | 20.1030 | 20.1514 | 20.1523 | 20.1555 | 20.1367 | 19.9351 | 19.6150 | 19.3460 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.3654 | (91) |
| MIT | 19.7046 | 19.8089 | 19.9767 | 20.2446 | 20.4130 | 20.4606 | 20.4620 | 20.4640 | 20.4451 | 20.2473 | 19.9525 | 19.7067 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.7046 | 19.8089 | 19.9767 | 20.2446 | 20.4130 | 20.4606 | 20.4620 | 20.4640 | 20.4451 | 20.2473 | 19.9525 | 19.7067 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9992 | 0.9982 | 0.9945 | 0.9656 | 0.8371 | 0.5825 | 0.4051 | 0.4551 | 0.7590 | 0.9763 | 0.9974 | 0.9994 | (94) |
| Useful gains | 578.2699 | 623.0088 | 649.5349 | 687.6037 | 629.9126 | 437.3897 | 289.0421 | 302.8301 | 467.2922 | 555.6219 | 557.6007 | 562.4737 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | 1214.9520 | 1171.2474 | 1054.5745 | 870.2090 | 665.6566 | 438.6814 | 289.0837 | 302.9439 | 478.8725 | 737.0341 | 989.8462 | 1203.8364 | (97) |
| Space heating kWh | 473.6915 | 368.4164 | 301.3495 | 131.4758 | 26.5936 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 134.9707 | 311.2168 | 477.1738 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 2224.8880 | |
| Solar heating kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | 473.6915 | 368.4164 | 301.3495 | 131.4758 | 26.5936 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 134.9707 | 311.2168 | 477.1738 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 2224.8880 | |
| Space heating per m2 | | | | | | | | | | (98c) / (4) = | | 27.2825 | (99) |

## 8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ext. temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | |
| Heat loss rate W | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 703.6170 | 553.9113 | 566.5338 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (100) |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.9546 | 0.9866 | 0.9746 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (101) |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 671.6424 | 546.4793 | 552.1239 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (102) |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 814.7903 | 774.3243 | 719.7295 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 103.0665 | 169.5167 | 124.6986 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (104) |
| Cooled fraction | | | | | | | | | | fC = cooled area / (4) = | | 0.8706 | (105) |
| Intermittency factor (Table 10b) | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | (106) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 22.4332 | 36.8966 | 27.1416 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) |
| Space cooling requirement | | | | | | | | | | | | 86.4715 | (107) |

## 9b. Energy requirements

| | | |
|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | 0.0000 | (301) |
| Fraction of space heat from community system | 1.0000 | (302) |
| Fraction of heat from community Heat pump-Space and Water | 1.0000 | (303a) |
| Factor for control and charging method (Table 4c(3)) for space heating | 1.0000 | (305) |
| Factor for charging method (Table 4c(3)) for water heating | 1.0000 | (305a) |
| Distribution loss factor (Table 12c) for community heating system | 2.0000 | (306) |
| Efficiency of secondary/supplementary heating system, % | 0.0000 | (208) |

Space heating:

| Space heating requirement | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 473.6915 | 368.4164 | 301.3495 | 131.4758 | 26.5936 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 134.9707 | 311.2168 | 477.1738 | (98) |
| Space heat from Heat pump = (98) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 307a | 947.3830 | 736.8328 | 602.6990 | 262.9516 | 53.1871 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 269.9414 | 622.4335 | 954.3476 | |
| Space heating requirement | | | | | | | | | | | | | |
| | 947.3830 | 736.8328 | 602.6990 | 262.9516 | 53.1871 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 269.9414 | 622.4335 | 954.3476 | (307) |

| | | |
|---|---|---|
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000 | (308) |

| Space heating fuel for secondary/supplementary system | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (309) |

Water heating

| Annual water heating requirement | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 250.1090 | 221.2529 | 235.2826 | 212.0452 | 206.1863 | 182.7179 | 175.3751 | 189.1775 | 189.2838 | 213.0004 | 226.3429 | 249.5150 | (64) |

Water heat from Heat pump = (64) x 1.00 x 1.00 x 2.00

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 310a | 500.2180 | 442.5057 | 470.5653 | 424.0905 | 412.3726 | 365.4358 | 350.7503 | 378.3550 | 378.5675 | 426.0008 | 452.6859 | 499.0300 | |
| Water heating fuel | | | | | | | | | | | | | |
| | 500.2180 | 442.5057 | 470.5653 | 424.0905 | 412.3726 | 365.4358 | 350.7503 | 378.3550 | 378.5675 | 426.0008 | 452.6859 | 499.0300 | (310) |
| Cooling System Energy Efficiency Ratio | | | | | | | | | | | | 2.6000 | (314) |
| Space coolin | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 8.6282 | 14.1910 | 10.4391 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (315) |
| Pumps and Fa | 22.8165 | 20.6085 | 22.8165 | 22.0805 | 22.8165 | 22.0805 | 22.8165 | 22.8165 | 22.0805 | 22.8165 | 22.0805 | 22.8165 | (331) |
| Lighting | 26.2304 | 21.0430 | 18.9469 | 13.8813 | 10.7223 | 8.7602 | 9.7813 | 12.7141 | 16.5143 | 21.6677 | 24.4736 | 26.9594 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333a)m | -4.8377 | -7.8845 | -13.1826 | -17.1916 | -20.6520 | -20.0832 | -19.7980 | -17.5521 | -14.0254 | -9.8853 | -5.6581 | -4.0557 | (333a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335a) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (333b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335b) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - community heating | 4449.7759 | (307) |
| Space heating fuel - secondary | 0.0000 | (309) |
| Water heating fuel - community heating | 5100.5774 | (310) |
| Efficiency of water heater | 0.0000 | (311) |
| Electricity used for heat distribution | 44.4978 | (313) |
| Space cooling fuel | 33.2583 | (321) |
| | | |
| Electricity for pumps and fans: | | |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8820) | | |
| mechanical ventilation fans (SFP = 0.8820) | 268.6463 | (330a) |
| Total electricity for the above, kWh/year | 268.6463 | (331) |
| Electricity for lighting (calculated in Appendix L) | 211.6945 | (332) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -154.8062 | (333) |
| Wind generation | 0.0000 | (334) |
| Hydro-electric generation (Appendix N) | 0.0000 | (335a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (335) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (336) |
| Energy used | 0.0000 | (337) |
| Total delivered energy for all uses | 9909.1462 | (338) |

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12b. Carbon dioxide emissions - Community heating scheme

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (367) |
| Space and Water heating from Heat pump | 3410.8405 | 0.1563 | 248.3609 | (367) |
| Electrical energy for heat distribution (space & water) | 44.4978 | 0.0000 | 14.1380 | (372) |
| Overall CO2 factor for heat network | | | 0.0544 | (386) |
| Total CO2 associated with community systems | | | 519.0672 | (373) |
| Space and water heating | | | 519.0672 | (376) |
| Space cooling | 33.2583 | 0.1136 | 3.7798 | (377) |
| Pumps, fans and electric keep-hot | 268.6463 | 0.1387 | 37.2646 | (378) |
| Energy for lighting | 211.6945 | 0.1443 | 30.5541 | (379) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -154.8062 | 0.1318 | -20.3958 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -20.3958 | (380) |
| Total CO2, kg/year | | | 570.2698 | (383) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 6.9900 | (384) |

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13b. Primary energy - Community heating scheme

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| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (467a) |
| Space and Water heating from Heat pump | 3410.8405 | 1.5786 | 2508.7272 | (467) |
| Electrical energy for heat distribution (space & water) | 44.4978 | 0.0000 | 147.8134 | (472) |
| Overall CO2 factor for heat network | | | 0.5682 | (486) |
| Total CO2 associated with community systems | | | 5426.8651 | (473) |
| Space and water heating | | | 5426.8651 | (476) |
| Space cooling | 33.2583 | 1.4190 | 47.1929 | (477) |
| Pumps, fans and electric keep-hot | 268.6463 | 1.5128 | 406.4081 | (478) |
| Energy for lighting | 211.6945 | 1.5338 | 324.7041 | (479) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -154.8062 | 1.4868 | -230.1601 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -230.1601 | (480) |
| Total Primary energy kWh/year | | | 5975.0101 | (483) |
| Dwelling Primary energy Rate (DPER) | | | 73.2700 | (484) |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 10.0800 | (1b) x | 2.9300 | (2b) = | 29.5344 | (1b) - (3b) |

| | | | | |
|---|---|---|---|---|
| First floor | 71.4700 (1c) | x 3.0800 (2c) | = 220.1276 (1c) - (3c) | |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 81.5500 | | | (4) |
| Dwelling volume | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 249.6620 | (5) |

## 2. Ventilation rate

| | | m3 per hour | |
|---|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 | (6a) |
| Number of open flues | 0 * 20 = | 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | 3 * 10 = | 30.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |
| | Air changes per hour | | |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 30.0000 / (5) = | 0.1202 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3702 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.3702 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | | | | | | | | | | | | | |
| | 0.4720 | 0.4627 | 0.4534 | 0.4072 | 0.3979 | 0.3517 | 0.3517 | 0.3424 | 0.3702 | 0.3979 | 0.4164 | 0.4349 | (22b) |
| Effective ac | 0.6114 | 0.6070 | 0.6028 | 0.5829 | 0.5792 | 0.5618 | 0.5618 | 0.5586 | 0.5685 | 0.5792 | 0.5867 | 0.5946 | (25) |

## 3. Heat losses and heat loss parameter

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| TER Opaque door | | | 4.2400 | 1.0000 | 4.2400 | | | (26) |
| TER Opening Type | | | 12.8700 | 1.1450 | 14.7366 | | | (27) |
| Ground Floor | | | 10.0800 | 0.1300 | 1.3104 | | | (28a) |
| First Floor | | | 59.0500 | 0.1300 | 7.6765 | | | (28b) |
| GF External | 38.0200 | 3.8200 | 34.2000 | 0.1800 | 6.1560 | | | (29a) |
| GF Wall to Comms | 4.9300 | | 4.9300 | 0.1800 | 0.8874 | | | (29a) |
| FF External Walls | 40.5300 | 11.2700 | 29.2600 | 0.1800 | 5.2668 | | | (29a) |
| FF Wall to Communal Corridor | 31.0100 | 2.0200 | 28.9900 | 0.1800 | 5.2182 | | | (29a) |
| External Roof 1 | 4.8000 | | 4.8000 | 0.1100 | 0.5280 | | | (30) |
| Total net area of external elements Aum(A, m2) | | | 188.4200 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 46.0199 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall To Unit 4 | | | 20.1200 | 0.0000 | 0.0000 | | | (32) |
| Party Wall to Unit 6 | | | 20.1300 | 0.0000 | 0.0000 | | | (32) |

| | | | |
|---|---|---|---|
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | | | 391.4818 (35) |
| List of Thermal Bridges | | | |
| K1 Element | Length | Psi-value | Total |
| E1 Steel lintel with perforated steel base plate | 6.7900 | 0.0500 | 0.3395 |
| E4 Jamb | 17.7800 | 0.0500 | 0.8890 |
| E5 Ground floor (normal) | 14.3700 | 0.1600 | 2.2992 |
| E6 Intermediate floor within a dwelling | 9.0970 | 0.0000 | 0.0000 |
| E7 Party floor between dwellings (in blocks of flats) | 4.1450 | 0.0700 | 0.2902 |
| E15 Flat roof with parapet | 4.4450 | 0.5600 | 2.4892 |
| E16 Corner (normal) | 12.0400 | 0.0900 | 1.0836 |
| E17 Corner (inverted - internal area greater than external area) | 6.0200 | -0.0900 | -0.5418 |
| E20 Exposed floor (normal) | 3.3850 | 0.3200 | 1.0832 |
| E21 Exposed floor (inverted) | 10.2120 | 0.3200 | 3.2678 |
| E25 Staggered party wall between dwellings | 6.0200 | 0.0600 | 0.3612 |
| P7 Party Wall - Exposed floor (normal) | 6.5370 | 0.1600 | 1.0459 |
| P7 Party Wall - Exposed floor (normal) | 10.0720 | 0.1600 | 1.6115 |
| E7 Party floor between dwellings (in blocks of flats) | 10.0720 | 0.0700 | 0.7050 |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | | 14.9236 (36) |
| Point Thermal bridges | | (36a) = | 0.0000 |
| Total fabric heat loss | | (33) + (36) + (36a) = | 60.9435 (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 50.3700 | 50.0137 | 49.6644 | 48.0240 | 47.7171 | 46.2883 | 46.2883 | 46.0238 | 46.8387 | 47.7171 | 48.3380 | 48.9871 | (38) |
| Heat transfer coeff | | | | | | | | | | | | | |
| | 111.3135 | 110.9572 | 110.6079 | 108.9675 | 108.6606 | 107.2319 | 107.2319 | 106.9673 | 107.7822 | 108.6606 | 109.2815 | 109.9306 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 108.9660 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.3650 | 1.3606 | 1.3563 | 1.3362 | 1.3324 | 1.3149 | 1.3149 | 1.3117 | 1.3217 | 1.3324 | 1.3401 | 1.3480 | (40) |
| HLP (average) | | | | | | | | | | | | 1.3362 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

## 4. Water heating energy requirements (kWh/year)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Assumed occupancy | | | | | | | | | | | 2.4916 | (42) |
| Hot water usage for mixer showers | | | | | | | | | | | | |
| | 65.9959 | 65.0041 | 63.5589 | 60.7937 | 58.7530 | 56.4773 | 55.1838 | 56.6181 | 58.1904 | 60.6338 | 63.4584 | 65.7430 | (42a) |
| Hot water usage for baths | | | | | | | | | | | | |
| | 28.5036 | 28.0803 | 27.4842 | 26.3850 | 25.5620 | 24.6494 | 24.1565 | 24.7484 | 25.3929 | 26.3695 | 27.4912 | 28.4072 | (42b) |
| Hot water usage for other uses | | | | | | | | | | | | |
| | 40.1466 | 38.6867 | 37.2269 | 35.7670 | 34.3071 | 32.8472 | 32.8472 | 34.3071 | 35.7670 | 37.2269 | 38.6867 | 40.1466 | (42c) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 123.7702 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | | | | | | | | | | | | | |
| | 134.6461 | 131.7711 | 128.2699 | 122.9457 | 118.6221 | 113.9739 | 112.1875 | 115.6736 | 119.3503 | 124.2301 | 129.6363 | 134.2969 | (44) |
| Energy conte | 213.2465 | 187.6403 | 197.1460 | 168.3065 | 159.6882 | 140.1443 | 135.6811 | 143.2281 | 147.1708 | 168.5790 | 184.6907 | 210.2765 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 2055.7979 | |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | | |
| | 31.9870 | 28.1460 | 29.5719 | 25.2460 | 23.9532 | 21.0216 | 20.3522 | 21.4842 | 22.0756 | 25.2869 | 27.7036 | 31.5415 | (46) |
| Water storage loss: | | | | | | | | | | | | | |
| Store volume | | | | | | | | | | | | 150.0000 | (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | | | | | | | | | | | | 1.3938 | (48) |
| Temperature factor from Table 2b | | | | | | | | | | | | 0.5400 | (49) |
| Enter (49) or (54) in (55) | | | | | | | | | | | | 0.7527 | (55) |
| Total storage loss | | | | | | | | | | | | | |
| | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (56) |
| If cylinder contains dedicated solar storage | | | | | | | | | | | | | |
| | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (57) |
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | | | | | | | | | | | | | |
| | 259.8414 | 229.7260 | 243.7409 | 213.3983 | 206.2831 | 185.2361 | 182.2760 | 189.8230 | 192.2627 | 215.1739 | 229.7825 | 256.8714 | (62) |
| WWHRS | -30.1706 | -26.6831 | -27.9410 | -23.1362 | -21.5622 | -18.4509 | -17.2948 | -18.3912 | -19.0900 | -22.5050 | -25.4954 | -29.6118 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | | | | | | | | | | | | | |
| | 229.6708 | 203.0429 | 215.7999 | 190.2621 | 184.7209 | 166.7852 | 164.9812 | 171.4318 | 173.1727 | 192.6689 | 204.2871 | 227.2595 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2324.0831 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2324 | (64) |
| Electric shower(s) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | | | | | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | | | | | | | | | | | | | |
| | 108.1804 | 96.0590 | 102.8270 | 92.0354 | 90.3722 | 82.6714 | 82.3899 | 84.8993 | 85.0078 | 93.3285 | 97.4831 | 107.1928 | (65) |

## 5. Internal gains (see Table 5 and 5a)

| Metabolic gains (Table 5), Watts | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 124.5807 | 124.5807 | 124.5807 | 124.5807 | 124.5807 | 124.5807 | 124.5807 | 124.5807 | 124.5807 | 124.5807 | 124.5807 | 124.5807 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 117.4819 | 130.0693 | 117.4819 | 121.3980 | 117.4819 | 121.3980 | 117.4819 | 117.4819 | 121.3980 | 117.4819 | 121.3980 | 117.4819 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 222.6495 | 224.9599 | 219.1377 | 206.7431 | 191.0970 | 176.3920 | 166.5681 | 164.2577 | 170.0798 | 182.4745 | 198.1205 | 212.8256 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 35.4581 | 35.4581 | 35.4581 | 35.4581 | 35.4581 | 35.4581 | 35.4581 | 35.4581 | 35.4581 | 35.4581 | 35.4581 | 35.4581 | (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.0000 | 3.0000 | 3.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | | | | | | | | | | | | | |
| | -99.6645 | -99.6645 | -99.6645 | -99.6645 | -99.6645 | -99.6645 | -99.6645 | -99.6645 | -99.6645 | -99.6645 | -99.6645 | -99.6645 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 145.4037 | 142.9449 | 138.2083 | 127.8269 | 121.4681 | 114.8214 | 110.7391 | 114.1119 | 118.0663 | 125.4415 | 135.3932 | 144.0764 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 548.9093 | 561.3482 | 538.2021 | 519.3422 | 493.4212 | 472.9856 | 455.1633 | 456.2257 | 469.9184 | 488.7721 | 518.2859 | 537.7581 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Northwest | 12.8700 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 44.3785 | (81) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 44.3785 | 90.3337 | 162.7527 | 267.2866 | 359.2857 | 383.0366 | 358.3228 | 285.6591 | 198.3167 | 110.3950 | 55.8396 | 36.2417 | (83) |
| Total gains | 593.2878 | 651.6820 | 700.9548 | 786.6288 | 852.7069 | 856.0222 | 813.4861 | 741.8848 | 668.2350 | 599.1671 | 574.1256 | 573.9998 | (84) |

## 7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 79.6682 | 79.9241 | 80.1764 | 81.3834 | 81.6133 | 82.7007 | 82.7007 | 82.9053 | 82.2784 | 81.6133 | 81.1496 | 80.6704 | |
| alpha | 6.3112 | 6.3283 | 6.3451 | 6.4256 | 6.4409 | 6.5134 | 6.5134 | 6.5270 | 6.4852 | 6.4409 | 6.4100 | 6.3780 | |
| util living area | | | | | | | | | | | | | |
| | 0.9995 | 0.9989 | 0.9970 | 0.9851 | 0.9271 | 0.7552 | 0.5729 | 0.6472 | 0.9080 | 0.9920 | 0.9988 | 0.9996 | (86) |
| MIT | 19.8806 | 19.9954 | 20.1990 | 20.5176 | 20.8047 | 20.9646 | 20.9948 | 20.9894 | 20.8783 | 20.5244 | 20.1613 | 19.8719 | (87) |
| Th 2 | 19.7903 | 19.7937 | 19.7970 | 19.8126 | 19.8155 | 19.8292 | 19.8292 | 19.8317 | 19.8239 | 19.8155 | 19.8096 | 19.8034 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9992 | 0.9983 | 0.9952 | 0.9750 | 0.8797 | 0.6401 | 0.4247 | 0.4922 | 0.8294 | 0.9850 | 0.9980 | 0.9994 | (89) |
| MIT 2 | 18.5065 | 18.6561 | 18.9188 | 19.3319 | 19.6655 | 19.8145 | 19.8283 | 19.8295 | 19.7524 | 19.3471 | 18.8809 | 18.5053 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.3654 | (91) |
| MIT | 19.0086 | 19.1456 | 19.3866 | 19.7652 | 20.0817 | 20.2348 | 20.2546 | 20.2534 | 20.1638 | 19.7773 | 19.3488 | 19.0047 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.0086 | 19.1456 | 19.3866 | 19.7652 | 20.0817 | 20.2348 | 20.2546 | 20.2534 | 20.1638 | 19.7773 | 19.3488 | 19.0047 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9989 | 0.9978 | 0.9943 | 0.9745 | 0.8924 | 0.6827 | 0.4796 | 0.5502 | 0.8566 | 0.9847 | 0.9975 | 0.9992 | (94) |
| Useful gains | 592.6630 | 650.2735 | 696.9889 | 766.5839 | 760.9184 | 584.3971 | 390.1344 | 408.1848 | 572.4090 | 589.9703 | 572.6801 | 573.5173 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | | | | | | | | | | | | | |
| | 1637.2641 | 1580.6463 | 1425.3585 | 1183.9531 | 910.7658 | 604.2263 | 391.8864 | 412.1855 | 653.5699 | 997.2106 | 1338.5648 | 1627.4903 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 777.1832 | 625.2105 | 541.9070 | 300.5058 | 111.4864 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 302.9868 | 551.4370 | 784.1559 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 3994.8727 | |
| Solar heating kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |

Solar heating contribution - total per year (kWh/year) 0.0000

Space heating kWh

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 777.1832 | 625.2105 | 541.9070 | 300.5058 | 111.4864 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 302.9868 | 551.4370 | 784.1559 | (98c) |

Space heating requirement after solar contribution - total per year (kWh/year) 3994.8727

Space heating per m2 (98c) / (4) = 48.9868 (99)

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9a. Energy requirements - Individual heating systems, including micro-CHP

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Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)

Fraction of space heat from main system(s) 1.0000 (202)

Efficiency of main space heating system 1 (in %) 92.3000 (206)

Efficiency of main space heating system 2 (in %) 0.0000 (207)

Efficiency of secondary/supplementary heating system, % 0.0000 (208)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement | | | | | | | | | | | | | |
| | 777.1832 | 625.2105 | 541.9070 | 300.5058 | 111.4864 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 302.9868 | 551.4370 | 784.1559 | (98) |
| Space heating efficiency (main heating system 1) | | | | | | | | | | | | | |
| | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.3000 | 92.3000 | 92.3000 | (210) |
| Space heating fuel (main heating system) | | | | | | | | | | | | | |
| | 842.0186 | 677.3679 | 587.1148 | 325.5751 | 120.7870 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 328.2631 | 597.4399 | 849.5730 | (211) |
| Space heating efficiency (main heating system 2) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (212) |
| Space heating fuel (main heating system 2) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (213) |
| Space heating fuel (secondary) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (215) |
| Water heating | | | | | | | | | | | | | |
| Water heating requirement | | | | | | | | | | | | | |
| | 229.6708 | 203.0429 | 215.7999 | 190.2621 | 184.7209 | 166.7852 | 164.9812 | 171.4318 | 173.1727 | 192.6689 | 204.2871 | 227.2595 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 | (216) |
| (217)m | 86.5728 | 86.4109 | 86.0364 | 85.0800 | 82.9648 | 79.8000 | 79.8000 | 79.8000 | 79.8000 | 85.0705 | 86.1728 | 86.6053 | (217) |
| Fuel for water heating, kWh/month | | | | | | | | | | | | | |
| | 265.2922 | 234.9737 | 250.8239 | 223.6273 | 222.6497 | 209.0040 | 206.7433 | 214.8268 | 217.0084 | 226.4815 | 237.0667 | 262.4083 | (219) |
| Space cooling fuel requirement | | | | | | | | | | | | | |
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (221) |
| Pumps and Fa | 7.3041 | 6.5973 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | (231) |
| Lighting | 24.4104 | 19.5829 | 17.6323 | 12.9182 | 9.9784 | 8.1524 | 9.1026 | 11.8319 | 15.3685 | 20.1642 | 22.7755 | 25.0889 | (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233a)m | -17.9858 | -26.9245 | -41.0608 | -49.0679 | -55.4734 | -52.7135 | -52.0673 | -47.8751 | -40.9453 | -32.0358 | -20.3211 | -15.3722 | (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233b)m | -5.8952 | -12.7259 | -25.9144 | -39.8547 | -53.6298 | -54.2366 | -53.6033 | -44.9579 | -32.3940 | -18.5036 | -7.9663 | -4.6382 | (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235d) |

Annual totals kWh/year

Space heating fuel - main system 1 4328.1394 (211)

Space heating fuel - main system 2 0.0000 (213)

Space heating fuel - secondary 0.0000 (215)

Efficiency of water heater 79.8000

Water heating fuel used 2770.9059 (219)

Space cooling fuel 0.0000 (221)

Electricity for pumps and fans:

Total electricity for the above, kWh/year 86.0000 (231)

Electricity for lighting (calculated in Appendix L) 197.0061 (232)

Energy saving/generation technologies (Appendices M ,N and Q)

PV generation -806.1626 (233)

Wind generation 0.0000 (234)

Hydro-electric generation (Appendix N) 0.0000 (235a)

Electricity generated - Micro CHP (Appendix N) 0.0000 (235)

Appendix Q - special features

Energy saved or generated -0.0000 (236)

Energy used 0.0000 (237)

Total delivered energy for all uses 6575.8887 (238)

---

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

---

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 4328.1394 | 0.2100 | 908.9093 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2770.9059 | 0.2100 | 581.8902 | (264) |
| Space and water heating | | | 1490.7995 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 197.0061 | 0.1443 | 28.4341 | (268) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -451.8427 | 0.1334 | -60.2546 | |
| PV Unit electricity exported | -354.3199 | 0.1252 | -44.3629 | |
| Total | | | -104.6175 | (269) |
| Total CO2, kg/year | | | 1426.5453 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 17.4900 | (273) |

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13a. Primary energy - Individual heating systems including micro-CHP

---

| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 4328.1394 | 1.1300 | 4890.7975 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2770.9059 | 1.1300 | 3131.1236 | (278) |
| Space and water heating | | | 8021.9212 | (279) |

| | | | | |
|---|---|---|---|---|
| Pumps, fans and electric keep-hot | | 86.0000 | 1.5128 | 130.1008 (281) |
| Energy for lighting | | 197.0061 | 1.5338 | 302.1745 (282) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | | -451.8427 | 1.4928 | -674.5016 |
| PV Unit electricity exported | | -354.3199 | 0.4596 | -162.8306 |
| Total | | | | -837.3322 (283) |
| Total Primary energy kWh/year | | | | 7616.8642 (286) |
| Target Primary Energy Rate (TPER) | | | | 93.4000 (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Property Reference** | Unit 6 | **Issued on Date** | 17/05/2025 |
| **Assessment Reference** | 00001 | **Prop Type Ref** | Unit 4 |
| **Property** | | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 74 C | **DER** | 6.99 | **TER** | 17.47 |
| **Environmental** | 94 A | **% DER < TER** | | | 59.99 |
| **$CO_2$ Emissions (t/year)** | 0.49 | **DFEE** | 51.12 | **TFEE** | 55.91 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 8.55 |
| **% DPER < TPER** | 21.51 | **DPER** | 73.22 | **TPER** | 93.28 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Robert Arnold | **Assessor ID** | BA04-0001 |
| **Client** | | | |

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SAP 10 WORKSHEET FOR New Build (As Designed)  (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 10.0800 (1b) | x | 2.9300 (2b) | = | 29.5344 | (1b) - (3b) |
| First floor | 71.4700 (1c) | x | 3.0800 (2c) | = | 220.1276 | (1c) - (3c) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 81.5500 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = | 249.6620 | (5) |

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2. Ventilation rate

---

| | | | |
|---|---|---|---|
| | | m3 per hour | |
| Number of open chimneys | 0 * 80 = | 0.0000 | (6a) |
| Number of open flues | 0 * 20 = | 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | 0 * 10 = | 0.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |
| | | Air changes per hour | |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 0.0000 / (5) = | 0.0000 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 3.0000 | (17) |
| Infiltration rate | | 0.1500 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.1500 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.1912 | 0.1875 | 0.1837 | 0.1650 | 0.1612 | 0.1425 | 0.1425 | 0.1388 | 0.1500 | 0.1612 | 0.1687 | 0.1762 | (22b) |

| | | |
|---|---|---|
| Balanced mechanical ventilation with heat recovery | | |
| If mechanical ventilation | | 0.5000 (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | | 0.5000 (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | | 81.0000 (23c) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective ac | 0.2862 | 0.2825 | 0.2787 | 0.2600 | 0.2562 | 0.2375 | 0.2375 | 0.2337 | 0.2450 | 0.2562 | 0.2637 | 0.2712 | (25) |

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3. Heat losses and heat loss parameter

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| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| Window | | | 10.4700 | 1.0536 | 11.0316 | | | (27) |
| Solid Door | | | 4.2400 | 1.4000 | 5.9360 | | | (26) |
| Glass Door | | | 2.4000 | 1.3258 | 3.1818 | | | (27) |
| Ground Floor | | | 10.0800 | 0.1000 | 1.0080 | 110.0000 | 1108.8000 | (28a) |
| First Floor | | | 59.0500 | 0.1000 | 5.9050 | 110.0000 | 6495.5000 | (28b) |
| GF External | 44.2500 | 3.8200 | 40.4300 | 0.1500 | 6.0645 | 150.0000 | 6064.5000 | (29a) |
| FF External Walls | 40.5300 | 11.2700 | 29.2600 | 0.1500 | 4.3890 | 150.0000 | 4389.0000 | (29a) |
| FF Wall to Communal Corridor | 31.0100 | 2.0200 | 28.9900 | 0.1300 | 3.7687 | 150.0000 | 4348.5000 | (29a) |
| External Roof 1 | 4.8000 | | 4.8000 | 0.1000 | 0.4800 | 9.0000 | 43.2000 | (30) |
| Total net area of external elements Aum(A, m2) | | | 189.7200 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | | (26)...(30) + (32) = | 41.7646 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall To Unit 5 | | | 20.1200 | 0.0000 | 0.0000 | 70.0000 | 1408.4000 | (32) |
| Party Wall to Unit 7 | | | 20.1300 | 0.0000 | 0.0000 | 70.0000 | 1409.1000 | (32) |

| | | | | |
|---|---|---|---|---|
| Party Ceiling 1 | 64.6000 | | 100.0000 | 6460.0000 (32b) |
| Partitions | 157.0200 | | 9.0000 | 1413.1800 (32c) |
| First Floor Internal | 10.0800 | | 18.0000 | 181.4400 (32d) |
| Internal Ceiling 1 | 10.0800 | | 9.0000 | 90.7200 (32e) |

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 33412.3400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 409.7160 (35)
List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E1 Steel lintel with perforated steel base plate | 6.7900 | 0.0500 | 0.3395 |
| E4 Jamb | 17.7800 | 0.0500 | 0.8890 |
| E5 Ground floor (normal) | 14.3700 | 0.1600 | 2.2992 |
| E6 Intermediate floor within a dwelling | 9.0970 | 0.0000 | 0.0000 |
| E7 Party floor between dwellings (in blocks of flats) | 4.1450 | 0.0700 | 0.2902 |
| E15 Flat roof with parapet | 4.4450 | 0.5600 | 2.4892 |
| E16 Corner (normal) | 12.0400 | 0.0900 | 1.0836 |
| E17 Corner (inverted - internal area greater than external area) | 6.0200 | -0.0900 | -0.5418 |
| E20 Exposed floor (normal) | 3.3850 | 0.3200 | 1.0832 |
| E21 Exposed floor (inverted) | 9.2120 | 0.3200 | 2.9478 |
| E25 Staggered party wall between dwellings | 6.0200 | 0.0600 | 0.3612 |
| P7 Party Wall - Exposed floor (normal) | 6.0000 | 0.1600 | 0.9600 |
| P7 Party Wall - Exposed floor (normal) | 10.0720 | 0.0800 | 0.8058 |
| E7 Party floor between dwellings (in blocks of flats) | 10.0720 | 0.0350 | 0.3525 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 13.3594 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 55.1240 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 23.5837 | 23.2747 | 22.9658 | 21.4210 | 21.1120 | 19.5673 | 19.5673 | 19.2583 | 20.1852 | 21.1120 | 21.7300 | 22.3479 | (38) |

Heat transfer coeff

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 78.7077 | 78.3987 | 78.0898 | 76.5450 | 76.2360 | 74.6913 | 74.6913 | 74.3823 | 75.3092 | 76.2360 | 76.8540 | 77.4719 | (39) |

Average = Sum(39)m / 12 = 76.4678

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 0.9651 | 0.9614 | 0.9576 | 0.9386 | 0.9348 | 0.9159 | 0.9159 | 0.9121 | 0.9235 | 0.9348 | 0.9424 | 0.9500 | (40) |
| HLP (average) | | | | | | | | | | | | 0.9377 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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4. Water heating energy requirements (kWh/year)

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Assumed occupancy 2.4916 (42)
Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 64.3285 | 63.3436 | 61.8922 | 59.6594 | 57.6589 | 54.8602 | 52.6466 | 55.2344 | 56.5360 | 59.3080 | 62.1948 | 64.2705 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 27.8682 | 27.4475 | 26.8490 | 25.9528 | 25.1451 | 24.0331 | 23.1896 | 24.2211 | 24.7625 | 25.8642 | 27.0097 | 27.8461 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 40.1466 | 38.6867 | 37.2269 | 35.7670 | 34.3071 | 32.8472 | 32.8472 | 34.3071 | 35.7670 | 37.2269 | 38.6867 | 40.1466 | (42c) |

Average daily hot water use (litres/day) 121.6432 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | | | | | | | | | | | | | |
| | 132.3433 | 129.4779 | 125.9681 | 121.3792 | 117.1111 | 111.7406 | 108.6834 | 113.7626 | 117.0655 | 122.3991 | 127.8912 | 132.2632 | (44) |
| Energy conte | 194.8322 | 171.3254 | 180.0058 | 158.5516 | 150.9095 | 129.2242 | 120.0983 | 133.9007 | 135.7901 | 157.7236 | 172.8493 | 194.2382 | (45) |

Energy content (annual) Total = Sum(45)m = 1899.4489
Distribution loss (46)m = 0.15 x (45)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 29.2248 | 25.6988 | 27.0009 | 23.7827 | 22.6364 | 19.3836 | 18.0148 | 20.0851 | 20.3685 | 23.6585 | 25.9274 | 29.1357 | (46) |

Water storage loss:
Store volume 110.0000 (47)
b) If manufacturer declared loss factor is not known :
Hot water storage loss factor from Table 2 (kWh/litre/day) 0.0152 (51)
Volume factor from Table 2a 1.0294 (52)
Temperature factor from Table 2b 0.6000 (53)
Enter (49) or (54) in (55) 1.0327 (55)
Total storage loss

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (56) |

If cylinder contains dedicated solar storage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (57) |
| Primary loss 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |

Total heat required for water heating calculated for each month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 250.1090 | 221.2529 | 235.2826 | 212.0452 | 206.1863 | 182.7179 | 175.3751 | 189.1775 | 189.2838 | 213.0004 | 226.3429 | 249.5150 | (62) |
| WWHRS 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63a) |
| PV diverter -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |

Output from w/h

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 250.1090 | 221.2529 | 235.2826 | 212.0452 | 206.1863 | 182.7179 | 175.3751 | 189.1775 | 189.2838 | 213.0004 | 226.3429 | 249.5150 | (64) |

Total per year (kWh/year) = Sum(64)m = 2550.2887 (64)
12Total per year (kWh/year) 2550 (64)
Electric shower(s)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)
Heat gains from water heating, kWh/month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 109.0031 | 96.9076 | 104.0734 | 95.5133 | 94.3988 | 85.7620 | 84.1541 | 88.7434 | 87.9451 | 96.6645 | 100.2673 | 108.8056 | (65) |

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5. Internal gains (see Table 5 and 5a)

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Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 124.5807 | 124.5807 | 124.5807 | 124.5807 | 124.5807 | 124.5807 | 124.5807 | 124.5807 | 124.5807 | 124.5807 | 124.5807 | 124.5807 | (66) |

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 117.4819 | 130.0693 | 117.4819 | 121.3980 | 117.4819 | 121.3980 | 117.4819 | 117.4819 | 121.3980 | 117.4819 | 121.3980 | 117.4819 | (67) |

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 222.6495 | 224.9599 | 219.1377 | 206.7431 | 191.0970 | 176.3920 | 166.5681 | 164.2577 | 170.0798 | 182.4745 | 198.1205 | 212.8256 | (68) |

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 35.4581 | 35.4581 | 35.4581 | 35.4581 | 35.4581 | 35.4581 | 35.4581 | 35.4581 | 35.4581 | 35.4581 | 35.4581 | 35.4581 | (69) |
| Pumps, fans 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (70) |

Losses e.g. evaporation (negative values) (Table 5)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| -99.6645 | -99.6645 | -99.6645 | -99.6645 | -99.6645 | -99.6645 | -99.6645 | -99.6645 | -99.6645 | -99.6645 | -99.6645 | -99.6645 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 146.5096 | 144.2078 | 139.8836 | 132.6574 | 126.8802 | 119.1139 | 113.1104 | 119.2788 | 122.1460 | 129.9255 | 139.2602 | 146.2441 | (72) |

Total internal gains

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 547.0152 | 559.6111 | 536.8774 | 521.1727 | 495.8333 | 477.2780 | 457.5346 | 461.3926 | 473.9980 | 490.2561 | 519.1529 | 536.9258 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Northwest | 10.4700 | 11.2829 | 0.4500 | 0.7000 | 0.7700 | 25.7877 | (81) |
| Northwest | 2.4000 | 11.2829 | 0.4500 | 0.7000 | 0.7700 | 5.9112 | (81) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 31.6989 | 64.5241 | 116.2519 | 190.9190 | 256.6326 | 273.5975 | 255.9449 | 204.0422 | 141.6548 | 78.8536 | 39.8855 | 25.8869 | (83) |
| Total gains | 578.7141 | 624.1352 | 653.1293 | 712.0917 | 752.4659 | 750.8756 | 713.4795 | 665.4348 | 615.6528 | 569.1096 | 559.0383 | 562.8128 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| tau | 117.9199 | 118.3846 | 118.8530 | 121.2516 | 121.7430 | 124.2609 | 124.2609 | 124.7771 | 123.2414 | 121.7430 | 120.7642 | 119.8010 | |
| alpha | 8.8613 | 8.8923 | 8.9235 | 9.0834 | 9.1162 | 9.2841 | 9.2841 | 9.3185 | 9.2161 | 9.1162 | 9.0509 | 8.9867 | |
| util living area | 0.9996 | 0.9990 | 0.9969 | 0.9772 | 0.8723 | 0.6331 | 0.4604 | 0.5137 | 0.8105 | 0.9858 | 0.9986 | 0.9997 | (86) |
| MIT | 20.3425 | 20.4291 | 20.5697 | 20.7935 | 20.9528 | 20.9976 | 20.9999 | 20.9997 | 20.9815 | 20.7921 | 20.5431 | 20.3387 | (87) |
| Th 2 | 20.1125 | 20.1157 | 20.1188 | 20.1348 | 20.1380 | 20.1540 | 20.1540 | 20.1572 | 20.1476 | 20.1380 | 20.1316 | 20.1252 | (88) |
| util rest of house | 0.9994 | 0.9985 | 0.9950 | 0.9636 | 0.8175 | 0.5515 | 0.3720 | 0.4199 | 0.7272 | 0.9746 | 0.9977 | 0.9995 | (89) |
| MIT 2 | 19.3488 | 19.4623 | 19.6442 | 19.9349 | 20.1056 | 20.1531 | 20.1540 | 20.1572 | 20.1387 | 19.9395 | 19.6215 | 19.3543 | (90) |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.3654 | (91) |
| MIT | 19.7119 | 19.8156 | 19.9824 | 20.2487 | 20.4152 | 20.4617 | 20.4631 | 20.4650 | 20.4467 | 20.2511 | 19.9582 | 19.7140 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.7119 | 19.8156 | 19.9824 | 20.2487 | 20.4152 | 20.4617 | 20.4631 | 20.4650 | 20.4467 | 20.2511 | 19.9582 | 19.7140 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9993 | 0.9982 | 0.9946 | 0.9658 | 0.8366 | 0.5814 | 0.4044 | 0.4542 | 0.7581 | 0.9765 | 0.9975 | 0.9994 | (94) |
| Useful gains | 578.2845 | 623.0385 | 649.5992 | 687.7039 | 629.4966 | 436.5952 | 288.5010 | 302.2612 | 466.7488 | 555.7119 | 557.6343 | 562.4854 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | 1213.0360 | 1169.3633 | 1052.8376 | 868.6825 | 664.4129 | 437.8200 | 288.5395 | 302.3672 | 477.9618 | 735.7586 | 988.2067 | 1201.8996 | (97) |
| Space heating kWh | 472.2551 | 367.1303 | 300.0094 | 130.3046 | 25.9777 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 133.9547 | 310.0121 | 475.7242 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 2215.3682 | |
| Solar heating kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | 472.2551 | 367.1303 | 300.0094 | 130.3046 | 25.9777 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 133.9547 | 310.0121 | 475.7242 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 2215.3682 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 27.1658 | (99) |

## 8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ext. temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | |
| Heat loss rate W | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 702.0978 | 552.7153 | 565.3055 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (100) |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.9557 | 0.9871 | 0.9754 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (101) |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 670.9860 | 545.5778 | 551.3752 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (102) |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 814.7903 | 774.3243 | 719.7295 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 103.5391 | 170.1874 | 125.2556 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (104) |
| Cooled fraction | | | | | | | | | | fC = cooled area / (4) = | | 0.9933 | (105) |
| Intermittency factor (Table 10b) | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | (106) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 25.7102 | 42.2599 | 31.1027 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) |
| Space cooling requirement | | | | | | | | | | | | 99.0728 | (107) |

## 9b. Energy requirements

| | | |
|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | 0.0000 | (301) |
| Fraction of space heat from community system | 1.0000 | (302) |
| Fraction of heat from community Heat pump-Space and Water | 1.0000 | (303a) |
| Factor for control and charging method (Table 4c(3)) for space heating | 1.0000 | (305) |
| Factor for charging method (Table 4c(3)) for water heating | 1.0000 | (305a) |
| Distribution loss factor (Table 12c) for community heating system | 2.0000 | (306) |
| Efficiency of secondary/supplementary heating system, % | 0.0000 | (208) |

Space heating:

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement | 472.2551 | 367.1303 | 300.0094 | 130.3046 | 25.9777 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 133.9547 | 310.0121 | 475.7242 | (98) |
| Space heat from Heat pump = (98) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 307a | 944.5102 | 734.2606 | 600.0188 | 260.6092 | 51.9555 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 267.9094 | 620.0242 | 951.4484 | |
| Space heating requirement | 944.5102 | 734.2606 | 600.0188 | 260.6092 | 51.9555 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 267.9094 | 620.0242 | 951.4484 | (307) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | | | | | | | | | | | 0.0000 | (308) |
| Space heating fuel for secondary/supplementary system | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (309) |

Water heating

Annual water heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 250.1090 | 221.2529 | 235.2826 | 212.0452 | 206.1863 | 182.7179 | 175.3751 | 189.1775 | 189.2838 | 213.0004 | 226.3429 | 249.5150 | (64) |

Water heat from Heat pump = (64) x 1.00 x 1.00 x 2.00

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 310a | 500.2180 | 442.5057 | 470.5653 | 424.0905 | 412.3726 | 365.4358 | 350.7503 | 378.3550 | 378.5675 | 426.0008 | 452.6859 | 499.0300 | |
| Water heating fuel | | | | | | | | | | | | | |
| | 500.2180 | 442.5057 | 470.5653 | 424.0905 | 412.3726 | 365.4358 | 350.7503 | 378.3550 | 378.5675 | 426.0008 | 452.6859 | 499.0300 | (310) |
| Cooling System Energy Efficiency Ratio | | | | | | | | | | | | 2.6000 | (314) |
| Space coolin | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 9.8885 | 16.2538 | 11.9626 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (315) |
| Pumps and Fa | 22.8165 | 20.6085 | 22.8165 | 22.0805 | 22.8165 | 22.0805 | 22.8165 | 22.8165 | 22.0805 | 22.8165 | 22.0805 | 22.8165 | (331) |
| Lighting | 26.2304 | 21.0430 | 18.9469 | 13.8813 | 10.7223 | 8.7602 | 9.7813 | 12.7141 | 16.5143 | 21.6677 | 24.4736 | 26.9594 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333a)m | -4.8377 | -7.8845 | -13.1826 | -17.1916 | -20.6520 | -20.0832 | -19.7980 | -17.5521 | -14.0254 | -9.8853 | -5.6581 | -4.0557 | (333a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335a) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (333b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335b) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - community heating | 4430.7365 | (307) |
| Space heating fuel - secondary | 0.0000 | (309) |
| Water heating fuel - community heating | 5100.5774 | (310) |
| Efficiency of water heater | 0.0000 | (311) |
| Electricity used for heat distribution | 44.3074 | (313) |
| Space cooling fuel | 38.1049 | (321) |
| | | |
| Electricity for pumps and fans: | | |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8820) | | |
| mechanical ventilation fans (SFP = 0.8820) | 268.6463 | (330a) |
| Total electricity for the above, kWh/year | 268.6463 | (331) |
| Electricity for lighting (calculated in Appendix L) | 211.6945 | (332) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -154.8062 | (333) |
| Wind generation | 0.0000 | (334) |
| Hydro-electric generation (Appendix N) | 0.0000 | (335a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (335) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (336) |
| Energy used | 0.0000 | (337) |
| Total delivered energy for all uses | 9894.9534 | (338) |

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12b. Carbon dioxide emissions - Community heating scheme

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (367) |
| Space and Water heating from Heat pump | 3404.0407 | 0.1563 | 247.3252 | (367) |
| Electrical energy for heat distribution (space & water) | 44.3074 | 0.0000 | 14.1090 | (372) |
| Overall CO2 factor for heat network | | | 0.0543 | (386) |
| Total CO2 associated with community systems | | | 518.0025 | (373) |
| Space and water heating | | | 518.0025 | (376) |
| Space cooling | 38.1049 | 0.1136 | 4.3306 | (377) |
| Pumps, fans and electric keep-hot | 268.6463 | 0.1387 | 37.2646 | (378) |
| Energy for lighting | 211.6945 | 0.1443 | 30.5541 | (379) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -154.8062 | 0.1318 | -20.3958 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -20.3958 | (380) |
| Total CO2, kg/year | | | 569.7559 | (383) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 6.9900 | (384) |

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13b. Primary energy - Community heating scheme

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| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (467a) |
| Space and Water heating from Heat pump | 3404.0407 | 1.5787 | 2498.0924 | (467) |
| Electrical energy for heat distribution (space & water) | 44.3074 | 0.0000 | 147.5157 | (472) |
| Overall CO2 factor for heat network | | | 0.5682 | (486) |
| Total CO2 associated with community systems | | | 5415.9326 | (473) |
| Space and water heating | | | 5415.9326 | (476) |
| Space cooling | 38.1049 | 1.4190 | 54.0704 | (477) |
| Pumps, fans and electric keep-hot | 268.6463 | 1.5128 | 406.4081 | (478) |
| Energy for lighting | 211.6945 | 1.5338 | 324.7041 | (479) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -154.8062 | 1.4868 | -230.1601 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -230.1601 | (480) |
| Total Primary energy kWh/year | | | 5970.9550 | (483) |
| Dwelling Primary energy Rate (DPER) | | | 73.2200 | (484) |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 10.0800 | (1b) x | 2.9300 | (2b) = | 29.5344 | (1b) - (3b) |
| First floor | 71.4700 | (1c) x | 3.0800 | (2c) = | 220.1276 | (1c) - (3c) |

Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 81.5500 (4)
Dwelling volume (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 249.6620 (5)

## 2. Ventilation rate

| | m3 per hour | |
|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 (6a) |
| Number of open flues | 0 * 20 = | 0.0000 (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 (6f) |
| Number of intermittent extract fans | 3 * 10 = | 30.0000 (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 (7c) |

| | Air changes per hour | |
|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 30.0000 / (5) = | 0.1202 (8) |
| Pressure test | | Yes |
| Pressure Test Method | | Blower Door |
| Measured/design AP50 | | 5.0000 (17) |
| Infiltration rate | | 0.3702 (18) |
| Number of sides sheltered | | 0 (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.3702 (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.4720 | 0.4627 | 0.4534 | 0.4072 | 0.3979 | 0.3517 | 0.3517 | 0.3424 | 0.3702 | 0.3979 | 0.4164 | 0.4349 | (22b) |
| Effective ac | 0.6114 | 0.6070 | 0.6028 | 0.5829 | 0.5792 | 0.5618 | 0.5618 | 0.5586 | 0.5685 | 0.5792 | 0.5867 | 0.5946 | (25) |

## 3. Heat losses and heat loss parameter

| Element | Gross | Openings | NetArea | U-value | A x U | K-value | A x K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | m2 | m2 | m2 | W/m2K | W/K | kJ/m2K | kJ/K | |
| TER Opaque door | | | 4.2400 | 1.0000 | 4.2400 | | | (26) |
| TER Opening Type | | | 12.8700 | 1.1450 | 14.7366 | | | (27) |
| Ground Floor | | | 10.0800 | 0.1300 | 1.3104 | | | (28a) |
| First Floor | | | 59.0500 | 0.1300 | 7.6765 | | | (28b) |
| GF External | 44.2500 | 3.8200 | 40.4300 | 0.1800 | 7.2774 | | | (29a) |
| FF External Walls | 40.5300 | 11.2700 | 29.2600 | 0.1800 | 5.2668 | | | (29a) |
| FF Wall to Communal Corridor | 31.0100 | 2.0200 | 28.9900 | 0.1800 | 5.2182 | | | (29a) |
| External Roof 1 | 4.8000 | | 4.8000 | 0.1100 | 0.5280 | | | (30) |
| Total net area of external elements Aum(A, m2) | | | 189.7200 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 46.2539 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall To Unit 5 | | | 20.1200 | 0.0000 | 0.0000 | | | (32) |
| Party Wall to Unit 7 | | | 20.1300 | 0.0000 | 0.0000 | | | (32) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 393.8730 (35)
List of Thermal Bridges

| K1 Element | Length | Psi-value | Total |
|---|---|---|---|
| E1 Steel lintel with perforated steel base plate | 6.7900 | 0.0500 | 0.3395 |
| E4 Jamb | 17.7800 | 0.0500 | 0.8890 |
| E5 Ground floor (normal) | 14.3700 | 0.1600 | 2.2992 |
| E6 Intermediate floor within a dwelling | 9.0970 | 0.0000 | 0.0000 |
| E7 Party floor between dwellings (in blocks of flats) | 4.1450 | 0.0700 | 0.2902 |
| E15 Flat roof with parapet | 4.4450 | 0.5600 | 2.4892 |
| E16 Corner (normal) | 12.0400 | 0.0900 | 1.0836 |
| E17 Corner (inverted - internal area greater than external area) | 6.0200 | -0.0900 | -0.5418 |
| E20 Exposed floor (normal) | 3.3850 | 0.3200 | 1.0832 |
| E21 Exposed floor (inverted) | 9.2120 | 0.3200 | 2.9478 |
| E25 Staggered party wall between dwellings | 6.0200 | 0.0600 | 0.3612 |
| P7 Party Wall - Exposed floor (normal) | 6.0000 | 0.1600 | 0.9600 |
| P7 Party Wall - Exposed floor (normal) | 10.0720 | 0.1600 | 1.6115 |
| E7 Party floor between dwellings (in blocks of flats) | 10.0720 | 0.0700 | 0.7050 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 14.5177 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 60.7716 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 50.3700 | 50.0137 | 49.6644 | 48.0240 | 47.7171 | 46.2883 | 46.2883 | 46.0238 | 46.8387 | 47.7171 | 48.3380 | 48.9871 | (38) |
| Heat transfer coeff | 111.1416 | 110.7853 | 110.4360 | 108.7956 | 108.4887 | 107.0599 | 107.0599 | 106.7953 | 107.6103 | 108.4887 | 109.1096 | 109.7587 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 108.7941 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.3629 | 1.3585 | 1.3542 | 1.3341 | 1.3303 | 1.3128 | 1.3128 | 1.3096 | 1.3196 | 1.3303 | 1.3379 | 1.3459 | (40) |
| HLP (average) | | | | | | | | | | | | 1.3341 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

## 4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.4916 (42)
Hot water usage for mixer showers

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 65.9959 | 65.0041 | 63.5589 | 60.7937 | 58.7530 | 56.4773 | 55.1838 | 56.6181 | 58.1904 | 60.6338 | 63.4584 | 65.7430 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 28.5036 | 28.0803 | 27.4842 | 26.3850 | 25.5620 | 24.6494 | 24.1565 | 24.7484 | 25.3929 | 26.3695 | 27.4912 | 28.4072 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 40.1466 | 38.6867 | 37.2269 | 35.7670 | 34.3071 | 32.8472 | 32.8472 | 34.3071 | 35.7670 | 37.2269 | 38.6867 | 40.1466 | (42c) |

Average daily hot water use (litres/day) 123.7702 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 134.6461 | 131.7711 | 128.2699 | 122.9457 | 118.6221 | 113.9739 | 112.1875 | 115.6736 | 119.3503 | 124.2301 | 129.6363 | 134.2969 | (44) |
| Energy conte | 213.2465 | 187.6403 | 197.1460 | 168.3065 | 159.6882 | 140.1443 | 135.6811 | 143.2281 | 147.1708 | 168.5790 | 184.6907 | 210.2765 | (45) |
| Energy content (annual) | | | | | | | | | | | Total = Sum(45)m = | 2055.7979 | |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | | |
| | 31.9870 | 28.1460 | 29.5719 | 25.2460 | 23.9532 | 21.0216 | 20.3522 | 21.4842 | 22.0756 | 25.2869 | 27.7036 | 31.5415 | (46) |
| Water storage loss: | | | | | | | | | | | | | |
| Store volume | | | | | | | | | | | | 150.0000 | (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | | | | | | | | | | | | 1.3938 | (48) |
| Temperature factor from Table 2b | | | | | | | | | | | | 0.5400 | (49) |
| Enter (49) or (54) in (55) | | | | | | | | | | | | 0.7527 | (55) |
| Total storage loss | | | | | | | | | | | | | |
| | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (56) |
| If cylinder contains dedicated solar storage | | | | | | | | | | | | | |
| | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (57) |
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | | | | | | | | | | | | | |
| | 259.8414 | 229.7260 | 243.7409 | 213.3983 | 206.2831 | 185.2361 | 182.2760 | 189.8230 | 192.2627 | 215.1739 | 229.7825 | 256.8714 | (62) |
| WWHRS | -30.1706 | -26.6831 | -27.9410 | -23.1362 | -21.5622 | -18.4509 | -17.2948 | -18.3912 | -19.0900 | -22.5050 | -25.4954 | -29.6118 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | | | | | | | | | | | | | |
| | 229.6708 | 203.0429 | 215.7999 | 190.2621 | 184.7209 | 166.7852 | 164.9812 | 171.4318 | 173.1727 | 192.6689 | 204.2871 | 227.2595 | (64) |
| | | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | 2324.0831 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2324 | (64) |
| Electric shower(s) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | | | | | | | | | | | | | |
| | 108.1804 | 96.0590 | 102.8270 | 92.0354 | 90.3722 | 82.6714 | 82.3899 | 84.8993 | 85.0078 | 93.3285 | 97.4831 | 107.1928 | (65) |

## 5. Internal gains (see Table 5 and 5a)

| Metabolic gains (Table 5), Watts | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 124.5807 | 124.5807 | 124.5807 | 124.5807 | 124.5807 | 124.5807 | 124.5807 | 124.5807 | 124.5807 | 124.5807 | 124.5807 | 124.5807 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 117.4819 | 130.0693 | 117.4819 | 121.3980 | 117.4819 | 121.3980 | 117.4819 | 117.4819 | 121.3980 | 117.4819 | 121.3980 | 117.4819 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 222.6495 | 224.9599 | 219.1377 | 206.7431 | 191.0970 | 176.3920 | 166.5681 | 164.2577 | 170.0798 | 182.4745 | 198.1205 | 212.8256 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 35.4581 | 35.4581 | 35.4581 | 35.4581 | 35.4581 | 35.4581 | 35.4581 | 35.4581 | 35.4581 | 35.4581 | 35.4581 | 35.4581 | (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.0000 | 3.0000 | 3.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | | | | | | | | | | | | | |
| | -99.6645 | -99.6645 | -99.6645 | -99.6645 | -99.6645 | -99.6645 | -99.6645 | -99.6645 | -99.6645 | -99.6645 | -99.6645 | -99.6645 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 145.4037 | 142.9449 | 138.2083 | 127.8269 | 121.4681 | 114.8214 | 110.7391 | 114.1119 | 118.0663 | 125.4415 | 135.3932 | 144.0764 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 548.9093 | 561.3482 | 538.2021 | 519.3422 | 493.4212 | 472.9856 | 455.1633 | 456.2257 | 469.9184 | 488.7721 | 518.2859 | 537.7581 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Northwest | 12.8700 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 44.3785 | (81) |
| Solar gains | 44.3785 | 90.3337 | 162.7527 | 267.2866 | 359.2857 | 383.0366 | 358.3228 | 285.6591 | 198.3167 | 110.3950 | 55.8396 | 36.2417 | (83) |
| Total gains | 593.2878 | 651.6820 | 700.9548 | 786.6288 | 852.7069 | 856.0222 | 813.4861 | 741.8848 | 668.2350 | 599.1671 | 574.1256 | 573.9998 | (84) |

## 7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 80.2788 | 80.5370 | 80.7917 | 82.0099 | 82.2419 | 83.3395 | 83.3395 | 83.5459 | 82.9132 | 82.2419 | 81.7739 | 81.2903 | |
| alpha | 6.3519 | 6.3691 | 6.3861 | 6.4673 | 6.4828 | 6.5560 | 6.5560 | 6.5697 | 6.5275 | 6.4828 | 6.4516 | 6.4194 | |
| util living area | | | | | | | | | | | | | |
| | 0.9995 | 0.9990 | 0.9971 | 0.9853 | 0.9273 | 0.7548 | 0.5722 | 0.6466 | 0.9082 | 0.9922 | 0.9988 | 0.9996 | (86) |
| MIT | 19.8885 | 20.0027 | 20.2050 | 20.5219 | 20.8072 | 20.9654 | 20.9950 | 20.9897 | 20.8800 | 20.5284 | 20.1675 | 19.8799 | (87) |
| Th 2 | 19.7919 | 19.7953 | 19.7986 | 19.8142 | 19.8171 | 19.8308 | 19.8308 | 19.8333 | 19.8255 | 19.8171 | 19.8112 | 19.8050 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9992 | 0.9984 | 0.9953 | 0.9753 | 0.8799 | 0.6396 | 0.4243 | 0.4918 | 0.8295 | 0.9852 | 0.9980 | 0.9994 | (89) |
| MIT 2 | 18.5171 | 18.6660 | 18.9271 | 19.3381 | 19.6694 | 19.8166 | 19.8300 | 19.8313 | 19.7553 | 19.3527 | 18.8893 | 18.5161 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.3654 | (91) |
| MIT | 19.0182 | 19.1544 | 19.3941 | 19.7707 | 20.0852 | 20.2364 | 20.2557 | 20.2546 | 20.1663 | 19.7823 | 19.3564 | 19.0144 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.0182 | 19.1544 | 19.3941 | 19.7707 | 20.0852 | 20.2364 | 20.2557 | 20.2546 | 20.1663 | 19.7823 | 19.3564 | 19.0144 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9990 | 0.9979 | 0.9945 | 0.9748 | 0.8927 | 0.6823 | 0.4790 | 0.5497 | 0.8568 | 0.9849 | 0.9976 | 0.9992 | (94) |
| Useful gains | 592.6852 | 650.3165 | 697.0828 | 766.8369 | 761.1891 | 584.0661 | 389.6969 | 407.7859 | 572.5477 | 590.1208 | 572.7226 | 573.5352 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | | | | | | | | | | | | | |
| | 1635.8057 | 1579.1829 | 1423.9722 | 1182.6793 | 909.6970 | 603.4343 | 391.3804 | 411.6541 | 652.7979 | 996.1780 | 1337.2882 | 1626.0129 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 776.0817 | 624.1982 | 540.8057 | 299.4065 | 110.4899 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 302.1065 | 550.4873 | 783.0434 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 3986.6192 | |
| Solar heating kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | | | | | | | | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 776.0817 | 624.1982 | 540.8057 | 299.4065 | 110.4899 | 0.0000 | 0.0000 | 0.0000 | 302.1065 | 550.4873 | 783.0434 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | 3986.6192 | |
| Space heating per m2 | | | | | | | | | | (98c) / (4) = | 48.8856 | (99) |

---

9a. Energy requirements - Individual heating systems, including micro-CHP

---

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | 0.0000 | (201) |
| Fraction of space heat from main system(s) | | | | | | | | | | | 1.0000 | (202) |
| Efficiency of main space heating system 1 (in %) | | | | | | | | | | | 92.3000 | (206) |
| Efficiency of main space heating system 2 (in %) | | | | | | | | | | | 0.0000 | (207) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | 0.0000 | (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement | | | | | | | | | | | | | |
| | 776.0817 | 624.1982 | 540.8057 | 299.4065 | 110.4899 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 302.1065 | 550.4873 | 783.0434 | (98) |
| Space heating efficiency (main heating system 1) | | | | | | | | | | | | | |
| | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.3000 | 92.3000 | 92.3000 | (210) |
| Space heating fuel (main heating system) | | | | | | | | | | | | | |
| | 840.8252 | 676.2711 | 585.9217 | 324.3841 | 119.7074 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 327.3094 | 596.4109 | 848.3677 | (211) |
| Space heating efficiency (main heating system 2) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (212) |
| Space heating fuel (main heating system 2) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (213) |
| Space heating fuel (secondary) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (215) |
| Water heating | | | | | | | | | | | | | |
| Water heating requirement | | | | | | | | | | | | | |
| | 229.6708 | 203.0429 | 215.7999 | 190.2621 | 184.7209 | 166.7852 | 164.9812 | 171.4318 | 173.1727 | 192.6689 | 204.2871 | 227.2595 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 | (216) |
| (217)m | 86.5704 | 86.4081 | 86.0325 | 85.0720 | 82.9464 | 79.8000 | 79.8000 | 79.8000 | 79.8000 | 85.0641 | 86.1696 | 86.6029 | (217) |
| Fuel for water heating, kWh/month | | | | | | | | | | | | | |
| | 265.2995 | 234.9815 | 250.8353 | 223.6483 | 222.6991 | 209.0040 | 206.7433 | 214.8268 | 217.0084 | 226.4984 | 237.0755 | 262.4155 | (219) |
| Space cooling fuel requirement | | | | | | | | | | | | | |
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (221) |
| Pumps and Fa | 7.3041 | 6.5973 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | (231) |
| Lighting | 24.4104 | 19.5829 | 17.6323 | 12.9182 | 9.9784 | 8.1524 | 9.1026 | 11.8319 | 15.3685 | 20.1642 | 22.7755 | 25.0889 | (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233a)m | -17.9858 | -26.9245 | -41.0608 | -49.0679 | -55.4734 | -52.7135 | -52.0673 | -47.8751 | -40.9453 | -32.0358 | -20.3211 | -15.3722 | (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233b)m | -5.8952 | -12.7259 | -25.9144 | -39.8547 | -53.6298 | -54.2366 | -53.6033 | -44.9579 | -32.3940 | -18.5036 | -7.9663 | -4.6382 | (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235d) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - main system 1 | 4319.1974 | (211) |
| Space heating fuel - main system 2 | 0.0000 | (213) |
| Space heating fuel - secondary | 0.0000 | (215) |
| Efficiency of water heater | 79.8000 | |
| Water heating fuel used | 2771.0356 | (219) |
| Space cooling fuel | 0.0000 | (221) |
| Electricity for pumps and fans: | | |
| Total electricity for the above, kWh/year | 86.0000 | (231) |
| Electricity for lighting (calculated in Appendix L) | 197.0061 | (232) |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -806.1626 | (233) |
| Wind generation | 0.0000 | (234) |
| Hydro-electric generation (Appendix N) | 0.0000 | (235a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (235) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (236) |
| Energy used | 0.0000 | (237) |
| Total delivered energy for all uses | 6567.0764 | (238) |

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12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 4319.1974 | 0.2100 | 907.0315 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2771.0356 | 0.2100 | 581.9175 | (264) |
| Space and water heating | | | 1488.9489 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 197.0061 | 0.1443 | 28.4341 | (268) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -451.8427 | 0.1334 | -60.2546 | |
| PV Unit electricity exported | -354.3199 | 0.1252 | -44.3629 | |
| Total | | | -104.6175 | (269) |
| Total CO2, kg/year | | | 1424.6947 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 17.4700 | (273) |

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13a. Primary energy - Individual heating systems including micro-CHP

---

| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 4319.1974 | 1.1300 | 4880.6931 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2771.0356 | 1.1300 | 3131.2702 | (278) |
| Space and water heating | | | 8011.9632 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 197.0061 | 1.5338 | 302.1745 | (282) |

| | | | | |
|---|---|---|---|---|
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -451.8427 | 1.4928 | -674.5016 | |
| PV Unit electricity exported | -354.3199 | 0.4596 | -162.8306 | |
| Total | | | -837.3322 | (283) |
| Total Primary energy kWh/year | | | 7606.9063 | (286) |
| Target Primary Energy Rate (TPER) | | | 93.2800 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Property Reference** | Unit 7 | **Issued on Date** | 17/05/2025 |
| **Assessment Reference** | 00001 | **Prop Type Ref** | Unit 4 |
| **Property** | | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 73 C | **DER** | 7.35 | **TER** | 18.15 |
| **Environmental** | 94 A | **% DER < TER** | | | 59.50 |
| **$CO_2$ Emissions (t/year)** | 0.51 | **DFEE** | 54.15 | **TFEE** | 58.64 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 7.65 |
| **% DPER < TPER** | 20.62 | **DPER** | 76.94 | **TPER** | 96.93 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Robert Arnold | **Assessor ID** | BA04-0001 |
| **Client** | | | |

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SAP 10 WORKSHEET FOR New Build (As Designed)  (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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## 1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 10.0800 (1b) | x | 2.9300 (2b) | = | 29.5344 | (1b) - (3b) |
| First floor | 69.8800 (1c) | x | 3.0800 (2c) | = | 215.2304 | (1c) - (3c) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 79.9600 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = | 244.7648 | (5) |

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## 2. Ventilation rate

---

| | | | |
|---|---|---|---|
| | | m3 per hour | |
| Number of open chimneys | 0 * 80 = | 0.0000 | (6a) |
| Number of open flues | 0 * 20 = | 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | 0 * 10 = | 0.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |
| | | Air changes per hour | |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 0.0000 / (5) = | 0.0000 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 3.0000 | (17) |
| Infiltration rate | | 0.1500 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.1500 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.1912 | 0.1875 | 0.1837 | 0.1650 | 0.1612 | 0.1425 | 0.1425 | 0.1388 | 0.1500 | 0.1612 | 0.1687 | 0.1762 | (22b) |

| | | |
|---|---|---|
| Balanced mechanical ventilation with heat recovery | | |
| If mechanical ventilation | | 0.5000 (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | | 0.5000 (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | | 81.0000 (23c) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective ac | 0.2862 | 0.2825 | 0.2787 | 0.2600 | 0.2562 | 0.2375 | 0.2375 | 0.2337 | 0.2450 | 0.2562 | 0.2637 | 0.2712 | (25) |

---

## 3. Heat losses and heat loss parameter

---

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| Window | | | 10.4700 | 1.0536 | 11.0316 | | | (27) |
| Solid Door | | | 4.2400 | 1.4000 | 5.9360 | | | (26) |
| Glass Door | | | 2.4000 | 1.3258 | 3.1818 | | | (27) |
| Ground Floor | | | 10.0800 | 0.1000 | 1.0080 | 110.0000 | 1108.8000 | (28a) |
| First Floor | | | 59.0500 | 0.1000 | 5.9050 | 110.0000 | 6495.5000 | (28b) |
| GF External | 44.2500 | 3.8200 | 40.4300 | 0.1500 | 6.0645 | 150.0000 | 6064.5000 | (29a) |
| FF External Walls | 54.6800 | 11.2700 | 43.4100 | 0.1500 | 6.5115 | 150.0000 | 6511.5000 | (29a) |
| FF Wall to Communal Corridor | 33.9500 | 2.0200 | 31.9300 | 0.1300 | 4.1509 | 150.0000 | 4789.5000 | (29a) |
| External Roof 1 | 4.8000 | | 4.8000 | 0.1000 | 0.4800 | 9.0000 | 43.2000 | (30) |
| Total net area of external elements Aum(A, m2) | | | 206.8100 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | | (26)...(30) + (32) = | 44.2693 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall To Unit 6 | | | 20.1200 | 0.0000 | 0.0000 | 70.0000 | 1408.4000 | (32) |
| Party Ceiling 1 | | | 64.6000 | | | 100.0000 | 6460.0000 | (32b) |

| | | | | |
|---|---|---|---|---|
| Partitions | 151.8400 | | 9.0000 | 1366.5600 (32c) |
| First Floor Internal | 10.0800 | | 18.0000 | 181.4400 (32d) |
| Internal Ceiling 1 | 10.0800 | | 9.0000 | 90.7200 (32e) |

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 34520.1200 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 431.7174 (35)
List of Thermal Bridges

| K1 Element | Length | Psi-value | Total |
|---|---|---|---|
| E1 Steel lintel with perforated steel base plate | 6.7900 | 0.0500 | 0.3395 |
| E4 Jamb | 17.7800 | 0.0500 | 0.8890 |
| E5 Ground floor (normal) | 14.3700 | 0.1600 | 2.2992 |
| E6 Intermediate floor within a dwelling | 9.0970 | 0.0000 | 0.0000 |
| E7 Party floor between dwellings (in blocks of flats) | 14.3700 | 0.0700 | 1.0059 |
| E15 Flat roof with parapet | 4.4450 | 0.5600 | 2.4892 |
| E16 Corner (normal) | 14.9500 | 0.0900 | 1.3455 |
| E17 Corner (inverted - internal area greater than external area) | 2.9300 | -0.0900 | -0.2637 |
| E20 Exposed floor (normal) | 8.7300 | 0.3200 | 2.7936 |
| E21 Exposed floor (inverted) | 5.2720 | 0.3200 | 1.6870 |
| E25 Staggered party wall between dwellings | 6.0200 | 0.0600 | 0.3612 |
| P7 Party Wall - Exposed floor (normal) | 6.5120 | 0.1600 | 1.0419 |
| E17 Corner (inverted - internal area greater than external area) | 2.9300 | -0.0450 | -0.1318 |
| E7 Party floor between dwellings (in blocks of flats) | 11.5880 | 0.0350 | 0.4056 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 14.2621 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 58.5314 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 23.1211 | 22.8182 | 22.5153 | 21.0008 | 20.6979 | 19.1834 | 19.1834 | 18.8805 | 19.7892 | 20.6979 | 21.3037 | 21.9095 | (38) |
| Heat transfer coeff | 81.6525 | 81.3496 | 81.0467 | 79.5322 | 79.2293 | 77.7149 | 77.7149 | 77.4120 | 78.3207 | 79.2293 | 79.8351 | 80.4409 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 79.4565 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.0212 | 1.0174 | 1.0136 | 0.9947 | 0.9909 | 0.9719 | 0.9719 | 0.9681 | 0.9795 | 0.9909 | 0.9984 | 1.0060 | (40) |
| HLP (average) | | | | | | | | | | | | 0.9937 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

---

4. Water heating energy requirements (kWh/year)

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Assumed occupancy 2.4621 (42)
Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 63.8462 | 62.8687 | 61.4282 | 59.2121 | 57.2266 | 54.4489 | 52.2519 | 54.8203 | 56.1121 | 58.8633 | 61.7285 | 63.7886 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 27.6601 | 27.2426 | 26.6486 | 25.7590 | 24.9573 | 23.8537 | 23.0164 | 24.0403 | 24.5776 | 25.6711 | 26.8081 | 27.6382 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 39.8444 | 38.3955 | 36.9466 | 35.4977 | 34.0488 | 32.6000 | 32.6000 | 34.0488 | 35.4977 | 36.9466 | 38.3955 | 39.8444 | (42c) |

Average daily hot water use (litres/day) 120.7309 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 131.3507 | 128.5068 | 125.0234 | 120.4689 | 116.2328 | 110.9026 | 107.8683 | 112.9094 | 116.1875 | 121.4811 | 126.9320 | 131.2712 | (44) |
| Energy conte | 193.3709 | 170.0405 | 178.6558 | 157.3625 | 149.7777 | 128.2551 | 119.1976 | 132.8965 | 134.7716 | 156.5407 | 171.5529 | 192.7814 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1885.2032 | |
| Distribution loss (46)m = 0.15 x (45)m | 29.0056 | 25.5061 | 26.7984 | 23.6044 | 22.4667 | 19.2383 | 17.8796 | 19.9345 | 20.2157 | 23.4811 | 25.7329 | 28.9172 | (46) |

Water storage loss:
Store volume 110.0000 (47)
b) If manufacturer declared loss factor is not known :
Hot water storage loss factor from Table 2 (kWh/litre/day) 0.0152 (51)
Volume factor from Table 2a 1.0294 (52)
Temperature factor from Table 2b 0.6000 (53)
Enter (49) or (54) in (55) 1.0327 (55)
Total storage loss

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (56) |

If cylinder contains dedicated solar storage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (57) |
| Primary loss 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |

Total heat required for water heating calculated for each month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 248.6478 | 219.9679 | 233.9326 | 210.8562 | 205.0545 | 181.7488 | 174.4744 | 188.1733 | 188.2653 | 211.8175 | 225.0466 | 248.0582 | (62) |
| WWHRS 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63a) |
| PV diverter -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |

Output from w/h

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 248.6478 | 219.9679 | 233.9326 | 210.8562 | 205.0545 | 181.7488 | 174.4744 | 188.1733 | 188.2653 | 211.8175 | 225.0466 | 248.0582 | (64) |

Total per year (kWh/year) = Sum(64)m = 2536.0430 (64)
12Total per year (kWh/year) 2536 (64)
Electric shower(s)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)
Heat gains from water heating, kWh/month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 108.5173 | 96.4804 | 103.6245 | 95.1180 | 94.0225 | 85.4398 | 83.8546 | 88.4095 | 87.6065 | 96.2712 | 99.8363 | 108.3213 | (65) |

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5. Internal gains (see Table 5 and 5a)

---

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 123.1051 | 123.1051 | 123.1051 | 123.1051 | 123.1051 | 123.1051 | 123.1051 | 123.1051 | 123.1051 | 123.1051 | 123.1051 | 123.1051 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 115.2938 | 127.6467 | 115.2938 | 119.1370 | 115.2938 | 119.1370 | 115.2938 | 115.2938 | 119.1370 | 115.2938 | 119.1370 | 115.2938 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 219.3569 | 221.6332 | 215.8971 | 203.6857 | 188.2711 | 173.7835 | 164.1049 | 161.8286 | 167.5647 | 179.7761 | 195.1907 | 209.6783 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 35.3105 | 35.3105 | 35.3105 | 35.3105 | 35.3105 | 35.3105 | 35.3105 | 35.3105 | 35.3105 | 35.3105 | 35.3105 | 35.3105 | (69) |
| Pumps, fans | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | -98.4841 | -98.4841 | -98.4841 | -98.4841 | -98.4841 | -98.4841 | -98.4841 | -98.4841 | -98.4841 | -98.4841 | -98.4841 | -98.4841 | (71) |
| Water heating gains (Table 5) | 145.8566 | 143.5720 | 139.2803 | 132.1083 | 126.3744 | 118.6663 | 112.7079 | 118.8300 | 121.6757 | 129.3968 | 138.6615 | 145.5931 | (72) |
| Total internal gains | 540.4389 | 552.7835 | 530.4027 | 514.8625 | 489.8708 | 471.5183 | 452.0381 | 455.8840 | 468.3089 | 484.3982 | 512.9207 | 530.4968 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Northwest | 10.4700 | 11.2829 | 0.4500 | 0.7000 | 0.7700 | 25.7877 | (81) |
| Northwest | 2.4000 | 11.2829 | 0.4500 | 0.7000 | 0.7700 | 5.9112 | (81) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 31.6989 | 64.5241 | 116.2519 | 190.9190 | 256.6326 | 273.5975 | 255.9449 | 204.0422 | 141.6548 | 78.8536 | 39.8855 | 25.8869 | (83) |
| Total gains | 572.1378 | 617.3076 | 646.6546 | 705.7815 | 746.5034 | 745.1159 | 707.9830 | 659.9262 | 609.9637 | 563.2518 | 552.8062 | 556.3837 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| tau | 117.4357 | 117.8730 | 118.3135 | 120.5665 | 121.0274 | 123.3860 | 123.3860 | 123.8687 | 122.4316 | 121.0274 | 120.1091 | 119.2045 | |
| alpha | 8.8290 | 8.8582 | 8.8876 | 9.0378 | 9.0685 | 9.2257 | 9.2257 | 9.2579 | 9.1621 | 9.0685 | 9.0073 | 8.9470 | |
| util living area | 0.9997 | 0.9993 | 0.9978 | 0.9831 | 0.8947 | 0.6621 | 0.4827 | 0.5388 | 0.8389 | 0.9897 | 0.9991 | 0.9998 | (86) |
| MIT | 20.3158 | 20.4009 | 20.5416 | 20.7672 | 20.9402 | 20.9965 | 20.9998 | 20.9995 | 20.9751 | 20.7688 | 20.5169 | 20.3115 | (87) |
| Th 2 | 20.0657 | 20.0689 | 20.0720 | 20.0878 | 20.0910 | 20.1068 | 20.1068 | 20.1100 | 20.1005 | 20.0910 | 20.0846 | 20.0783 | (88) |
| util rest of house | 0.9996 | 0.9989 | 0.9963 | 0.9718 | 0.8411 | 0.5729 | 0.3849 | 0.4351 | 0.7530 | 0.9807 | 0.9984 | 0.9997 | (89) |
| MIT 2 | 19.2723 | 19.3839 | 19.5662 | 19.8609 | 20.0499 | 20.1056 | 20.1068 | 20.1099 | 20.0886 | 19.8688 | 19.5456 | 19.2772 | (90) |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.3185 | (91) |
| MIT | 19.6047 | 19.7079 | 19.8769 | 20.1496 | 20.3335 | 20.3894 | 20.3912 | 20.3933 | 20.3710 | 20.1555 | 19.8550 | 19.6067 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.6047 | 19.7079 | 19.8769 | 20.1496 | 20.3335 | 20.3894 | 20.3912 | 20.3933 | 20.3710 | 20.1555 | 19.8550 | 19.6067 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9995 | 0.9987 | 0.9959 | 0.9727 | 0.8570 | 0.6015 | 0.4161 | 0.4682 | 0.7810 | 0.9815 | 0.9981 | 0.9996 | (94) |
| Useful gains | 571.8243 | 616.5000 | 643.9960 | 686.5312 | 639.7448 | 448.2123 | 294.5824 | 308.9802 | 476.3682 | 552.8541 | 551.7736 | 556.1466 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | 1249.6673 | 1204.6144 | 1084.1518 | 894.7057 | 684.0235 | 449.9194 | 294.6353 | 309.1269 | 491.1457 | 757.0759 | 1018.2988 | 1239.3277 | (97) |
| Space heating kWh | 504.3152 | 395.2129 | 327.4759 | 149.8856 | 32.9434 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 151.9410 | 335.8982 | 508.2867 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 2405.9589 | |
| Solar heating kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | 504.3152 | 395.2129 | 327.4759 | 149.8856 | 32.9434 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 151.9410 | 335.8982 | 508.2867 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 2405.9589 | |
| Space heating per m2 | | | | | | | | | | (98c) / (4) = | | 30.0895 | (99) |

## 8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ext. temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | |
| Heat loss rate W | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 730.5197 | 575.0900 | 588.3309 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (100) |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.9417 | 0.9818 | 0.9662 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (101) |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 687.9618 | 564.6342 | 568.4256 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (102) |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 809.4054 | 769.1813 | 714.5111 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 87.4394 | 152.1830 | 108.6876 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (104) |
| Cooled fraction | | | | | | | | | fC = cooled area / (4) = | | | 0.9880 | (105) |
| Intermittency factor (Table 10b) | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | (106) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 21.5974 | 37.5890 | 26.8457 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) |
| Space cooling requirement | | | | | | | | | | | | 86.0321 | (107) |

## 9b. Energy requirements

| | | |
|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | 0.0000 | (301) |
| Fraction of space heat from community system | 1.0000 | (302) |
| Fraction of space heat from community Heat pump-Space and Water | 1.0000 | (303a) |
| Factor for control and charging method (Table 4c(3)) for space heating | 1.0000 | (305) |
| Factor for charging method (Table 4c(3)) for water heating | 1.0000 | (305a) |
| Distribution loss factor (Table 12c) for community heating system | 2.0000 | (306) |
| Efficiency of secondary/supplementary heating system, % | 0.0000 | (208) |

Space heating:

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement | 504.3152 | 395.2129 | 327.4759 | 149.8856 | 32.9434 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 151.9410 | 335.8982 | 508.2867 | (98) |
| Space heat from Heat pump = (98) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 307a | 1008.6303 | 790.4258 | 654.9519 | 299.7713 | 65.8867 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 303.8821 | 671.7963 | 1016.5735 | |
| Space heating requirement | 1008.6303 | 790.4258 | 654.9519 | 299.7713 | 65.8867 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 303.8821 | 671.7963 | 1016.5735 | (307) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | | | | | | | | | | | 0.0000 | (308) |
| Space heating fuel for secondary/supplementary system | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (309) |

Water heating

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Annual water heating requirement | 248.6478 | 219.9679 | 233.9326 | 210.8562 | 205.0545 | 181.7488 | 174.4744 | 188.1733 | 188.2653 | 211.8175 | 225.0466 | 248.0582 | (64) |
| Water heat from Heat pump = (64) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 310a | 497.2955 | 439.9359 | 467.8653 | 421.7123 | 410.1090 | 363.4976 | 348.9488 | 376.3465 | 376.5306 | 423.6349 | 450.0931 | 496.1164 | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Water heating fuel | | | | | | | | | | | | | |
| | 497.2955 | 439.9359 | 467.8653 | 421.7123 | 410.1090 | 363.4976 | 348.9488 | 376.3465 | 376.5306 | 423.6349 | 450.0931 | 496.1164 | (310) |
| Cooling System Energy Efficiency Ratio | | | | | | | | | | | | 2.6000 | (314) |
| Space coolin | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 8.3067 | 14.4573 | 10.3253 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (315) |
| Pumps and Fa | 22.3690 | 20.2042 | 22.3690 | 21.6474 | 22.3690 | 21.6474 | 22.3690 | 22.3690 | 21.6474 | 22.3690 | 21.6474 | 22.3690 | (331) |
| Lighting | 25.6033 | 20.5399 | 18.4939 | 13.5494 | 10.4660 | 8.5508 | 9.5474 | 12.4101 | 16.1195 | 21.1496 | 23.8884 | 26.3149 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333a)m | -4.8327 | -7.8733 | -13.1586 | -17.1533 | -20.5996 | -20.0299 | -19.7456 | -17.5086 | -13.9950 | -9.8687 | -5.6513 | -4.0518 | (333a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335a) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (333b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335b) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - community heating | 4811.9178 | (307) |
| Space heating fuel - secondary | 0.0000 | (309) |
| Water heating fuel - community heating | 5072.0860 | (310) |
| Efficiency of water heater | 0.0000 | (311) |
| Electricity used for heat distribution | 48.1192 | (313) |
| Space cooling fuel | 33.0893 | (321) |
| Electricity for pumps and fans: | | |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8820) | | |
| mechanical ventilation fans (SFP = 0.8820) | 263.3767 | (330a) |
| Total electricity for the above, kWh/year | 263.3767 | (331) |
| Electricity for lighting (calculated in Appendix L) | 206.6331 | (332) |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -154.4684 | (333) |
| Wind generation | 0.0000 | (334) |
| Hydro-electric generation (Appendix N) | 0.0000 | (335a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (335) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (336) |
| Energy used | 0.0000 | (337) |
| Total delivered energy for all uses | 10232.6345 | (338) |

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12b. Carbon dioxide emissions - Community heating scheme

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (367) |
| Space and Water heating from Heat pump | 3530.0014 | 0.1561 | 268.2563 | (367) |
| Electrical energy for heat distribution (space & water) | 48.1192 | 0.0000 | 14.6548 | (372) |
| Overall CO2 factor for heat network | | | 0.0544 | (386) |
| Total CO2 associated with community systems | | | 538.0387 | (373) |
| Space and water heating | | | 538.0387 | (376) |
| Space cooling | 33.0893 | 0.1136 | 3.7580 | (377) |
| Pumps, fans and electric keep-hot | 263.3767 | 0.1387 | 36.5336 | (378) |
| Energy for lighting | 206.6331 | 0.1443 | 29.8235 | (379) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -154.4684 | 0.1318 | -20.3524 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -20.3524 | (380) |
| Total CO2, kg/year | | | 587.8014 | (383) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 7.3500 | (384) |

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13b. Primary energy - Community heating scheme

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| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (467a) |
| Space and Water heating from Heat pump | 3530.0014 | 1.5779 | 2711.7298 | (467) |
| Electrical energy for heat distribution (space & water) | 48.1192 | 0.0000 | 153.0634 | (472) |
| Overall CO2 factor for heat network | | | 0.5686 | (486) |
| Total CO2 associated with community systems | | | 5619.6150 | (473) |
| Space and water heating | | | 5619.6150 | (476) |
| Space cooling | 33.0893 | 1.4187 | 46.9443 | (477) |
| Pumps, fans and electric keep-hot | 263.3767 | 1.5128 | 398.4363 | (478) |
| Energy for lighting | 206.6331 | 1.5338 | 316.9408 | (479) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -154.4684 | 1.4868 | -229.6622 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -229.6622 | (480) |
| Total Primary energy kWh/year | | | 6152.2743 | (483) |
| Dwelling Primary energy Rate (DPER) | | | 76.9400 | (484) |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 10.0800 | (1b) x | 2.9300 | (2b) = | 29.5344 | (1b) - (3b) |
| First floor | 69.8800 | (1c) x | 3.0800 | (2c) = | 215.2304 | (1c) - (3c) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 79.9600 | | | | | (4) |

Dwelling volume (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 244.7648 (5)

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2. Ventilation rate

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| | | | |
|---|---|---|---|
| | | m3 per hour | |
| Number of open chimneys | 0 * 80 = | 0.0000 | (6a) |
| Number of open flues | 0 * 20 = | 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | 3 * 10 = | 30.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |
| | | Air changes per hour | |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 30.0000 / (5) = | 0.1226 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3726 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.3726 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.4750 | 0.4657 | 0.4564 | 0.4098 | 0.4005 | 0.3539 | 0.3539 | 0.3446 | 0.3726 | 0.4005 | 0.4191 | 0.4378 | (22b) |
| Effective ac | 0.6128 | 0.6084 | 0.6041 | 0.5840 | 0.5802 | 0.5626 | 0.5626 | 0.5594 | 0.5694 | 0.5802 | 0.5878 | 0.5958 | (25) |

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3. Heat losses and heat loss parameter

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| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| TER Opaque door | | | 4.2400 | 1.0000 | 4.2400 | | | (26) |
| TER Opening Type | | | 12.8700 | 1.1450 | 14.7366 | | | (27) |
| Ground Floor | | | 10.0800 | 0.1300 | 1.3104 | | | (28a) |
| First Floor | | | 59.0500 | 0.1300 | 7.6765 | | | (28b) |
| GF External | 44.2500 | 3.8200 | 40.4300 | 0.1800 | 7.2774 | | | (29a) |
| FF External Walls | 54.6800 | 11.2700 | 43.4100 | 0.1800 | 7.8138 | | | (29a) |
| FF Wall to Communal Corridor | 33.9500 | 2.0200 | 31.9300 | 0.1800 | 5.7474 | | | (29a) |
| External Roof 1 | 4.8000 | | 4.8000 | 0.1100 | 0.5280 | | | (30) |
| Total net area of external elements Aum(A, m2) | | | 206.8100 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 49.3301 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall To Unit 6 | | | 20.1200 | 0.0000 | 0.0000 | | | (32) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 415.5593 (35)

List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E1 Steel lintel with perforated steel base plate | 6.7900 | 0.0500 | 0.3395 |
| E4 Jamb | 17.7800 | 0.0500 | 0.8890 |
| E5 Ground floor (normal) | 14.3700 | 0.1600 | 2.2992 |
| E6 Intermediate floor within a dwelling | 9.0970 | 0.0000 | 0.0000 |
| E7 Party floor between dwellings (in blocks of flats) | 14.3700 | 0.0700 | 1.0059 |
| E15 Flat roof with parapet | 4.4450 | 0.5600 | 2.4892 |
| E16 Corner (normal) | 14.9500 | 0.0900 | 1.3455 |
| E17 Corner (inverted - internal area greater than external area) | 2.9300 | -0.0900 | -0.2637 |
| E20 Exposed floor (normal) | 8.7300 | 0.3200 | 2.7936 |
| E21 Exposed floor (inverted) | 5.2720 | 0.3200 | 1.6870 |
| E25 Staggered party wall between dwellings | 6.0200 | 0.0600 | 0.3612 |
| P7 Party Wall - Exposed floor (normal) | 6.5120 | 0.1600 | 1.0419 |
| E17 Corner (inverted - internal area greater than external area) | 2.9300 | -0.0900 | -0.2637 |
| E7 Party floor between dwellings (in blocks of flats) | 11.5880 | 0.0700 | 0.8112 |

| | | | |
|---|---|---|---|
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | 14.5358 | (36) |
| Point Thermal bridges | (36a) = | 0.0000 | |
| Total fabric heat loss | (33) + (36) + (36a) = | 63.8660 | (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 49.4992 | 49.1453 | 48.7985 | 47.1693 | 46.8644 | 45.4455 | 45.4455 | 45.1827 | 45.9920 | 46.8644 | 47.4811 | 48.1258 | (38) |
| Heat transfer coeff | 113.3651 | 113.0113 | 112.6644 | 111.0352 | 110.7304 | 109.3114 | 109.3114 | 109.0487 | 109.8580 | 110.7304 | 111.3470 | 111.9917 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 111.0338 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.4178 | 1.4133 | 1.4090 | 1.3886 | 1.3848 | 1.3671 | 1.3671 | 1.3638 | 1.3739 | 1.3848 | 1.3925 | 1.4006 | (40) |
| HLP (average) | | | | | | | | | | | | 1.3886 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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4. Water heating energy requirements (kWh/year)

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Assumed occupancy 2.4621 (42)

Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 65.5011 | 64.5167 | 63.0823 | 60.3379 | 58.3125 | 56.0539 | 54.7701 | 56.1936 | 57.7541 | 60.1792 | 62.9826 | 65.2501 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 28.2908 | 27.8707 | 27.2790 | 26.1881 | 25.3712 | 24.4654 | 23.9761 | 24.5637 | 25.2034 | 26.1726 | 27.2860 | 28.1952 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 39.8444 | 38.3955 | 36.9466 | 35.4977 | 34.0488 | 32.6000 | 32.6000 | 34.0488 | 35.4977 | 36.9466 | 38.3955 | 39.8444 | (42c) |

Average daily hot water use (litres/day) 122.8420 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 133.6363 | 130.7829 | 127.3079 | 122.0236 | 117.7325 | 113.1192 | 111.3461 | 114.8061 | 118.4552 | 123.2984 | 128.6641 | 133.2897 | (44) |
| Energy conte | 211.6472 | 186.2331 | 195.6675 | 167.0443 | 158.4906 | 139.0933 | 134.6635 | 142.1539 | 146.0671 | 167.3147 | 183.3055 | 208.6994 | (45) |

Energy content (annual) Total = Sum(45)m = 2040.3800
Distribution loss (46)m = 0.15 x (45)m
31.7471 27.9350 29.3501 25.0566 23.7736 20.8640 20.1995 21.3231 21.9101 25.0972 27.4958 31.3049 (46)
Water storage loss:
Store volume 150.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.3938 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 0.7527 (55)
Total storage loss
23.3325 21.0745 23.3325 22.5798 23.3325 22.5798 23.3325 23.3325 22.5798 23.3325 22.5798 23.3325 (56)
If cylinder contains dedicated solar storage
23.3325 21.0745 23.3325 22.5798 23.3325 22.5798 23.3325 23.3325 22.5798 23.3325 22.5798 23.3325 (57)
Primary loss 23.2624 21.0112 23.2624 22.5120 23.2624 22.5120 23.2624 23.2624 22.5120 23.2624 22.5120 23.2624 (59)
Combi loss 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (61)
Total heat required for water heating calculated for each month
258.2421 228.3188 242.2624 212.1361 205.0855 184.1851 181.2584 188.7488 191.1589 213.9096 228.3974 255.2943 (62)
WWHRS -29.9443 -26.4830 -27.7315 -22.9628 -21.4005 -18.3125 -17.1651 -18.2534 -18.9469 -22.3363 -25.3043 -29.3898 (63a)
PV diverter -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 (63b)
Solar input 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (63c)
FGHRS 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (63d)
Output from w/h
228.2977 201.8358 214.5309 189.1733 183.6850 165.8726 164.0933 170.4955 172.2120 191.5734 203.0931 225.9045 (64)
Total per year (kWh/year) = Sum(64)m = 2310.7671 (64)
12Total per year (kWh/year) 2311 (64)
Electric shower(s)
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)
Heat gains from water heating, kWh/month
107.6486 95.5911 102.3354 91.6157 89.9740 82.3220 82.0515 84.5421 84.6408 92.9081 97.0226 106.6685 (65)

## 5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 123.1051 | 123.1051 | 123.1051 | 123.1051 | 123.1051 | 123.1051 | 123.1051 | 123.1051 | 123.1051 | 123.1051 | 123.1051 | 123.1051 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 115.2938 | 127.6467 | 115.2938 | 119.1370 | 115.2938 | 119.1370 | 115.2938 | 115.2938 | 119.1370 | 115.2938 | 119.1370 | 115.2938 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 219.3569 | 221.6332 | 215.8971 | 203.6857 | 188.2711 | 173.7835 | 164.1049 | 161.8286 | 167.5647 | 179.7761 | 195.1907 | 209.6783 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 35.3105 | 35.3105 | 35.3105 | 35.3105 | 35.3105 | 35.3105 | 35.3105 | 35.3105 | 35.3105 | 35.3105 | 35.3105 | 35.3105 | (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.0000 | 3.0000 | 3.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | | | | | | | | | | | | | |
| | -98.4841 | -98.4841 | -98.4841 | -98.4841 | -98.4841 | -98.4841 | -98.4841 | -98.4841 | -98.4841 | -98.4841 | -98.4841 | -98.4841 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 144.6890 | 142.2486 | 137.5475 | 127.2440 | 120.9329 | 114.3361 | 110.2843 | 113.6319 | 117.5566 | 124.8764 | 134.7536 | 143.3716 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 542.2713 | 554.4601 | 531.6700 | 512.9983 | 487.4293 | 467.1881 | 449.6146 | 450.6859 | 464.1898 | 482.8779 | 512.0128 | 531.2753 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Northwest | 12.8700 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 44.3785 | (81) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 44.3785 | 90.3337 | 162.7527 | 267.2866 | 359.2857 | 383.0366 | 358.3228 | 285.6591 | 198.3167 | 110.3950 | 55.8396 | 36.2417 | (83) |
| Total gains | 586.6498 | 644.7938 | 694.4227 | 780.2849 | 846.7150 | 850.2246 | 807.9374 | 736.3450 | 662.5065 | 593.2728 | 567.8524 | 567.5170 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| tau | 81.4186 | 81.6736 | 81.9250 | 83.1271 | 83.3559 | 84.4380 | 84.4380 | 84.6414 | 84.0179 | 83.3559 | 82.8943 | 82.4171 | |
| alpha | 6.4279 | 6.4449 | 6.4617 | 6.5418 | 6.5571 | 6.6292 | 6.6292 | 6.6428 | 6.6012 | 6.5571 | 6.5263 | 6.4945 | |
| util living area | | | | | | | | | | | | | |
| | 0.9996 | 0.9992 | 0.9977 | 0.9878 | 0.9362 | 0.7711 | 0.5874 | 0.6633 | 0.9192 | 0.9937 | 0.9991 | 0.9997 | (86) |
| MIT | 19.8858 | 19.9974 | 20.1970 | 20.5100 | 20.7971 | 20.9623 | 20.9945 | 20.9887 | 20.8722 | 20.5189 | 20.1616 | 19.8773 | (87) |
| Th 2 | 19.7497 | 19.7531 | 19.7564 | 19.7721 | 19.7750 | 19.7887 | 19.7887 | 19.7912 | 19.7834 | 19.7750 | 19.7691 | 19.7629 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9994 | 0.9987 | 0.9962 | 0.9789 | 0.8901 | 0.6512 | 0.4305 | 0.4996 | 0.8413 | 0.9876 | 0.9984 | 0.9995 | (89) |
| MIT 2 | 18.4749 | 18.6205 | 18.8783 | 19.2853 | 19.6207 | 19.7738 | 19.7878 | 19.7891 | 19.7097 | 19.3027 | 18.8432 | 18.4740 | (90) |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.3185 | (91) |
| MIT | 18.9243 | 19.0591 | 19.2984 | 19.6754 | 19.9954 | 20.1524 | 20.1722 | 20.1712 | 20.0800 | 19.6901 | 19.2632 | 18.9210 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 18.9243 | 19.0591 | 19.2984 | 19.6754 | 19.9954 | 20.1524 | 20.1722 | 20.1712 | 20.0800 | 19.6901 | 19.2632 | 18.9210 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9992 | 0.9983 | 0.9954 | 0.9779 | 0.9002 | 0.6902 | 0.4813 | 0.5533 | 0.8648 | 0.9869 | 0.9980 | 0.9994 | (94) |
| Useful gains | 586.1725 | 643.6926 | 691.2034 | 763.0329 | 762.2416 | 586.8094 | 388.8496 | 407.4116 | 572.9083 | 585.5218 | 566.7168 | 567.1514 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | | | | | | | | | | | | | |
| | 1657.8882 | 1600.1416 | 1441.9211 | 1196.4483 | 918.5534 | 606.9377 | 390.4834 | 411.2455 | 656.9543 | 1006.5474 | 1354.3348 | 1648.6292 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 797.3565 | 642.7338 | 558.5340 | 312.0591 | 116.2960 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 313.2430 | 567.0849 | 804.6195 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 4111.9267 | |
| Solar heating kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | | | | | | | | | | | | | |
| | 797.3565 | 642.7338 | 558.5340 | 312.0591 | 116.2960 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 313.2430 | 567.0849 | 804.6195 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 4111.9267 | |

Space heating per m2 (98c) / (4) = 51.4248 (99)

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9a. Energy requirements - Individual heating systems, including micro-CHP

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Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 92.3000 (206)
Efficiency of main space heating system 2 (in %) 0.0000 (207)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement | | | | | | | | | | | | | |
| | 797.3565 | 642.7338 | 558.5340 | 312.0591 | 116.2960 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 313.2430 | 567.0849 | 804.6195 | (98) |
| Space heating efficiency (main heating system 1) | | | | | | | | | | | | | |
| | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.3000 | 92.3000 | 92.3000 | (210) |
| Space heating fuel (main heating system) | | | | | | | | | | | | | |
| | 863.8748 | 696.3530 | 605.1289 | 338.0921 | 125.9979 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 339.3749 | 614.3932 | 871.7437 | (211) |
| Space heating efficiency (main heating system 2) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (212) |
| Space heating fuel (main heating system 2) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (213) |
| Space heating fuel (secondary) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (215) |
| Water heating | | | | | | | | | | | | | |
| Water heating requirement | | | | | | | | | | | | | |
| | 228.2977 | 201.8358 | 214.5309 | 189.1733 | 183.6850 | 165.8726 | 164.0933 | 170.4955 | 172.2120 | 191.5734 | 203.0931 | 225.9045 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 | (216) |
| (217)m | 86.6254 | 86.4694 | 86.1051 | 85.1745 | 83.0637 | 79.8000 | 79.8000 | 79.8000 | 79.8000 | 85.1554 | 86.2353 | 86.6575 | (217) |
| Fuel for water heating, kWh/month | | | | | | | | | | | | | |
| | 263.5460 | 233.4187 | 249.1501 | 222.1009 | 221.1375 | 207.8603 | 205.6307 | 213.6535 | 215.8046 | 224.9692 | 235.5103 | 260.6865 | (219) |
| Space cooling fuel requirement | | | | | | | | | | | | | |
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (221) |
| Pumps and Fa | 7.3041 | 6.5973 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | (231) |
| Lighting | 23.9558 | 19.2182 | 17.3039 | 12.6776 | 9.7925 | 8.0006 | 8.9331 | 11.6115 | 15.0822 | 19.7887 | 22.3513 | 24.6216 | (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233a)m | -17.6492 | -26.4284 | -40.3167 | -48.1949 | -54.5020 | -51.7973 | -51.1631 | -47.0363 | -40.2168 | -31.4529 | -19.9436 | -15.0836 | (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233b)m | -5.7662 | -12.4489 | -25.3527 | -38.9939 | -52.4740 | -53.0676 | -52.4472 | -43.9866 | -31.6926 | -18.1012 | -7.7922 | -4.5366 | (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235d) |

Annual totals kWh/year
Space heating fuel - main system 1 4454.9586 (211)
Space heating fuel - main system 2 0.0000 (213)
Space heating fuel - secondary 0.0000 (215)
Efficiency of water heater 79.8000
Water heating fuel used 2753.4682 (219)
Space cooling fuel 0.0000 (221)

Electricity for pumps and fans:
Total electricity for the above, kWh/year 86.0000 (231)
Electricity for lighting (calculated in Appendix L) 193.3369 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV generation -790.4447 (233)
Wind generation 0.0000 (234)
Hydro-electric generation (Appendix N) 0.0000 (235a)
Electricity generated - Micro CHP (Appendix N) 0.0000 (235)
Appendix Q - special features
Energy saved or generated -0.0000 (236)
Energy used 0.0000 (237)
Total delivered energy for all uses 6697.3190 (238)

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12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 4454.9586 | 0.2100 | 935.5413 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2753.4682 | 0.2100 | 578.2283 | (264) |
| Space and water heating | | | 1513.7696 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 193.3369 | 0.1443 | 27.9045 | (268) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -443.7848 | 0.1333 | -59.1770 | |
| PV Unit electricity exported | -346.6599 | 0.1252 | -43.4032 | |
| Total | | | -102.5802 | (269) |
| Total CO2, kg/year | | | 1451.0232 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 18.1500 | (273) |

---

13a. Primary energy - Individual heating systems including micro-CHP

---

| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 4454.9586 | 1.1300 | 5034.1032 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2753.4682 | 1.1300 | 3111.4191 | (278) |
| Space and water heating | | | 8145.5223 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 193.3369 | 1.5338 | 296.5466 | (282) |
| Energy saving/generation technologies | | | | |

| | | | | |
|---|---|---|---|---|
| PV Unit electricity used in dwelling | -443.7848 | 1.4928 | -662.4614 | |
| PV Unit electricity exported | -346.6599 | 0.4596 | -159.3080 | |
| Total | | | -821.7694 | (283) |
| Total Primary energy kWh/year | | | 7750.4002 | (286) |
| Target Primary Energy Rate (TPER) | | | 96.9300 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Property Reference** | Unit 8 | **Issued on Date** | 17/05/2025 |
| **Assessment Reference** | 00001 | **Prop Type Ref** | Unit 8 |
| **Property** | | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 77 C | **DER** | 6.81 | **TER** | 18.10 |
| **Environmental** | 95 A | **% DER < TER** | | | 62.38 |
| **$CO_2$ Emissions (t/year)** | 0.31 | **DFEE** | 42.08 | **TFEE** | 48.89 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 13.92 |
| **% DPER < TPER** | 25.73 | **DPER** | 72.10 | **TPER** | 97.09 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Robert Arnold | **Assessor ID** | BA04-0001 |
| **Client** | | | |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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## 1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 51.0300 | (1b) | x 2.9300 | (2b) = | 149.5179 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 51.0300 | | | | | (4) |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | 149.5179 | (5) |

---

## 2. Ventilation rate

---

| | | m3 per hour | |
|---|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 | (6a) |
| Number of open flues | 0 * 20 = | 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | 0 * 10 = | 0.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |

| | Air changes per hour | | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 0.0000 / (5) = | 0.0000 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 3.0000 | (17) |
| Infiltration rate | | 0.1500 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.1500 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.1912 | 0.1875 | 0.1837 | 0.1650 | 0.1612 | 0.1425 | 0.1425 | 0.1388 | 0.1500 | 0.1612 | 0.1687 | 0.1762 | (22b) |

Balanced mechanical ventilation with heat recovery

| | | |
|---|---|---|
| If mechanical ventilation | 0.5000 | (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | 0.5000 | (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | 81.0000 | (23c) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective ac | 0.2862 | 0.2825 | 0.2787 | 0.2600 | 0.2562 | 0.2375 | 0.2375 | 0.2337 | 0.2450 | 0.2562 | 0.2637 | 0.2712 | (25) |

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## 3. Heat losses and heat loss parameter

---

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| Windows | | | 6.9800 | 1.0536 | 7.3544 | | | (27) |
| Solid Door | | | 1.8900 | 1.4000 | 2.6460 | | | (26) |
| Glass Door | | | 2.2900 | 1.3258 | 3.0360 | | | (27) |
| Heatloss Floor 1 | | | 51.0300 | 0.1000 | 5.1030 | 110.0000 | 5613.3000 | (28a) |
| External Wall | 29.5500 | 9.2700 | 20.2800 | 0.1500 | 3.0420 | 150.0000 | 3042.0000 | (29a) |
| Wall to Comm Corridor | 20.7500 | 1.8900 | 18.8600 | 0.1400 | 2.6404 | 150.0000 | 2829.0000 | (29a) |
| Wall to Stairs | 25.2700 | | 25.2700 | 0.1100 | 2.7797 | 150.0000 | 3790.5000 | (29a) |
| Total net area of external elements Aum(A, m2) | | | 126.6000 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 26.6015 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 9 | | | 22.7200 | 0.0000 | 0.0000 | 70.0000 | 1590.4000 | (32) |
| Party Ceiling 1 | | | 51.0300 | | | 100.0000 | 5103.0000 | (32b) |
| Internal Wall 1 | | | 107.0400 | | | 9.0000 | 963.3600 | (32c) |

| | | |
|---|---|---|
| Heat capacity Cm = Sum(A x k) | (28)...(30) + (32) + (32a)...(32e) = 22931.5600 | (34) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 449.3741 (35)

List of Thermal Bridges

| | K1 Element | Length | Psi-value | Total |
|---|---|---|---|---|
| E1 | Steel lintel with perforated steel base plate | 5.4500 | 0.0500 | 0.2725 |
| E3 | Sill | 1.8100 | 0.0500 | 0.0905 |
| E4 | Jamb | 12.0700 | 0.0500 | 0.6035 |
| E5 | Ground floor (normal) | 7.2500 | 0.1600 | 1.1600 |
| E16 | Corner (normal) | 2.9300 | 0.0900 | 0.2637 |
| E18 | Party wall between dwellings | 5.8600 | 0.0600 | 0.3516 |
| E7 | Party floor between dwellings (in blocks of flats) | 7.0820 | 0.0350 | 0.2479 |
| E7 | Party floor between dwellings (in blocks of flats) | 7.2250 | 0.0700 | 0.5058 |
| E17 | Corner (inverted - internal area greater than external area) | 2.9300 | -0.0900 | -0.2637 |
| P8 | Party Wall - Exposed floor (inverted) | 2.8650 | 0.0800 | 0.2292 |
| E5 | Ground floor (normal) | 7.0820 | 0.0800 | 0.5666 |
| P1 | Party wall - Ground floor | 7.7570 | 0.0800 | 0.6206 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 4.6480 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 31.2495 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 14.1238 | 13.9388 | 13.7538 | 12.8286 | 12.6436 | 11.7185 | 11.7185 | 11.5334 | 12.0885 | 12.6436 | 13.0137 | 13.3837 | (38) |
| Heat transfer coeff | 45.3734 | 45.1883 | 45.0033 | 44.0782 | 43.8931 | 42.9680 | 42.9680 | 42.7830 | 43.3381 | 43.8931 | 44.2632 | 44.6333 | (39) |

Average = Sum(39)m / 12 = 44.0319

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 0.8892 | 0.8855 | 0.8819 | 0.8638 | 0.8601 | 0.8420 | 0.8420 | 0.8384 | 0.8493 | 0.8601 | 0.8674 | 0.8746 | (40) |
| HLP (average) | | | | | | | | | | | | 0.8629 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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4. Water heating energy requirements (kWh/year)

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Assumed occupancy 1.7205 (42)

Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 51.7252 | 50.9333 | 49.7662 | 47.9709 | 46.3623 | 44.1119 | 42.3320 | 44.4128 | 45.4594 | 47.6883 | 50.0095 | 51.6785 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 22.4318 | 22.0932 | 21.6115 | 20.8901 | 20.2399 | 19.3449 | 18.6659 | 19.4962 | 19.9320 | 20.8188 | 21.7408 | 22.4140 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.2492 | 31.0765 | 29.9038 | 28.7311 | 27.5584 | 26.3857 | 26.3857 | 27.5584 | 28.7311 | 29.9038 | 31.0765 | 32.2492 | (42c) |

Average daily hot water use (litres/day) 97.8037 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 106.4062 | 104.1030 | 101.2815 | 97.5920 | 94.1606 | 89.8425 | 87.3836 | 91.4674 | 94.1225 | 98.4109 | 102.8268 | 106.3418 | (44) |
| Energy conte | 156.6483 | 137.7493 | 144.7292 | 127.4796 | 121.3355 | 103.8999 | 96.5614 | 107.6588 | 109.1773 | 126.8124 | 138.9739 | 156.1707 | (45) |

Energy content (annual) Total = Sum(45)m = 1527.1962

Distribution loss (46)m = 0.15 x (45)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.4972 | 20.6624 | 21.7094 | 19.1219 | 18.2003 | 15.5850 | 14.4842 | 16.1488 | 16.3766 | 19.0219 | 20.8461 | 23.4256 | (46) |

Water storage loss:

Store volume 110.0000 (47)

b) If manufacturer declared loss factor is not known :

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.0152 (51)

Volume factor from Table 2a 1.0294 (52)

Temperature factor from Table 2b 0.6000 (53)

Enter (49) or (54) in (55) 1.0327 (55)

Total storage loss

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (56) |

If cylinder contains dedicated solar storage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (57) |
| Primary loss 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |

Total heat required for water heating calculated for each month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 211.9251 | 187.6767 | 200.0060 | 180.9733 | 176.6123 | 157.3936 | 151.8382 | 162.9356 | 162.6710 | 182.0892 | 192.4675 | 211.4475 | (62) |
| WWHRS 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63a) |
| PV diverter -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |

Output from w/h

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 211.9251 | 187.6767 | 200.0060 | 180.9733 | 176.6123 | 157.3936 | 151.8382 | 162.9356 | 162.6710 | 182.0892 | 192.4675 | 211.4475 | (64) |

Total per year (kWh/year) = Sum(64)m = 2178.0360 (64)

12Total per year (kWh/year) 2178 (64)

Electric shower(s)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)

Heat gains from water heating, kWh/month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 96.3070 | 85.7436 | 92.3439 | 85.1819 | 84.5655 | 77.3417 | 76.3281 | 80.0180 | 79.0964 | 86.3866 | 89.0038 | 96.1482 | (65) |

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5. Internal gains (see Table 5 and 5a)

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Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 86.0228 | 86.0228 | 86.0228 | 86.0228 | 86.0228 | 86.0228 | 86.0228 | 86.0228 | 86.0228 | 86.0228 | 86.0228 | 86.0228 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 78.4556 | 86.8615 | 78.4556 | 81.0707 | 78.4556 | 81.0707 | 78.4556 | 78.4556 | 81.0707 | 78.4556 | 81.0707 | 78.4556 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 149.9087 | 151.4643 | 147.5442 | 139.1990 | 128.6646 | 118.7638 | 112.1494 | 110.5938 | 114.5138 | 122.8591 | 133.3935 | 143.2943 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 31.6023 | 31.6023 | 31.6023 | 31.6023 | 31.6023 | 31.6023 | 31.6023 | 31.6023 | 31.6023 | 31.6023 | 31.6023 | 31.6023 | (69) |
| Pumps, fans | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | -68.8182 | -68.8182 | -68.8182 | -68.8182 | -68.8182 | -68.8182 | -68.8182 | -68.8182 | -68.8182 | -68.8182 | -68.8182 | -68.8182 | (71) |
| Water heating gains (Table 5) | 129.4449 | 127.5946 | 124.1181 | 118.3082 | 113.6633 | 107.4190 | 102.5916 | 107.5511 | 109.8561 | 116.1110 | 123.6163 | 129.2314 | (72) |
| Total internal gains | 406.6160 | 414.7272 | 398.9248 | 387.3848 | 369.5903 | 356.0603 | 342.0034 | 345.4073 | 354.2475 | 366.2324 | 386.8874 | 399.7882 | (73) |

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6. Solar gains

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| [Jan] | Area m2 | Solar flux Table 6a | g Specific data | FF Specific data | Access factor | Gains W |
|---|---|---|---|---|---|---|

| | | | | W/m2 | or Table 6b | or Table 6c | Table 6d | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northeast | | | 3.8400 | 11.2829 | 0.4500 | 0.7000 | 0.7700 | | | | 9.4580 | (75) |
| Southeast | | | 3.1400 | 36.7938 | 0.4500 | 0.7000 | 0.7700 | | | | 25.2202 | (77) |
| Northeast | | | 2.2900 | 11.2829 | 0.4500 | 0.7000 | 0.7700 | | | | 5.6403 | (75) |
| Solar gains | 40.3184 | 73.6922 | 114.1498 | 163.7648 | 203.8100 | 211.3005 | 199.9856 | 168.7397 | 131.1154 | 85.0373 | 49.2055 | 33.9132 | (83) |
| Total gains | 446.9344 | 488.4195 | 513.0746 | 551.1496 | 573.4002 | 567.3608 | 541.9890 | 514.1470 | 485.3629 | 451.2697 | 436.0929 | 433.7014 | (84) |

7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 140.3880 | 140.9629 | 141.5424 | 144.5132 | 145.1224 | 148.2470 | 148.2470 | 148.8882 | 146.9812 | 145.1224 | 143.9091 | 142.7160 | |
| alpha | 10.3592 | 10.3975 | 10.4362 | 10.6342 | 10.6748 | 10.8831 | 10.8831 | 10.9259 | 10.7987 | 10.6748 | 10.5939 | 10.5144 | |
| util living area | | | | | | | | | | | | | |
| | 0.9983 | 0.9947 | 0.9814 | 0.8983 | 0.7063 | 0.4846 | 0.3488 | 0.3828 | 0.6148 | 0.9195 | 0.9923 | 0.9987 | (86) |
| MIT | 20.5865 | 20.6791 | 20.8021 | 20.9491 | 20.9958 | 20.9999 | 21.0000 | 21.0000 | 20.9992 | 20.9447 | 20.7571 | 20.5790 | (87) |
| Th 2 | 20.1767 | 20.1798 | 20.1829 | 20.1984 | 20.2015 | 20.2171 | 20.2171 | 20.2202 | 20.2108 | 20.2015 | 20.1953 | 20.1891 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9973 | 0.9918 | 0.9716 | 0.8608 | 0.6484 | 0.4254 | 0.2868 | 0.3179 | 0.5453 | 0.8798 | 0.9874 | 0.9979 | (89) |
| MIT 2 | 19.7090 | 19.8288 | 19.9831 | 20.1581 | 20.1992 | 20.2170 | 20.2171 | 20.2202 | 20.2105 | 20.1598 | 19.9409 | 19.7100 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.6439 | (91) |
| MIT | 20.2741 | 20.3764 | 20.5105 | 20.6674 | 20.7121 | 20.7212 | 20.7212 | 20.7223 | 20.7184 | 20.6652 | 20.4665 | 20.2696 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 20.2741 | 20.3764 | 20.5105 | 20.6674 | 20.7121 | 20.7212 | 20.7212 | 20.7223 | 20.7184 | 20.6652 | 20.4665 | 20.2696 | (93) |

8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9974 | 0.9927 | 0.9761 | 0.8837 | 0.6857 | 0.4635 | 0.3267 | 0.3597 | 0.5901 | 0.9043 | 0.9893 | 0.9980 | (94) |
| Useful gains | 445.7849 | 484.8339 | 500.7918 | 487.0596 | 393.2086 | 262.9817 | 177.0801 | 184.9205 | 286.4262 | 408.0904 | 431.4293 | 432.8337 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | | | | | | | | | | | | | |
| | 724.7974 | 699.3513 | 630.5179 | 518.6871 | 395.5711 | 263.0145 | 177.0807 | 184.9222 | 286.8274 | 441.7939 | 591.6437 | 717.2382 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 207.5853 | 144.1557 | 96.5162 | 22.7719 | 1.7577 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 25.0754 | 115.3544 | 211.5969 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 824.8134 | |
| Solar heating kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | | | | | | | | | | | | | |
| | 207.5853 | 144.1557 | 96.5162 | 22.7719 | 1.7577 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 25.0754 | 115.3544 | 211.5969 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 824.8134 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 16.1633 | (99) |

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ext. temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | |
| Heat loss rate W | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 403.8992 | 317.9632 | 325.1506 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (100) |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.9966 | 0.9995 | 0.9989 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (101) |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 402.5456 | 317.7922 | 324.7892 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (102) |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 619.0858 | 591.6427 | 559.6968 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103) |
| Space cooling kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 155.9089 | 203.7447 | 174.7713 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (104) |
| Cooled fraction | | | | | | | | | | fC = cooled area / (4) = | | 0.9994 | (105) |
| Intermittency factor (Table 10b) | | | | | | | | | | | | | |
| | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | (106) |
| Space cooling kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 38.9543 | 50.9062 | 43.6671 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) |
| Space cooling requirement | | | | | | | | | | | | 133.5277 | (107) |

9b. Energy requirements

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | 0.0000 | (301) |
| Fraction of space heat from community system | | | | | | | | | | | | 1.0000 | (302) |
| Fraction of heat from community Heat pump-Space and Water | | | | | | | | | | | | 1.0000 | (303a) |
| Factor for control and charging method (Table 4c(3)) for space heating | | | | | | | | | | | | 1.0000 | (305) |
| Factor for charging method (Table 4c(3)) for water heating | | | | | | | | | | | | 1.0000 | (305a) |
| Distribution loss factor (Table 12c) for community heating system | | | | | | | | | | | | 2.0000 | (306) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 | (208) |
| Space heating: | | | | | | | | | | | | | |
| Space heating requirement | | | | | | | | | | | | | |
| | 207.5853 | 144.1557 | 96.5162 | 22.7719 | 1.7577 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 25.0754 | 115.3544 | 211.5969 | (98) |
| Space heat from Heat pump = (98) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 307a | 415.1706 | 288.3113 | 193.0324 | 45.5437 | 3.5153 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 50.1508 | 230.7088 | 423.1939 | |
| Space heating requirement | | | | | | | | | | | | | |
| | 415.1706 | 288.3113 | 193.0324 | 45.5437 | 3.5153 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 50.1508 | 230.7088 | 423.1939 | (307) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | | | | | | | | | | | 0.0000 | (308) |
| Space heating fuel for secondary/supplementary system | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (309) |
| Water heating | | | | | | | | | | | | | |
| Annual water heating requirement | | | | | | | | | | | | | |
| | 211.9251 | 187.6767 | 200.0060 | 180.9733 | 176.6123 | 157.3936 | 151.8382 | 162.9356 | 162.6710 | 182.0892 | 192.4675 | 211.4475 | (64) |
| Water heat from Heat pump = (64) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 310a | 423.8502 | 375.3534 | 400.0119 | 361.9466 | 353.2246 | 314.7871 | 303.6765 | 325.8713 | 325.3420 | 364.1783 | 384.9351 | 422.8950 | |
| Water heating fuel | | | | | | | | | | | | | |
| | 423.8502 | 375.3534 | 400.0119 | 361.9466 | 353.2246 | 314.7871 | 303.6765 | 325.8713 | 325.3420 | 364.1783 | 384.9351 | 422.8950 | (310) |
| Cooling System Energy Efficiency Ratio | | | | | | | | | | | | 2.6000 | (314) |
| Space coolin | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 14.9824 | 19.5793 | 16.7951 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (315) |
| Pumps and Fa | 13.6644 | 12.3420 | 13.6644 | 13.2236 | 13.6644 | 13.2236 | 13.6644 | 13.6644 | 13.2236 | 13.6644 | 13.2236 | 13.6644 | (331) |
| Lighting | 15.1687 | 12.1689 | 10.9567 | 8.0274 | 6.2006 | 5.0659 | 5.6564 | 7.3523 | 9.5500 | 12.5301 | 14.1527 | 15.5902 | (332) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (333a)m | -4.6982 | -7.5718 | -12.5152 | -16.1286 | -19.2020 | -18.6140 | -18.3534 | -16.3551 | -13.1859 | -9.4249 | -5.4680 | -3.9473 (333a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (334a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (334a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (335a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (335a) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (333b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (333b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (334b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (334b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (335b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (335b) |

| | |
|---|---|
| Annual totals kWh/year | |
| Space heating fuel - community heating | 1649.6269 (307) |
| Space heating fuel - secondary | 0.0000 (309) |
| Water heating fuel - community heating | 4356.0720 (310) |
| Efficiency of water heater | 0.0000 (311) |
| Electricity used for heat distribution | 16.4963 (313) |
| Space cooling fuel | 51.3568 (321) |
| | |
| Electricity for pumps and fans: | |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8820) | |
| mechanical ventilation fans (SFP = 0.8820) | 160.8872 (330a) |
| Total electricity for the above, kWh/year | 160.8872 (331) |
| Electricity for lighting (calculated in Appendix L) | 122.4197 (332) |
| | |
| Energy saving/generation technologies (Appendices M ,N and Q) | |
| PV generation | -145.4644 (333) |
| Wind generation | 0.0000 (334) |
| Hydro-electric generation (Appendix N) | 0.0000 (335a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 (335) |
| Appendix Q - special features | |
| Energy saved or generated | -0.0000 (336) |
| Energy used | 0.0000 (337) |
| Total delivered energy for all uses | 6194.8983 (338) |

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12b. Carbon dioxide emissions - Community heating scheme

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (367) |
| Space and Water heating from Heat pump | 2144.8925 | 0.1582 | 93.1970 | (367) |
| Electrical energy for heat distribution (space & water) | 16.4963 | 0.0000 | 8.7394 | (372) |
| Overall CO2 factor for heat network | | | 0.0534 | (386) |
| Total CO2 associated with community systems | | | 320.8603 | (373) |
| Space and water heating | | | 320.8603 | (376) |
| Space cooling | 51.3568 | 0.1140 | 5.8522 | (377) |
| Pumps, fans and electric keep-hot | 160.8872 | 0.1387 | 22.3170 | (378) |
| Energy for lighting | 122.4197 | 0.1443 | 17.6689 | (379) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -145.4644 | 0.1320 | -19.1954 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -19.1954 | (380) |
| Total CO2, kg/year | | | 347.5032 | (383) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 6.8100 | (384) |

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13b. Primary energy - Community heating scheme

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| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (467a) |
| Space and Water heating from Heat pump | 2144.8925 | 1.5856 | 934.1576 | (467) |
| Electrical energy for heat distribution (space & water) | 16.4963 | 0.0000 | 92.3827 | (472) |
| Overall CO2 factor for heat network | | | 0.5648 | (486) |
| Total CO2 associated with community systems | | | 3391.7666 | (473) |
| Space and water heating | | | 3391.7666 | (476) |
| Space cooling | 51.3568 | 1.4200 | 72.9279 | (477) |
| Pumps, fans and electric keep-hot | 160.8872 | 1.5128 | 243.3902 | (478) |
| Energy for lighting | 122.4197 | 1.5338 | 187.7715 | (479) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -145.4644 | 1.4875 | -216.3852 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -216.3852 | (480) |
| Total Primary energy kWh/year | | | 3679.4710 | (483) |
| Dwelling Primary energy Rate (DPER) | | | 72.1000 | (484) |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 51.0300 | (1b) x | 2.9300 | (2b) = | 149.5179 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 51.0300 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = | 149.5179 | (5) |

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2. Ventilation rate

| | | | |
|---|---|---|---|
| | | m3 per hour | |
| Number of open chimneys | 0 * 80 = | 0.0000 | (6a) |
| Number of open flues | 0 * 20 = | 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | 2 * 10 = | 20.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |
| | | Air changes per hour | |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 20.0000 / (5) = | 0.1338 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3838 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.3838 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.4893 | 0.4797 | 0.4701 | 0.4221 | 0.4125 | 0.3646 | 0.3646 | 0.3550 | 0.3838 | 0.4125 | 0.4317 | 0.4509 | (22b) |
| Effective ac | 0.6197 | 0.6151 | 0.6105 | 0.5891 | 0.5851 | 0.5665 | 0.5665 | 0.5630 | 0.5736 | 0.5851 | 0.5932 | 0.6017 | (25) |

## 3. Heat losses and heat loss parameter

| Element | Gross | Openings | NetArea | U-value | A x U | K-value | A x K | |
|---|---|---|---|---|---|---|---|---|
| | m2 | m2 | m2 | W/m2K | W/K | kJ/m2K | kJ/K | |
| Main dwelling | | | | | | | | |
| TER Opaque door | | | 1.8900 | 1.0000 | 1.8900 | | | (26) |
| TER Opening Type | | | 9.2700 | 1.1450 | 10.6145 | | | (27) |
| Heatloss Floor 1 | | | 51.0300 | 0.1300 | 6.6339 | | | (28a) |
| External Wall | 29.5500 | 9.2700 | 20.2800 | 0.1800 | 3.6504 | | | (29a) |
| Wall to Comm Corridor | 20.7500 | 1.8900 | 18.8600 | 0.1800 | 3.3948 | | | (29a) |
| Wall to Stairs | 25.2700 | | 25.2700 | 0.1800 | 4.5486 | | | (29a) |
| Total net area of external elements Aum(A, m2) | | | 126.6000 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 30.7322 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 9 | | | 22.7200 | 0.0000 | 0.0000 | | | (32) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 429.3741 (35)

List of Thermal Bridges

| | Length | Psi-value | Total | |
|---|---|---|---|---|
| K1 Element | | | | |
| E1 Steel lintel with perforated steel base plate | 5.4500 | 0.0500 | 0.2725 | |
| E3 Sill | 1.8100 | 0.0500 | 0.0905 | |
| E4 Jamb | 12.0700 | 0.0500 | 0.6035 | |
| E5 Ground floor (normal) | 7.2500 | 0.1600 | 1.1600 | |
| E16 Corner (normal) | 2.9300 | 0.0900 | 0.2637 | |
| E18 Party wall between dwellings | 5.8600 | 0.0600 | 0.3516 | |
| E7 Party floor between dwellings (in blocks of flats) | 7.0820 | 0.0700 | 0.4957 | |
| E7 Party floor between dwellings (in blocks of flats) | 7.2250 | 0.0700 | 0.5058 | |
| E17 Corner (inverted - internal area greater than external area) | 2.9300 | -0.0900 | -0.2637 | |
| P8 Party Wall - Exposed floor (inverted) | 2.8650 | 0.2400 | 0.6876 | |
| E5 Ground floor (normal) | 7.0820 | 0.1600 | 1.1331 | |
| P1 Party wall - Ground floor | 7.7570 | 0.0800 | 0.6206 | |

| | | |
|---|---|---|
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | 5.9209 (36) |
| Point Thermal bridges | (36a) = | 0.0000 |
| Total fabric heat loss | (33) + (36) + (36a) = | 36.6531 (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 30.5769 | 30.3475 | 30.1227 | 29.0668 | 28.8692 | 27.9495 | 27.9495 | 27.7792 | 28.3038 | 28.8692 | 29.2689 | 29.6867 | (38) |
| Heat transfer coeff | 67.2299 | 67.0006 | 66.7758 | 65.7198 | 65.5223 | 64.6026 | 64.6026 | 64.4323 | 64.9568 | 65.5223 | 65.9220 | 66.3398 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 65.7189 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.3175 | 1.3130 | 1.3086 | 1.2879 | 1.2840 | 1.2660 | 1.2660 | 1.2626 | 1.2729 | 1.2840 | 1.2918 | 1.3000 | (40) |
| HLP (average) | | | | | | | | | | | | 1.2878 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

## 4. Water heating energy requirements (kWh/year)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Assumed occupancy | | | | | | | | | | | | 1.7205 | (42) |
| Hot water usage for mixer showers | 53.0659 | 52.2684 | 51.1063 | 48.8829 | 47.2421 | 45.4122 | 44.3721 | 45.5254 | 46.7896 | 48.7543 | 51.0255 | 52.8626 | (42a) |
| Hot water usage for baths | 22.9433 | 22.6026 | 22.1227 | 21.2380 | 20.5755 | 19.8409 | 19.4442 | 19.9206 | 20.4394 | 21.2255 | 22.1284 | 22.8657 | (42b) |
| Hot water usage for other uses | 32.2492 | 31.0765 | 29.9038 | 28.7311 | 27.5584 | 26.3857 | 26.3857 | 27.5584 | 28.7311 | 29.9038 | 31.0765 | 32.2492 | (42c) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 99.5145 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 108.2584 | 105.9474 | 103.1328 | 98.8520 | 95.3760 | 91.6389 | 90.2020 | 93.0044 | 95.9602 | 99.8836 | 104.2304 | 107.9775 | (44) |
| Energy conte | 171.4548 | 150.8678 | 158.5113 | 135.3234 | 128.3944 | 112.6807 | 109.0915 | 115.1589 | 118.3285 | 135.5411 | 148.4953 | 169.0666 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1652.9143 | |
| Distribution loss (46)m = 0.15 x (45)m | 25.7182 | 22.6302 | 23.7767 | 20.2985 | 19.2592 | 16.9021 | 16.3637 | 17.2738 | 17.7493 | 20.3312 | 22.2743 | 25.3600 | (46) |
| Water storage loss: | | | | | | | | | | | | | |
| Store volume | | | | | | | | | | | | 150.0000 | (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | | | | | | | | | | | | 1.3938 | (48) |
| Temperature factor from Table 2b | | | | | | | | | | | | 0.5400 | (49) |
| Enter (49) or (54) in (55) | | | | | | | | | | | | 0.7527 | (55) |
| Total storage loss | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (56) |
| If cylinder contains dedicated solar storage | | | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (57) |
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | | | | | | | | | | | | | |
| | 218.0497 | 192.9535 | 205.1062 | 180.4153 | 174.9893 | 157.7725 | 155.6864 | 161.7538 | 163.4203 | 182.1360 | 193.5872 | 215.6615 | (62) |
| WWHRS | -24.2595 | -21.4553 | -22.4668 | -18.6034 | -17.3377 | -14.8360 | -13.9064 | -14.7880 | -15.3499 | -18.0958 | -20.5003 | -23.8103 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | | | | | | | | | | | | | |
| | 193.7902 | 171.4982 | 182.6395 | 161.8119 | 157.6516 | 142.9365 | 141.7800 | 146.9658 | 148.0704 | 164.0402 | 173.0868 | 191.8513 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 1976.1225 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 1976 | (64) |
| Electric shower(s) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | | | | | | | | | | | | | |
| | 94.2846 | 83.8321 | 89.9809 | 81.0685 | 79.9671 | 73.5398 | 73.5488 | 75.5663 | 75.4177 | 82.3433 | 85.4482 | 93.4906 | (65) |

## 5. Internal gains (see Table 5 and 5a)

| Metabolic gains (Table 5), Watts | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 86.0228 | 86.0228 | 86.0228 | 86.0228 | 86.0228 | 86.0228 | 86.0228 | 86.0228 | 86.0228 | 86.0228 | 86.0228 | 86.0228 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 77.1149 | 85.3772 | 77.1149 | 79.6854 | 77.1149 | 79.6854 | 77.1149 | 77.1149 | 79.6854 | 77.1149 | 79.6854 | 77.1149 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 149.9087 | 151.4643 | 147.5442 | 139.1990 | 128.6646 | 118.7638 | 112.1494 | 110.5938 | 114.5138 | 122.8591 | 133.3935 | 143.2943 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 31.6023 | 31.6023 | 31.6023 | 31.6023 | 31.6023 | 31.6023 | 31.6023 | 31.6023 | 31.6023 | 31.6023 | 31.6023 | 31.6023 | (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.0000 | 3.0000 | 3.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | | | | | | | | | | | | | |
| | -68.8182 | -68.8182 | -68.8182 | -68.8182 | -68.8182 | -68.8182 | -68.8182 | -68.8182 | -68.8182 | -68.8182 | -68.8182 | -68.8182 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 126.7267 | 124.7502 | 120.9421 | 112.5952 | 107.4826 | 102.1386 | 98.8560 | 101.5676 | 104.7468 | 110.6765 | 118.6780 | 125.6594 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 405.5571 | 413.3985 | 397.4081 | 383.2864 | 365.0689 | 349.3946 | 336.9271 | 338.0831 | 347.7528 | 362.4573 | 383.5637 | 397.8754 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Northeast | 6.1300 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 21.1375 | (75) |
| Southeast | 3.1400 | 36.7938 | 0.6300 | 0.7000 | 0.7700 | 35.3083 | (77) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 56.4458 | 103.1691 | 159.8097 | 229.2707 | 285.3339 | 295.8206 | 279.9799 | 236.2356 | 183.5616 | 119.0522 | 68.8877 | 47.4785 | (83) |
| Total gains | 462.0029 | 516.5676 | 557.2178 | 612.5571 | 650.4029 | 645.2152 | 616.9070 | 574.3187 | 531.3144 | 481.5095 | 452.4514 | 445.3539 | (84) |

## 7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 90.5308 | 90.8407 | 91.1465 | 92.6110 | 92.8902 | 94.2126 | 94.2126 | 94.4616 | 93.6988 | 92.8902 | 92.3270 | 91.7455 | |
| alpha | 7.0354 | 7.0560 | 7.0764 | 7.1741 | 7.1927 | 7.2808 | 7.2808 | 7.2974 | 7.2466 | 7.1927 | 7.1551 | 7.1164 | |
| util living area | | | | | | | | | | | | | |
| | 0.9989 | 0.9971 | 0.9914 | 0.9599 | 0.8475 | 0.6316 | 0.4599 | 0.5141 | 0.7926 | 0.9744 | 0.9967 | 0.9991 | (86) |
| MIT | 20.1306 | 20.2585 | 20.4527 | 20.7267 | 20.9232 | 20.9921 | 20.9993 | 20.9985 | 20.9642 | 20.7199 | 20.3864 | 20.1179 | (87) |
| Th 2 | 19.8272 | 19.8307 | 19.8341 | 19.8503 | 19.8534 | 19.8676 | 19.8676 | 19.8702 | 19.8621 | 19.8534 | 19.8472 | 19.8408 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9982 | 0.9954 | 0.9861 | 0.9360 | 0.7769 | 0.5250 | 0.3421 | 0.3891 | 0.6870 | 0.9538 | 0.9945 | 0.9986 | (89) |
| MIT 2 | 18.8441 | 19.0100 | 19.2584 | 19.6027 | 19.8044 | 19.8650 | 19.8675 | 19.8700 | 19.8464 | 19.6043 | 19.1867 | 18.8386 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.6439 | (91) |
| MIT | 19.6725 | 19.8140 | 20.0275 | 20.3265 | 20.5249 | 20.5908 | 20.5963 | 20.5967 | 20.5662 | 20.3227 | 19.9592 | 19.6624 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.6725 | 19.8140 | 20.0275 | 20.3265 | 20.5249 | 20.5908 | 20.5963 | 20.5967 | 20.5662 | 20.3227 | 19.9592 | 19.6624 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9981 | 0.9954 | 0.9872 | 0.9473 | 0.8206 | 0.5939 | 0.4181 | 0.4698 | 0.7553 | 0.9637 | 0.9947 | 0.9985 | (94) |
| Useful gains | 461.1157 | 514.1832 | 550.0805 | 580.2653 | 533.7081 | 383.2164 | 257.9062 | 269.8126 | 401.3094 | 464.0483 | 450.0757 | 444.6882 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | | | | | | | | | | | | | |
| | 1033.4915 | 999.2469 | 903.3063 | 750.9447 | 578.2246 | 387.0200 | 258.1706 | 270.4002 | 420.0233 | 637.0507 | 847.7045 | 1025.7719 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 425.8476 | 325.9628 | 262.8000 | 122.8892 | 33.1203 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 128.7138 | 286.2928 | 432.3263 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 2017.9527 | |
| Solar heating kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | | | | | | | | | | | | | |
| | 425.8476 | 325.9628 | 262.8000 | 122.8892 | 33.1203 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 128.7138 | 286.2928 | 432.3263 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 2017.9527 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 39.5444 | (99) |

## 9a. Energy requirements - Individual heating systems, including micro-CHP

| | | |
|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | 0.0000 | (201) |
| Fraction of space heat from main system(s) | 1.0000 | (202) |
| Efficiency of main space heating system 1 (in %) | 92.3000 | (206) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Efficiency of main space heating system 2 (in %) | | | | | | | | | | | | 0.0000 | (207) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 | (208) |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| Space heating requirement | | | | | | | | | | | | | |
| | 425.8476 | 325.9628 | 262.8000 | 122.8892 | 33.1203 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 128.7138 | 286.2928 | 432.3263 | (98) |
| Space heating efficiency (main heating system 1) | | | | | | | | | | | | | |
| | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.3000 | 92.3000 | 92.3000 | (210) |
| Space heating fuel (main heating system) | | | | | | | | | | | | | |
| | 461.3733 | 353.1558 | 284.7238 | 133.1410 | 35.8833 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 139.4516 | 310.1764 | 468.3925 | (211) |
| Space heating efficiency (main heating system 2) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (212) |
| Space heating fuel (main heating system 2) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (213) |
| Space heating fuel (secondary) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (215) |
| Water heating | | | | | | | | | | | | | |
| Water heating requirement | | | | | | | | | | | | | |
| | 193.7902 | 171.4982 | 182.6395 | 161.8119 | 157.6516 | 142.9365 | 141.7800 | 146.9658 | 148.0704 | 164.0402 | 173.0868 | 191.8513 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 | (216) |
| (217)m | 85.7745 | 85.4766 | 84.8751 | 83.4508 | 81.2293 | 79.8000 | 79.8000 | 79.8000 | 79.8000 | 83.5218 | 85.1803 | 85.8248 | (217) |
| Fuel for water heating, kWh/month | | | | | | | | | | | | | |
| | 225.9297 | 200.6376 | 215.1861 | 193.9010 | 194.0822 | 179.1185 | 177.6692 | 184.1677 | 185.5519 | 196.4041 | 203.2005 | 223.5382 | (219) |
| Space cooling fuel requirement | | | | | | | | | | | | | |
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (221) |
| Pumps and Fa | 7.3041 | 6.5973 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | (231) |
| Lighting | 16.0230 | 12.8542 | 11.5738 | 8.4795 | 6.5498 | 5.3512 | 5.9749 | 7.7664 | 10.0878 | 13.2358 | 14.9498 | 16.4683 | (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233a)m | -11.4185 | -17.1845 | -26.3529 | -31.6862 | -36.0143 | -34.3149 | -33.9147 | -31.1003 | -26.4629 | -20.5452 | -12.9385 | -9.7505 | (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233b)m | -3.5251 | -7.6268 | -15.5569 | -23.9572 | -32.2572 | -32.6092 | -32.2088 | -26.9900 | -19.4292 | -11.0799 | -4.7623 | -2.7710 | (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235d) |
| Annual totals kWh/year | | | | | | | | | | | | | |
| Space heating fuel - main system 1 | | | | | | | | | | | | 2186.2976 | (211) |
| Space heating fuel - main system 2 | | | | | | | | | | | | 0.0000 | (213) |
| Space heating fuel - secondary | | | | | | | | | | | | 0.0000 | (215) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 | |
| Water heating fuel used | | | | | | | | | | | | 2379.3868 | (219) |
| Space cooling fuel | | | | | | | | | | | | 0.0000 | (221) |
| Electricity for pumps and fans: | | | | | | | | | | | | | |
| Total electricity for the above, kWh/year | | | | | | | | | | | | 86.0000 | (231) |
| Electricity for lighting (calculated in Appendix L) | | | | | | | | | | | | 129.3144 | (232) |
| Energy saving/generation technologies (Appendices M ,N and Q) | | | | | | | | | | | | | |
| PV generation | | | | | | | | | | | | -504.4571 | (233) |
| Wind generation | | | | | | | | | | | | 0.0000 | (234) |
| Hydro-electric generation (Appendix N) | | | | | | | | | | | | 0.0000 | (235a) |
| Electricity generated - Micro CHP (Appendix N) | | | | | | | | | | | | 0.0000 | (235) |
| Appendix Q - special features | | | | | | | | | | | | | |
| Energy saved or generated | | | | | | | | | | | | -0.0000 | (236) |
| Energy used | | | | | | | | | | | | 0.0000 | (237) |
| Total delivered energy for all uses | | | | | | | | | | | | 4276.5417 | (238) |

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 2186.2976 | 0.2100 | 459.1225 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2379.3868 | 0.2100 | 499.6712 | (264) |
| Space and water heating | | | 958.7937 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 129.3144 | 0.1443 | 18.6641 | (268) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -291.6833 | 0.1332 | -38.8589 | |
| PV Unit electricity exported | -212.7739 | 0.1252 | -26.6359 | |
| Total | | | -65.4949 | (269) |
| Total CO2, kg/year | | | 923.8922 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 18.1000 | (273) |

13a. Primary energy - Individual heating systems including micro-CHP

| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 2186.2976 | 1.1300 | 2470.5163 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2379.3868 | 1.1300 | 2688.7071 | (278) |
| Space and water heating | | | 5159.2234 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 129.3144 | 1.5338 | 198.3467 | (282) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -291.6833 | 1.4923 | -435.2766 | |
| PV Unit electricity exported | -212.7739 | 0.4595 | -97.7652 | |
| Total | | | -533.0417 | (283) |
| Total Primary energy kWh/year | | | 4954.6292 | (286) |
| Target Primary Energy Rate (TPER) | | | 97.0900 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Property Reference** | Unit 9 | **Issued on Date** | 17/05/2025 |
| **Assessment Reference** | 00001 | **Prop Type Ref** | Unit 9 |
| **Property** | | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 78 C | **DER** | 5.41 | **TER** | 13.12 |
| **Environmental** | 95 A | **% DER < TER** | | | 58.77 |
| **$CO_2$ Emissions (t/year)** | 0.45 | **DFEE** | 37.56 | **TFEE** | 40.00 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 6.09 |
| **% DPER < TPER** | 18.16 | **DPER** | 57.03 | **TPER** | 69.69 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Robert Arnold | **Assessor ID** | BA04-0001 |
| **Client** | | | |

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SAP 10 WORKSHEET FOR New Build (As Designed)  (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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1. Overall dwelling characteristics

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| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | Area | | Storey height | | Volume | |
| Main dwelling | | (m2) | | (m) | | (m3) | |
| Ground floor | | 95.8300 | (1b) | x 2.9300 | (2b) = | 280.7819 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 95.8300 | | | | | | (4) |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | | 280.7819 | (5) |

---

2. Ventilation rate

---

| | | | |
|---|---|---|---|
| | | m3 per hour | |
| Number of open chimneys | 0 * 80 = | 0.0000 | (6a) |
| Number of open flues | 0 * 20 = | 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | 0 * 10 = | 0.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |
| | Air changes per hour | | |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 0.0000 / (5) = | 0.0000 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 3.0000 | (17) |
| Infiltration rate | | 0.1500 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.1500 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.1912 | 0.1875 | 0.1837 | 0.1650 | 0.1612 | 0.1425 | 0.1425 | 0.1388 | 0.1500 | 0.1612 | 0.1687 | 0.1762 | (22b) |

Balanced mechanical ventilation with heat recovery

| | | |
|---|---|---|
| If mechanical ventilation | 0.5000 | (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | 0.5000 | (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | 80.1000 | (23c) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective ac | 0.2907 | 0.2870 | 0.2833 | 0.2645 | 0.2607 | 0.2420 | 0.2420 | 0.2382 | 0.2495 | 0.2607 | 0.2682 | 0.2757 | (25) |

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3. Heat losses and heat loss parameter

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| Element | Gross | Openings | NetArea | U-value | A x U | K-value | A x K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | m2 | m2 | m2 | W/m2K | W/K | kJ/m2K | kJ/K | |
| Windows | | | 17.3200 | 1.0536 | 18.2490 | | | (27) |
| Front Door | | | 1.8900 | 1.4000 | 2.6460 | | | (26) |
| Glass Door | | | 2.2900 | 1.3258 | 3.0360 | | | (27) |
| Heatloss Floor 1 | | | 95.8300 | 0.1000 | 9.5830 | 110.0000 | 10541.3000 | (28a) |
| External Walls | 62.1900 | 19.6100 | 42.5800 | 0.1500 | 6.3870 | 150.0000 | 6387.0000 | (29a) |
| Wall to Communal Corridor | 5.1100 | 1.8900 | 3.2200 | 0.1500 | 0.4830 | 150.0000 | 483.0000 | (29a) |
| Total net area of external elements Aum(A, m2) | | | 163.1300 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 40.3840 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 2 | | | 32.9900 | 0.0000 | 0.0000 | 70.0000 | 2309.3000 | (32) |
| Party Wall to Unit 8 | | | 22.6900 | 0.0000 | 0.0000 | 70.0000 | 1588.3000 | (32) |
| Party Wall to Unit 1 | | | 12.8100 | 0.0000 | 0.0000 | 70.0000 | 896.7000 | (32) |
| Party Ceiling 1 | | | 95.8300 | | | 100.0000 | 9583.0000 | (32b) |
| Internal Walls | | | 213.5300 | | | 9.0000 | 1921.7700 | (32c) |

| | | |
|---|---|---|
| Heat capacity Cm = Sum(A x k) | (28)...(30) + (32) + (32a)...(32e) = | 33710.3700 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | | 351.7726 (35) |

List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E1 Steel lintel with perforated steel base plate | 10.6500 | 0.0500 | 0.5325 |
| E3 Sill | 4.5200 | 0.0500 | 0.2260 |
| E4 Jamb | 24.5800 | 0.0500 | 1.2290 |
| E5 Ground floor (normal) | 21.2200 | 0.1600 | 3.3952 |
| E16 Corner (normal) | 2.9300 | 0.0900 | 0.2637 |
| E18 Party wall between dwellings | 2.9300 | 0.0600 | 0.1758 |
| E25 Staggered party wall between dwellings | 8.7900 | 0.0600 | 0.5274 |
| E7 Party floor between dwellings (in blocks of flats) | 21.2200 | 0.0700 | 1.4854 |
| E7 Party floor between dwellings (in blocks of flats) | 1.7450 | 0.0350 | 0.0611 |
| P1 Party wall - Ground floor | 23.3770 | 0.0800 | 1.8702 |

| | | |
|---|---|---|
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | 9.7662 (36) |
| Point Thermal bridges | (36a) = | 0.0000 |
| Total fabric heat loss | (33) + (36) + (36a) = | 50.1503 (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 26.9403 | 26.5929 | 26.2454 | 24.5080 | 24.1606 | 22.4232 | 22.4232 | 22.0758 | 23.1182 | 24.1606 | 24.8555 | 25.5505 | (38) |
| Heat transfer coeff | 77.0906 | 76.7431 | 76.3956 | 74.6583 | 74.3108 | 72.5735 | 72.5735 | 72.2260 | 73.2684 | 74.3108 | 75.0058 | 75.7007 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 74.5714 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 0.8045 | 0.8008 | 0.7972 | 0.7791 | 0.7754 | 0.7573 | 0.7573 | 0.7537 | 0.7646 | 0.7754 | 0.7827 | 0.7899 | (40) |
| HLP (average) | | | | | | | | | | | | 0.7782 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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4. Water heating energy requirements (kWh/year)

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Assumed occupancy | | | | | | | | | | | | 2.6974 | (42) |
| Hot water usage for mixer showers | 67.6922 | 66.6558 | 65.1285 | 62.7789 | 60.6738 | 57.7288 | 55.3994 | 58.1226 | 59.4922 | 62.4091 | 65.4469 | 67.6311 | (42a) |
| Hot water usage for baths | 29.3191 | 28.8765 | 28.2469 | 27.3040 | 26.4542 | 25.2844 | 24.3969 | 25.4821 | 26.0517 | 27.2108 | 28.4159 | 29.2958 | (42b) |
| Hot water usage for other uses | 42.2543 | 40.7178 | 39.1813 | 37.6448 | 36.1082 | 34.5717 | 34.5717 | 36.1082 | 37.6448 | 39.1813 | 40.7178 | 42.2543 | (42c) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 128.0057 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 139.2656 | 136.2501 | 132.5566 | 127.7277 | 123.2363 | 117.5849 | 114.3680 | 119.7129 | 123.1886 | 128.8012 | 134.5806 | 139.1813 | (44) |
| Energy conte | 205.0230 | 180.2864 | 189.4207 | 166.8443 | 158.8024 | 135.9830 | 126.3800 | 140.9043 | 142.8927 | 165.9734 | 181.8901 | 204.3979 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1998.7982 | |
| Distribution loss (46)m = 0.15 x (45)m | 30.7534 | 27.0430 | 28.4131 | 25.0266 | 23.8204 | 20.3974 | 18.9570 | 21.1356 | 21.4339 | 24.8960 | 27.2835 | 30.6597 | (46) |
| Water storage loss: | | | | | | | | | | | | | |
| Store volume | | | | | | | | | | | | 110.0000 | (47) |
| b) If manufacturer declared loss factor is not known : | | | | | | | | | | | | | |
| Hot water storage loss factor from Table 2 (kWh/litre/day) | | | | | | | | | | | | 0.0152 | (51) |
| Volume factor from Table 2a | | | | | | | | | | | | 1.0294 | (52) |
| Temperature factor from Table 2b | | | | | | | | | | | | 0.6000 | (53) |
| Enter (49) or (54) in (55) | | | | | | | | | | | | 1.0327 | (55) |
| Total storage loss | 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (56) |
| If cylinder contains dedicated solar storage | 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (57) |
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | 260.2998 | 230.2139 | 244.6975 | 220.3379 | 214.0792 | 189.4767 | 181.6568 | 196.1811 | 196.3863 | 221.2502 | 235.3838 | 259.6747 | (62) |
| WWHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | 260.2998 | 230.2139 | 244.6975 | 220.3379 | 214.0792 | 189.4767 | 181.6568 | 196.1811 | 196.3863 | 221.2502 | 235.3838 | 259.6747 | (64) |
| | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | | 2649.6379 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2650 | (64) |
| Electric shower(s) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | 112.3916 | 99.8872 | 107.2038 | 98.2707 | 97.0232 | 88.0093 | 86.2428 | 91.0721 | 90.3068 | 99.4076 | 103.2734 | 112.1837 | (65) |

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5. Internal gains (see Table 5 and 5a)

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Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 134.8712 | 134.8712 | 134.8712 | 134.8712 | 134.8712 | 134.8712 | 134.8712 | 134.8712 | 134.8712 | 134.8712 | 134.8712 | 134.8712 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 126.4017 | 139.9448 | 126.4017 | 130.6151 | 126.4017 | 130.6151 | 126.4017 | 126.4017 | 130.6151 | 126.4017 | 130.6151 | 126.4017 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 249.4048 | 251.9928 | 245.4710 | 231.5869 | 214.0608 | 197.5886 | 186.5842 | 183.9962 | 190.5180 | 204.4021 | 221.9282 | 238.4004 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 36.4871 | 36.4871 | 36.4871 | 36.4871 | 36.4871 | 36.4871 | 36.4871 | 36.4871 | 36.4871 | 36.4871 | 36.4871 | 36.4871 | (69) |
| Pumps, fans | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | -107.8970 | -107.8970 | -107.8970 | -107.8970 | -107.8970 | -107.8970 | -107.8970 | -107.8970 | -107.8970 | -107.8970 | -107.8970 | -107.8970 | (71) |
| Water heating gains (Table 5) | 151.0640 | 148.6416 | 144.0912 | 136.4870 | 130.4076 | 122.2351 | 115.9177 | 122.4088 | 125.4260 | 133.6124 | 143.4353 | 150.7846 | (72) |
| Total internal gains | 590.3318 | 604.0406 | 579.4253 | 562.1505 | 534.3314 | 513.9002 | 492.3651 | 496.2681 | 510.0205 | 527.8775 | 559.4400 | 579.0481 | (73) |

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6. Solar gains

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| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W |
|---|---|---|---|---|---|---|

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northeast | | | | 9.8000 | 11.2829 | 0.4500 | 0.7000 | 0.7700 | | | | 24.1375 | (75) |
| Southeast | | | | 2.8200 | 36.7938 | 0.4500 | 0.7000 | 0.7700 | | | | 22.6500 | (77) |
| Southwest | | | | 4.7000 | 36.7938 | 0.4500 | 0.7000 | 0.7700 | | | | 37.7500 | (79) |
| Southeast | | | | 2.2900 | 36.7938 | 0.4500 | 0.7000 | 0.7700 | | | | 18.3931 | (77) |
| Solar gains | 102.9305 | 183.3463 | 272.1583 | 372.9125 | 450.2740 | 461.3491 | 438.8258 | 378.9196 | 306.7046 | 208.3786 | 124.7471 | 87.1423 | (83) |
| Total gains | 693.2624 | 787.3869 | 851.5836 | 935.0630 | 984.6055 | 975.2494 | 931.1909 | 875.1877 | 816.7251 | 736.2561 | 684.1871 | 666.1904 | (84) |

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| tau | 121.4674 | 122.0174 | 122.5723 | 125.4246 | 126.0111 | 129.0277 | 129.0277 | 129.6484 | 127.8039 | 126.0111 | 124.8436 | 123.6975 | |
| alpha | 9.0978 | 9.1345 | 9.1715 | 9.3616 | 9.4007 | 9.6018 | 9.6018 | 9.6432 | 9.5203 | 9.4007 | 9.3229 | 9.2465 | |
| util living area | 0.9983 | 0.9940 | 0.9777 | 0.8872 | 0.6942 | 0.4761 | 0.3429 | 0.3796 | 0.6165 | 0.9242 | 0.9931 | 0.9988 | (86) |
| MIT | 20.4710 | 20.5974 | 20.7553 | 20.9342 | 20.9932 | 20.9998 | 21.0000 | 21.0000 | 20.9982 | 20.9176 | 20.6763 | 20.4600 | (87) |
| Th 2 | 20.2495 | 20.2526 | 20.2558 | 20.2715 | 20.2747 | 20.2905 | 20.2905 | 20.2936 | 20.2841 | 20.2747 | 20.2684 | 20.2621 | (88) |
| util rest of house | 0.9976 | 0.9915 | 0.9688 | 0.8544 | 0.6433 | 0.4234 | 0.2876 | 0.3213 | 0.5539 | 0.8927 | 0.9897 | 0.9983 | (89) |
| MIT 2 | 19.6361 | 19.7991 | 19.9979 | 20.2142 | 20.2703 | 20.2904 | 20.2905 | 20.2936 | 20.2833 | 20.2041 | 19.9132 | 19.6326 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.4956 | (91) |
| MIT | 20.0499 | 20.1947 | 20.3732 | 20.5710 | 20.6286 | 20.6420 | 20.6421 | 20.6437 | 20.6376 | 20.5577 | 20.2914 | 20.0427 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 20.0499 | 20.1947 | 20.3732 | 20.5710 | 20.6286 | 20.6420 | 20.6421 | 20.6437 | 20.6376 | 20.5577 | 20.2914 | 20.0427 | (93) |

8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9974 | 0.9913 | 0.9704 | 0.8686 | 0.6684 | 0.4495 | 0.3150 | 0.3502 | 0.5850 | 0.9061 | 0.9899 | 0.9981 | (94) |
| Useful gains | 691.4399 | 780.5094 | 826.3610 | 812.2196 | 658.1079 | 438.3749 | 293.3455 | 306.4963 | 477.7617 | 667.1265 | 677.2599 | 664.8973 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | 1214.1663 | 1173.7635 | 1059.8551 | 871.3386 | 663.4893 | 438.4869 | 293.3485 | 306.5043 | 478.9981 | 739.9629 | 989.4291 | 1199.3008 | (97) |
| Space heating kWh | 388.9085 | 264.2668 | 173.7196 | 42.5656 | 4.0038 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 54.1903 | 224.7618 | 397.5962 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 1550.0125 | |
| Solar heating kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | 388.9085 | 264.2668 | 173.7196 | 42.5656 | 4.0038 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 54.1903 | 224.7618 | 397.5962 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 1550.0125 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 16.1746 | (99) |

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ext. temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | |
| Heat loss rate W | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 682.1909 | 537.0439 | 548.9179 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (100) |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.9954 | 0.9991 | 0.9981 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (101) |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 679.0194 | 536.5391 | 547.8800 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (102) |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 1075.7894 | 1027.6538 | 964.0124 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 285.6744 | 365.3894 | 309.6025 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (104) |
| Cooled fraction | | | | | | | | | fC = cooled area / (4) = | | | 0.9913 | (105) |
| Intermittency factor (Table 10b) | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | (106) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 70.8000 | 90.5562 | 76.7303 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) |
| Space cooling requirement | | | | | | | | | | | | 238.0864 | (107) |

9b. Energy requirements

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | 0.0000 | (301) |
| Fraction of space heat from community system | | | | | | | | | | | | 1.0000 | (302) |
| Fraction of heat from community Heat pump-Space and Water | | | | | | | | | | | | 1.0000 | (303a) |
| Factor for control and charging method (Table 4c(3)) for space heating | | | | | | | | | | | | 1.0000 | (305) |
| Factor for charging method (Table 4c(3)) for water heating | | | | | | | | | | | | 1.0000 | (305a) |
| Distribution loss factor (Table 12c) for community heating system | | | | | | | | | | | | 2.0000 | (306) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 | (208) |
| Space heating: | | | | | | | | | | | | | |
| Space heating requirement | 388.9085 | 264.2668 | 173.7196 | 42.5656 | 4.0038 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 54.1903 | 224.7618 | 397.5962 | (98) |
| Space heat from Heat pump = (98) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 307a | 777.8169 | 528.5336 | 347.4391 | 85.1313 | 8.0076 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 108.3805 | 449.5237 | 795.1923 | |
| Space heating requirement | 777.8169 | 528.5336 | 347.4391 | 85.1313 | 8.0076 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 108.3805 | 449.5237 | 795.1923 | (307) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | | | | | | | | | | | 0.0000 | (308) |
| Space heating fuel for secondary/supplementary system | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (309) |
| Water heating | | | | | | | | | | | | | |
| Annual water heating requirement | 260.2998 | 230.2139 | 244.6975 | 220.3379 | 214.0792 | 189.4767 | 181.6568 | 196.1811 | 196.3863 | 221.2502 | 235.3838 | 259.6747 | (64) |
| Water heat from Heat pump = (64) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 310a | 520.5996 | 460.4277 | 489.3950 | 440.6759 | 428.1584 | 378.9533 | 363.3137 | 392.3622 | 392.7727 | 442.5004 | 470.7676 | 519.3494 | |
| Water heating fuel | 520.5996 | 460.4277 | 489.3950 | 440.6759 | 428.1584 | 378.9533 | 363.3137 | 392.3622 | 392.7727 | 442.5004 | 470.7676 | 519.3494 | (310) |
| Cooling System Energy Efficiency Ratio | | | | | | | | | | | | 2.6000 | (314) |
| Space coolin | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 27.2308 | 34.8293 | 29.5116 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (315) |
| Pumps and Fa | 24.8460 | 22.4415 | 24.8460 | 24.0445 | 24.8460 | 24.0445 | 24.8460 | 24.8460 | 24.0445 | 24.8460 | 24.0445 | 24.8460 | (331) |
| Lighting | 29.3607 | 23.5543 | 21.2080 | 15.5379 | 12.0019 | 9.8057 | 10.9485 | 14.2313 | 18.4851 | 24.2534 | 27.3942 | 30.1767 | (332) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (333a)m | -4.8712 | -7.9605 | -13.3465 | -17.4553 | -21.0142 | -20.4503 | -20.1576 | -17.8476 | -14.2307 | -9.9967 | -5.7037 | -4.0816 (333a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (334a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (334a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (335a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (335a) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (333b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (333b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (334b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (334b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (335b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (335b) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - community heating | 3100.0250 | (307) |
| Space heating fuel - secondary | 0.0000 | (309) |
| Water heating fuel - community heating | 5299.2759 | (310) |
| Efficiency of water heater | 0.0000 | (311) |
| Electricity used for heat distribution | 31.0002 | (313) |
| Space cooling fuel | 91.5717 | (321) |
| | | |
| Electricity for pumps and fans: | | |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8540) | | |
| mechanical ventilation fans (SFP = 0.8540) | 292.5410 | (330a) |
| Total electricity for the above, kWh/year | 292.5410 | (331) |
| Electricity for lighting (calculated in Appendix L) | 236.9578 | (332) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -157.1159 | (333) |
| Wind generation | 0.0000 | (334) |
| Hydro-electric generation (Appendix N) | 0.0000 | (335a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (335) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (336) |
| Energy used | 0.0000 | (337) |
| Total delivered energy for all uses | 8863.2555 | (338) |

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12b. Carbon dioxide emissions - Community heating scheme

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (367) |
| Space and Water heating from Heat pump | 2999.7503 | 0.1581 | 174.9902 | (367) |
| Electrical energy for heat distribution (space & water) | 31.0002 | 0.0000 | 12.3649 | (372) |
| Overall CO2 factor for heat network | | | 0.0540 | (386) |
| Total CO2 associated with community systems | | | 453.9702 | (373) |
| Space and water heating | | | 453.9702 | (376) |
| Space cooling | 91.5717 | 0.1140 | 10.4390 | (377) |
| Pumps, fans and electric keep-hot | 292.5410 | 0.1387 | 40.5790 | (378) |
| Energy for lighting | 236.9578 | 0.1443 | 34.2003 | (379) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -157.1159 | 0.1317 | -20.6924 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -20.6924 | (380) |
| Total CO2, kg/year | | | 518.4963 | (383) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 5.4100 | (384) |

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13b. Primary energy - Community heating scheme

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| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (467a) |
| Space and Water heating from Heat pump | 2999.7503 | 1.5851 | 1754.9321 | (467) |
| Electrical energy for heat distribution (space & water) | 31.0002 | 0.0000 | 129.7344 | (472) |
| Overall CO2 factor for heat network | | | 0.5671 | (486) |
| Total CO2 associated with community systems | | | 4763.1063 | (473) |
| Space and water heating | | | 4763.1063 | (476) |
| Space cooling | 91.5717 | 1.4202 | 130.0488 | (477) |
| Pumps, fans and electric keep-hot | 292.5410 | 1.5128 | 442.5561 | (478) |
| Energy for lighting | 236.9578 | 1.5338 | 363.4537 | (479) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -157.1159 | 1.4866 | -233.5651 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -233.5651 | (480) |
| Total Primary energy kWh/year | | | 5465.5998 | (483) |
| Dwelling Primary energy Rate (DPER) | | | 57.0300 | (484) |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

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| | | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | |
| Ground floor | | 95.8300 (1b) | x | 2.9300 (2b) | = | 280.7819 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 95.8300 | | | | | | (4) |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = | 280.7819 | (5) |

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2. Ventilation rate

| | | |
|---|---|---|
| | m3 per hour | |
| Number of open chimneys | 0 * 80 = | 0.0000 (6a) |
| Number of open flues | 0 * 20 = | 0.0000 (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 (6f) |
| Number of intermittent extract fans | 3 * 10 = | 30.0000 (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 (7c) |
| | Air changes per hour | |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 30.0000 / (5) = | 0.1068 (8) |
| Pressure test | | Yes |
| Pressure Test Method | | Blower Door |
| Measured/design AP50 | | 5.0000 (17) |
| Infiltration rate | | 0.3568 (18) |
| Number of sides sheltered | | 0 (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.3568 (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.4550 | 0.4461 | 0.4371 | 0.3925 | 0.3836 | 0.3390 | 0.3390 | 0.3301 | 0.3568 | 0.3836 | 0.4015 | 0.4193 | (22b) |
| Effective ac | 0.6035 | 0.5995 | 0.5955 | 0.5770 | 0.5736 | 0.5575 | 0.5575 | 0.5545 | 0.5637 | 0.5736 | 0.5806 | 0.5879 | (25) |

## 3. Heat losses and heat loss parameter

| Element | Gross | Openings | NetArea | U-value | A x U | K-value | A x K | |
|---|---|---|---|---|---|---|---|---|
| | m2 | m2 | m2 | W/m2K | W/K | kJ/m2K | kJ/K | |
| Main dwelling | | | | | | | | |
| TER Opaque door | | | 1.8900 | 1.0000 | 1.8900 | | | (26) |
| TER Opening Type | | | 19.6100 | 1.1450 | 22.4542 | | | (27) |
| Heatloss Floor 1 | | | 95.8300 | 0.1300 | 12.4579 | | | (28a) |
| External Walls | 62.1900 | 19.6100 | 42.5800 | 0.1800 | 7.6644 | | | (29a) |
| Wall to Communal Corridor | 5.1100 | 1.8900 | 3.2200 | 0.1800 | 0.5796 | | | (29a) |
| Total net area of external elements Aum(A, m2) | | | 163.1300 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | | (26)...(30) + (32) = | 45.0461 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 2 | | | 32.9900 | 0.0000 | 0.0000 | | | (32) |
| Party Wall to Unit 8 | | | 22.6900 | 0.0000 | 0.0000 | | | (32) |
| Party Wall to Unit 1 | | | 12.8100 | 0.0000 | 0.0000 | | | (32) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 331.7726 (35)

List of Thermal Bridges

| K1 Element | Length | Psi-value | Total |
|---|---|---|---|
| E1 Steel lintel with perforated steel base plate | 10.6500 | 0.0500 | 0.5325 |
| E3 Sill | 4.5200 | 0.0500 | 0.2260 |
| E4 Jamb | 24.5800 | 0.0500 | 1.2290 |
| E5 Ground floor (normal) | 21.2200 | 0.1600 | 3.3952 |
| E16 Corner (normal) | 2.9300 | 0.0900 | 0.2637 |
| E18 Party wall between dwellings | 2.9300 | 0.0600 | 0.1758 |
| E25 Staggered party wall between dwellings | 8.7900 | 0.0600 | 0.5274 |
| E7 Party floor between dwellings (in blocks of flats) | 21.2200 | 0.0700 | 1.4854 |
| E7 Party floor between dwellings (in blocks of flats) | 1.7450 | 0.0700 | 0.1222 |
| P1 Party wall - Ground floor | 23.3770 | 0.0800 | 1.8702 |

| | | |
|---|---|---|
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | 9.8273 (36) |
| Point Thermal bridges | (36a) = | 0.0000 |
| Total fabric heat loss | (33) + (36) + (36a) = | 54.8734 (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 55.9193 | 55.5469 | 55.1819 | 53.4673 | 53.1466 | 51.6533 | 51.6533 | 51.3767 | 52.2285 | 53.1466 | 53.7955 | 54.4739 | (38) |
| Heat transfer coeff | 110.7927 | 110.4203 | 110.0553 | 108.3407 | 108.0200 | 106.5267 | 106.5267 | 106.2501 | 107.1019 | 108.0200 | 108.6689 | 109.3473 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 108.3392 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.1561 | 1.1523 | 1.1484 | 1.1306 | 1.1272 | 1.1116 | 1.1116 | 1.1087 | 1.1176 | 1.1272 | 1.1340 | 1.1411 | (40) |
| HLP (average) | | | | | | | | | | | | 1.1305 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

## 4. Water heating energy requirements (kWh/year)

| | | |
|---|---|---|
| Assumed occupancy | | 2.6974 (42) |

Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 69.4467 | 68.4031 | 66.8823 | 63.9725 | 61.8251 | 59.4304 | 58.0693 | 59.5786 | 61.2331 | 63.8042 | 66.7765 | 69.1806 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 29.9876 | 29.5422 | 28.9151 | 27.7587 | 26.8928 | 25.9327 | 25.4141 | 26.0369 | 26.7150 | 27.7423 | 28.9225 | 29.8862 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 42.2543 | 40.7178 | 39.1813 | 37.6448 | 36.1082 | 34.5717 | 34.5717 | 36.1082 | 37.6448 | 39.1813 | 40.7178 | 42.2543 | (42c) |

| | | |
|---|---|---|
| Average daily hot water use (litres/day) | | 130.2438 (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 141.6886 | 138.6631 | 134.9786 | 129.3760 | 124.8262 | 119.9349 | 118.0551 | 121.7237 | 125.5928 | 130.7278 | 136.4168 | 141.3212 | (44) |
| Energy conte | 224.4002 | 197.4544 | 207.4571 | 177.1092 | 168.0401 | 147.4739 | 142.7775 | 150.7194 | 154.8685 | 177.3964 | 194.3508 | 221.2748 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 2163.3222 | |
| Distribution loss (46)m = 0.15 x (45)m | 33.6600 | 29.6182 | 31.1186 | 26.5664 | 25.2060 | 22.1211 | 21.4166 | 22.6079 | 23.2303 | 26.6095 | 29.1526 | 33.1912 | (46) |

| | | |
|---|---|---|
| Water storage loss: | | |
| Store volume | | 150.0000 (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | | 1.3938 (48) |
| Temperature factor from Table 2b | | 0.5400 (49) |
| Enter (49) or (54) in (55) | | 0.7527 (55) |

Total storage loss

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (56) |

If cylinder contains dedicated solar storage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (57) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | | | | | | | | | | | | | |
| | 270.9951 | 239.5401 | 254.0520 | 222.2011 | 214.6350 | 192.5658 | 189.3724 | 197.3143 | 199.9603 | 223.9913 | 239.4426 | 267.8697 | (62) |
| WWHRS | -31.7481 | -28.0783 | -29.4020 | -24.3460 | -22.6896 | -19.4157 | -18.1991 | -19.3529 | -20.0882 | -23.6818 | -26.8286 | -31.1602 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | | | | | | | | | | | | | |
| | 239.2469 | 211.4618 | 224.6500 | 197.8550 | 191.9454 | 173.1501 | 171.1733 | 177.9614 | 179.8721 | 200.3096 | 212.6140 | 236.7095 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2416.9492 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2417 | (64) |
| Electric shower(s) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | | | | | | | | | | | | | |
| | 111.8890 | 99.3222 | 106.2554 | 94.9623 | 93.1492 | 85.1086 | 84.7494 | 87.3901 | 87.5672 | 96.2602 | 100.6951 | 110.8498 | (65) |

## 5. Internal gains (see Table 5 and 5a)

| Metabolic gains (Table 5), Watts | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 134.8712 | 134.8712 | 134.8712 | 134.8712 | 134.8712 | 134.8712 | 134.8712 | 134.8712 | 134.8712 | 134.8712 | 134.8712 | 134.8712 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 126.4017 | 139.9448 | 126.4017 | 130.6151 | 126.4017 | 130.6151 | 126.4017 | 126.4017 | 130.6151 | 126.4017 | 130.6151 | 126.4017 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 249.4048 | 251.9928 | 245.4710 | 231.5869 | 214.0608 | 197.5886 | 186.5842 | 183.9962 | 190.5180 | 204.4021 | 221.9282 | 238.4004 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 36.4871 | 36.4871 | 36.4871 | 36.4871 | 36.4871 | 36.4871 | 36.4871 | 36.4871 | 36.4871 | 36.4871 | 36.4871 | 36.4871 | (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.0000 | 3.0000 | 3.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | | | | | | | | | | | | | |
| | -107.8970 | -107.8970 | -107.8970 | -107.8970 | -107.8970 | -107.8970 | -107.8970 | -107.8970 | -107.8970 | -107.8970 | -107.8970 | -107.8970 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 150.3884 | 147.8008 | 142.8164 | 131.8921 | 125.2006 | 118.2063 | 113.9105 | 117.4598 | 121.6212 | 129.3820 | 139.8543 | 148.9917 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 592.6563 | 606.1998 | 581.1506 | 560.5555 | 532.1245 | 509.8714 | 490.3578 | 491.3191 | 506.2156 | 526.6472 | 558.8590 | 580.2551 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Northeast | 9.8000 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 33.7925 | (75) |
| Southeast | 5.1100 | 36.7938 | 0.6300 | 0.7000 | 0.7700 | 57.4603 | (77) |
| Southwest | 4.7000 | 36.7938 | 0.6300 | 0.7000 | 0.7700 | 52.8500 | (79) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 144.1027 | 256.6848 | 381.0216 | 522.0775 | 630.3836 | 645.8888 | 614.3561 | 530.4875 | 429.3864 | 291.7301 | 174.6460 | 121.9992 | (83) |
| Total gains | 736.7590 | 862.8846 | 962.1722 | 1082.6330 | 1162.5081 | 1155.7602 | 1104.7139 | 1021.8066 | 935.6021 | 818.3773 | 733.5050 | 702.2544 | (84) |

## 7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 79.7129 | 79.9817 | 80.2470 | 81.5169 | 81.7590 | 82.9051 | 82.9051 | 83.1209 | 82.4598 | 81.7590 | 81.2707 | 80.7665 | |
| alpha | 6.3142 | 6.3321 | 6.3498 | 6.4345 | 6.4506 | 6.5270 | 6.5270 | 6.5414 | 6.4973 | 6.4506 | 6.4180 | 6.3844 | |
| util living area | | | | | | | | | | | | | |
| | 0.9982 | 0.9947 | 0.9836 | 0.9330 | 0.7951 | 0.5820 | 0.4234 | 0.4763 | 0.7467 | 0.9612 | 0.9950 | 0.9987 | (86) |
| MIT | 20.0100 | 20.1830 | 20.4227 | 20.7319 | 20.9284 | 20.9919 | 20.9991 | 20.9982 | 20.9639 | 20.6996 | 20.3045 | 19.9893 | (87) |
| Th 2 | 19.9552 | 19.9584 | 19.9615 | 19.9760 | 19.9787 | 19.9914 | 19.9914 | 19.9937 | 19.9865 | 19.9787 | 19.9732 | 19.9674 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9974 | 0.9924 | 0.9764 | 0.9057 | 0.7312 | 0.4943 | 0.3269 | 0.3733 | 0.6560 | 0.9391 | 0.9924 | 0.9981 | (89) |
| MIT 2 | 18.8162 | 19.0390 | 19.3431 | 19.7250 | 19.9280 | 19.9879 | 19.9912 | 19.9933 | 19.9673 | 19.6988 | 19.2061 | 18.7990 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.4956 | (91) |
| MIT | 19.4078 | 19.6059 | 19.8781 | 20.2240 | 20.4238 | 20.4854 | 20.4907 | 20.4913 | 20.4612 | 20.1948 | 19.7505 | 19.3888 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.4078 | 19.6059 | 19.8781 | 20.2240 | 20.4238 | 20.4854 | 20.4907 | 20.4913 | 20.4612 | 20.1948 | 19.7505 | 19.3888 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9968 | 0.9914 | 0.9757 | 0.9131 | 0.7605 | 0.5378 | 0.3748 | 0.4245 | 0.7004 | 0.9446 | 0.9916 | 0.9976 | (94) |
| Useful gains | 734.4354 | 855.4326 | 938.7683 | 988.6039 | 884.0941 | 621.6061 | 414.0284 | 433.7630 | 655.3055 | 773.0634 | 727.3756 | 700.5879 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | | | | | | | | | | | | | |
| | 1673.8367 | 1623.8325 | 1472.3331 | 1226.8455 | 942.3444 | 626.9550 | 414.4594 | 434.6967 | 681.2966 | 1036.4294 | 1374.7125 | 1660.8590 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 698.9146 | 516.3648 | 396.9722 | 171.5339 | 43.3382 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 195.9443 | 466.0826 | 714.4417 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 3203.5924 | |
| Solar heating kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | | | | | | | | | | | | | |
| | 698.9146 | 516.3648 | 396.9722 | 171.5339 | 43.3382 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 195.9443 | 466.0826 | 714.4417 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 3203.5924 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 33.4300 | (99) |

## 9a. Energy requirements - Individual heating systems, including micro-CHP

| | | |
|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | 0.0000 | (201) |
| Fraction of space heat from main system(s) | 1.0000 | (202) |
| Efficiency of main space heating system 1 (in %) | 92.3000 | (206) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Efficiency of main space heating system 2 (in %) | | | | | | | | | | | | 0.0000 | (207) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 | (208) |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| Space heating requirement | | | | | | | | | | | | | |
| | 698.9146 | 516.3648 | 396.9722 | 171.5339 | 43.3382 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 195.9443 | 466.0826 | 714.4417 | (98) |
| Space heating efficiency (main heating system 1) | | | | | | | | | | | | | |
| | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.3000 | 92.3000 | 92.3000 | (210) |
| Space heating fuel (main heating system) | | | | | | | | | | | | | |
| | 757.2205 | 559.4418 | 430.0891 | 185.8439 | 46.9537 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 212.2907 | 504.9649 | 774.0430 | (211) |
| Space heating efficiency (main heating system 2) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (212) |
| Space heating fuel (main heating system 2) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (213) |
| Space heating fuel (secondary) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (215) |
| Water heating | | | | | | | | | | | | | |
| Water heating requirement | | | | | | | | | | | | | |
| | 239.2469 | 211.4618 | 224.6500 | 197.8550 | 191.9454 | 173.1501 | 171.1733 | 177.9614 | 179.8721 | 200.3096 | 212.6140 | 236.7095 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 | (216) |
| (217)m | 86.3174 | 85.9826 | 85.3224 | 83.7413 | 81.3181 | 79.8000 | 79.8000 | 79.8000 | 79.8000 | 84.0104 | 85.7697 | 86.3756 | (217) |
| Fuel for water heating, kWh/month | | | | | | | | | | | | | |
| | 277.1711 | 245.9357 | 263.2955 | 236.2695 | 236.0427 | 216.9801 | 214.5028 | 223.0093 | 225.4036 | 238.4343 | 247.8895 | 274.0466 | (219) |
| Space cooling fuel requirement | | | | | | | | | | | | | |
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (221) |
| Pumps and Fa | 7.3041 | 6.5973 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | (231) |
| Lighting | 26.2638 | 21.0698 | 18.9710 | 13.8990 | 10.7360 | 8.7714 | 9.7937 | 12.7302 | 16.5353 | 21.6952 | 24.5047 | 26.9937 | (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233a)m | -20.9535 | -31.2705 | -47.5434 | -56.6333 | -63.8608 | -60.6133 | -59.8551 | -55.1044 | -47.2435 | -37.1130 | -23.6358 | -17.9182 | (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233b)m | -7.1093 | -15.3229 | -31.1596 | -47.8603 | -64.3472 | -65.0645 | -64.3192 | -53.9843 | -38.9381 | -22.2762 | -9.6049 | -5.5962 | (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235d) |
| Annual totals kWh/year | | | | | | | | | | | | | |
| Space heating fuel - main system 1 | | | | | | | | | | | | 3470.8477 | (211) |
| Space heating fuel - main system 2 | | | | | | | | | | | | 0.0000 | (213) |
| Space heating fuel - secondary | | | | | | | | | | | | 0.0000 | (215) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 | |
| Water heating fuel used | | | | | | | | | | | | 2898.9808 | (219) |
| Space cooling fuel | | | | | | | | | | | | 0.0000 | (221) |
| Electricity for pumps and fans: | | | | | | | | | | | | | |
| Total electricity for the above, kWh/year | | | | | | | | | | | | 86.0000 | (231) |
| Electricity for lighting (calculated in Appendix L) | | | | | | | | | | | | 211.9638 | (232) |
| Energy saving/generation technologies (Appendices M ,N and Q) | | | | | | | | | | | | | |
| PV generation | | | | | | | | | | | | -947.3276 | (233) |
| Wind generation | | | | | | | | | | | | 0.0000 | (234) |
| Hydro-electric generation (Appendix N) | | | | | | | | | | | | 0.0000 | (235a) |
| Electricity generated - Micro CHP (Appendix N) | | | | | | | | | | | | 0.0000 | (235) |
| Appendix Q - special features | | | | | | | | | | | | | |
| Energy saved or generated | | | | | | | | | | | | -0.0000 | (236) |
| Energy used | | | | | | | | | | | | 0.0000 | (237) |
| Total delivered energy for all uses | | | | | | | | | | | | 5720.4647 | (238) |

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 3470.8477 | 0.2100 | 728.8780 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2898.9808 | 0.2100 | 608.7860 | (264) |
| Space and water heating | | | 1337.6640 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 211.9638 | 0.1443 | 30.5929 | (268) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -521.7448 | 0.1334 | -69.6110 | |
| PV Unit electricity exported | -425.5828 | 0.1252 | -53.2989 | |
| Total | | | -122.9098 | (269) |
| Total CO2, kg/year | | | 1257.2763 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 13.1200 | (273) |

13a. Primary energy - Individual heating systems including micro-CHP

| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 3470.8477 | 1.1300 | 3922.0579 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2898.9808 | 1.1300 | 3275.8483 | (278) |
| Space and water heating | | | 7197.9062 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 211.9638 | 1.5338 | 325.1171 | (282) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -521.7448 | 1.4930 | -778.9805 | |
| PV Unit electricity exported | -425.5828 | 0.4597 | -195.6297 | |
| Total | | | -974.6102 | (283) |
| Total Primary energy kWh/year | | | 6678.5139 | (286) |
| Target Primary Energy Rate (TPER) | | | 69.6900 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Property Reference** | Unit 10 | **Issued on Date** | 17/05/2025 |
| **Assessment Reference** | 00001 | **Prop Type Ref** | Unit 10 |
| **Property** | | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 75 C | **DER** | 7.37 | **TER** | 17.44 |
| **Environmental** | 95 A | **% DER < TER** | | | 57.74 |
| **$CO_2$ Emissions (t/year)** | 0.36 | **DFEE** | 46.88 | **TFEE** | 47.64 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 1.58 |
| **% DPER < TPER** | 16.71 | **DPER** | 77.80 | **TPER** | 93.40 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Robert Arnold | **Assessor ID** | BA04-0001 |
| **Client** | | | |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

## 1. Overall dwelling characteristics

| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 55.2800 | (1b) | x 3.0000 | (2b) = | 165.8400 | (1b) - (3b) (4) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 55.2800 | | | | | |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | | 165.8400 | (5) |

## 2. Ventilation rate

| | m3 per hour | |
|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 (6a) |
| Number of open flues | 0 * 20 = | 0.0000 (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 (6f) |
| Number of intermittent extract fans | 0 * 10 = | 0.0000 (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 (7c) |
| | Air changes per hour | |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 0.0000 / (5) = | 0.0000 (8) |
| Pressure test | | Yes |
| Pressure Test Method | | Blower Door |
| Measured/design AP50 | | 3.0000 (17) |
| Infiltration rate | | 0.1500 (18) |
| Number of sides sheltered | | 0 (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.1500 (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.1912 | 0.1875 | 0.1837 | 0.1650 | 0.1612 | 0.1425 | 0.1425 | 0.1388 | 0.1500 | 0.1612 | 0.1687 | 0.1762 | (22b) |
| Balanced mechanical ventilation with heat recovery | | | | | | | | | | | | | |
| If mechanical ventilation | | | | | | | | | | | | 0.5000 | (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | | | | | | | | | | | | 0.5000 | (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | | | | | | | | | | | | 81.0000 | (23c) |
| Effective ac | 0.2862 | 0.2825 | 0.2787 | 0.2600 | 0.2562 | 0.2375 | 0.2375 | 0.2337 | 0.2450 | 0.2562 | 0.2637 | 0.2712 | (25) |

## 3. Heat losses and heat loss parameter

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| Windows | | | 11.7100 | 1.0536 | 12.3381 | | | (27) |
| Door | | | 1.8900 | 1.4000 | 2.6460 | | | (26) |
| Glass Door | | | 4.9700 | 1.3258 | 6.5890 | | | (27) |
| Exposed Floor | | | 16.6800 | 0.1000 | 1.6680 | 0.0000 | 0.0000 | (28b) |
| Floor over Communal below | | | 34.4600 | 0.0952 | 3.2819 | 0.0000 | 0.0000 | (28b) |
| External Walls | 51.5600 | 16.6800 | 34.8800 | 0.1500 | 5.2320 | 150.0000 | 5232.0000 | (29a) |
| Wall to Communal | 6.3000 | 1.8900 | 4.4100 | 0.1400 | 0.6174 | 150.0000 | 661.5000 | (29a) |
| Total net area of external elements Aum(A, m2) | | | 109.0000 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 32.3724 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 3 | | | 15.1500 | 0.0000 | 0.0000 | 110.0000 | 1666.5000 | (32) |
| Party Wall to Unit 4 | | | 19.6100 | 0.0000 | 0.0000 | 110.0000 | 2157.1000 | (32) |
| Party Ceiling 1 | | | 55.2800 | | | 100.0000 | 5528.0000 | (32b) |
| Internal Walls | | | 98.3900 | | | 9.0000 | 885.5100 | (32c) |

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 16130.6100 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 291.7983 (35)
List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E1 Steel lintel with perforated steel base plate | 8.3000 | 0.0500 | 0.4150 |
| E4 Jamb | 31.2000 | 0.0500 | 1.5600 |
| E7 Party floor between dwellings (in blocks of flats) | 11.0000 | 0.0350 | 0.3850 |
| E16 Corner (normal) | 6.0000 | 0.0900 | 0.5400 |
| E21 Exposed floor (inverted) | 9.1600 | 0.3200 | 2.9312 |
| E20 Exposed floor (normal) | 13.9300 | 0.3200 | 4.4576 |
| E23 Balcony within or between dwellings, balcony support penetrates wall insulation | 6.4320 | 0.0200 | 0.1286 |
| E7 Party floor between dwellings (in blocks of flats) | 2.1000 | 0.0350 | 0.0735 |
| E25 Staggered party wall between dwellings | 6.0000 | 0.0300 | 0.1800 |
| E17 Corner (inverted - internal area greater than external area) | 3.0000 | -0.0900 | -0.2700 |
| P8 Party Wall - Exposed floor (inverted) | 1.5000 | 0.2500 | 0.3750 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 10.7759 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 43.1484 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 15.6657 | 15.4604 | 15.2552 | 14.2291 | 14.0238 | 12.9977 | 12.9977 | 12.7925 | 13.4082 | 14.0238 | 14.4343 | 14.8448 | (38) |
| Heat transfer coeff | 58.8140 | 58.6088 | 58.4036 | 57.3775 | 57.1722 | 56.1461 | 56.1461 | 55.9409 | 56.5565 | 57.1722 | 57.5827 | 57.9931 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 57.3261 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.0639 | 1.0602 | 1.0565 | 1.0379 | 1.0342 | 1.0157 | 1.0157 | 1.0120 | 1.0231 | 1.0342 | 1.0417 | 1.0491 | (40) |
| HLP (average) | | | | | | | | | | | | 1.0370 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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4. Water heating energy requirements (kWh/year)

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Assumed occupancy 1.8456 (42)
Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 53.7698 | 52.9466 | 51.7334 | 49.8671 | 48.1949 | 45.8556 | 44.0053 | 46.1684 | 47.2563 | 49.5733 | 51.9863 | 53.7213 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.3138 | 22.9618 | 22.4612 | 21.7114 | 21.0357 | 20.1055 | 19.3997 | 20.2627 | 20.7156 | 21.6373 | 22.5956 | 23.2953 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 33.5304 | 32.3111 | 31.0918 | 29.8725 | 28.6532 | 27.4339 | 27.4339 | 28.6532 | 29.8725 | 31.0918 | 32.3111 | 33.5304 | (42c) |

Average daily hot water use (litres/day) 101.6711 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 110.6139 | 108.2195 | 105.2864 | 101.4510 | 97.8838 | 93.3950 | 90.8390 | 95.0843 | 97.8445 | 102.3024 | 106.8930 | 110.5469 | (44) |
| Energy conte | 162.8428 | 143.1963 | 150.4520 | 132.5203 | 126.1332 | 108.0082 | 100.3798 | 111.9160 | 113.4947 | 131.8270 | 144.4694 | 162.3463 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1587.5860 | |
| Distribution loss (46)m = 0.15 x (45)m | 24.4264 | 21.4794 | 22.5678 | 19.8781 | 18.9200 | 16.2012 | 15.0570 | 16.7874 | 17.0242 | 19.7741 | 21.6704 | 24.3519 | (46) |

Water storage loss:
Store volume 110.0000 (47)
b) If manufacturer declared loss factor is not known :
Hot water storage loss factor from Table 2 (kWh/litre/day) 0.0152 (51)
Volume factor from Table 2a 1.0294 (52)
Temperature factor from Table 2b 0.6000 (53)
Enter (49) or (54) in (55) 1.0327 (55)
Total storage loss

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (56) |

If cylinder contains dedicated solar storage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (57) |
| Primary loss 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |

Total heat required for water heating calculated for each month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 218.1196 | 193.1237 | 205.7288 | 186.0140 | 181.4100 | 161.5019 | 155.6566 | 167.1928 | 166.9884 | 187.1038 | 197.9631 | 217.6231 | (62) |
| WWHRS 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63a) |
| PV diverter -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |

Output from w/h

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 218.1196 | 193.1237 | 205.7288 | 186.0140 | 181.4100 | 161.5019 | 155.6566 | 167.1928 | 166.9884 | 187.1038 | 197.9631 | 217.6231 | (64) |
| | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2238.4258 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | 2238 | (64) |

Electric shower(s)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)

Heat gains from water heating, kWh/month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 98.3667 | 87.5547 | 94.2467 | 86.8580 | 86.1607 | 78.7077 | 77.5977 | 81.4335 | 80.5319 | 88.0539 | 90.8310 | 98.2016 | (65) |

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5. Internal gains (see Table 5 and 5a)

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Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 92.2779 | 92.2779 | 92.2779 | 92.2779 | 92.2779 | 92.2779 | 92.2779 | 92.2779 | 92.2779 | 92.2779 | 92.2779 | 92.2779 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 81.1591 | 89.8547 | 81.1591 | 83.8644 | 81.1591 | 83.8644 | 81.1591 | 81.1591 | 83.8644 | 81.1591 | 83.8644 | 81.1591 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 160.9069 | 162.5766 | 158.3690 | 149.4115 | 138.1042 | 127.4770 | 120.3774 | 118.7077 | 122.9153 | 131.8728 | 143.1801 | 153.8073 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 32.2278 | 32.2278 | 32.2278 | 32.2278 | 32.2278 | 32.2278 | 32.2278 | 32.2278 | 32.2278 | 32.2278 | 32.2278 | 32.2278 | (69) |
| Pumps, fans 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | -73.8224 | -73.8224 | -73.8224 | -73.8224 | -73.8224 | -73.8224 | -73.8224 | -73.8224 | -73.8224 | -73.8224 | -73.8224 | -73.8224 | (71) |
| Water heating gains (Table 5) | 132.2133 | 130.2897 | 126.6757 | 120.6361 | 115.8074 | 109.3162 | 104.2980 | 109.4536 | 111.8499 | 118.3521 | 126.1542 | 131.9914 | (72) |
| Total internal gains | 424.9627 | 433.4045 | 416.8872 | 404.5953 | 385.7541 | 371.3410 | 356.5178 | 360.0038 | 369.3129 | 382.0673 | 403.8820 | 417.6411 | (73) |

---

6. Solar gains

---

| [Jan] | Area m2 | Solar flux Table 6a | g Specific data | FF Specific data | Access factor | Gains W |
|---|---|---|---|---|---|---|

| | | W/m2 | or Table 6b | or Table 6c | Table 6d | | |
|---|---|---|---|---|---|---|---|
| Southeast | 1.5500 | 36.7938 | 0.4500 | 0.7000 | 0.7700 | 12.4495 | (77) |
| Southwest | 3.5000 | 36.7938 | 0.4500 | 0.7000 | 0.7700 | 28.1117 | (79) |
| Northwest | 6.6600 | 11.2829 | 0.4500 | 0.7000 | 0.7700 | 16.4036 | (81) |
| Southwest | 4.9700 | 36.7938 | 0.4500 | 0.7000 | 0.7700 | 39.9186 | (79) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 96.8834 | 170.4769 | 247.7264 | 331.2032 | 393.1169 | 400.0135 | 381.6026 | 333.9232 | 276.4004 | 192.3154 | 117.0362 | 82.2699 | (83) |
| Total gains | 521.8460 | 603.8813 | 664.6136 | 735.7985 | 778.8711 | 771.3545 | 738.1205 | 693.9270 | 645.7134 | 574.3827 | 520.9182 | 499.9110 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| tau | 76.1846 | 76.4514 | 76.7200 | 78.0921 | 78.3724 | 79.8048 | 79.8048 | 80.0975 | 79.2256 | 78.3724 | 77.8138 | 77.2630 | |
| alpha | 6.0790 | 6.0968 | 6.1147 | 6.2061 | 6.2248 | 6.3203 | 6.3203 | 6.3398 | 6.2817 | 6.2248 | 6.1876 | 6.1509 | |
| util living area | 0.9899 | 0.9753 | 0.9405 | 0.8350 | 0.6612 | 0.4639 | 0.3345 | 0.3704 | 0.5940 | 0.8760 | 0.9743 | 0.9919 | (86) |
| MIT | 20.1913 | 20.3837 | 20.6143 | 20.8607 | 20.9708 | 20.9973 | 20.9997 | 20.9995 | 20.9883 | 20.8405 | 20.4895 | 20.1670 | (87) |
| Th 2 | 20.0304 | 20.0335 | 20.0365 | 20.0518 | 20.0549 | 20.0703 | 20.0703 | 20.0734 | 20.0641 | 20.0549 | 20.0488 | 20.0426 | (88) |
| util rest of house | 0.9863 | 0.9672 | 0.9223 | 0.7945 | 0.6016 | 0.3975 | 0.2639 | 0.2960 | 0.5181 | 0.8341 | 0.9645 | 0.9891 | (89) |
| MIT 2 | 19.1156 | 19.3581 | 19.6401 | 19.9282 | 20.0346 | 20.0691 | 20.0702 | 20.0732 | 20.0580 | 19.9173 | 19.5048 | 19.0947 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.6742 | (91) |
| MIT | 19.8408 | 20.0495 | 20.2969 | 20.5569 | 20.6658 | 20.6949 | 20.6969 | 20.6977 | 20.6852 | 20.5397 | 20.1687 | 19.8177 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.8408 | 20.0495 | 20.2969 | 20.5569 | 20.6658 | 20.6949 | 20.6969 | 20.6977 | 20.6852 | 20.5397 | 20.1687 | 19.8177 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9855 | 0.9674 | 0.9277 | 0.8170 | 0.6406 | 0.4422 | 0.3115 | 0.3462 | 0.5689 | 0.8569 | 0.9660 | 0.9883 | (94) |
| Useful gains | 514.2836 | 584.1848 | 616.5447 | 601.1264 | 498.9697 | 341.0822 | 229.9246 | 240.2280 | 367.3735 | 492.2113 | 503.1955 | 494.0372 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | 914.0188 | 887.8953 | 805.7901 | 668.8419 | 512.5939 | 342.2040 | 230.0244 | 240.4176 | 372.4356 | 568.2739 | 752.5317 | 905.7174 | (97) |
| Space heating kWh | 297.4030 | 204.0935 | 140.7986 | 48.7552 | 10.1364 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 56.5906 | 179.5221 | 306.2900 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 1243.5893 | |
| Solar heating kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | 297.4030 | 204.0935 | 140.7986 | 48.7552 | 10.1364 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 56.5906 | 179.5221 | 306.2900 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 1243.5893 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 22.4962 | (99) |

## 8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ext. temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | |
| Heat loss rate W | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 527.7733 | 415.4811 | 425.1506 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (100) |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.9817 | 0.9933 | 0.9895 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (101) |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 518.0896 | 412.7005 | 420.6997 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (102) |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 858.1839 | 821.5513 | 770.5025 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 244.8679 | 304.1850 | 260.2533 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (104) |
| Cooled fraction | | | | | | | | | | fC = cooled area / (4) = | | 0.9949 | (105) |
| Intermittency factor (Table 10b) | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | (106) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 60.9069 | 75.6611 | 64.7338 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) |
| Space cooling requirement | | | | | | | | | | | | 201.3018 | (107) |

## 9b. Energy requirements

| | | |
|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | 0.0000 | (301) |
| Fraction of space heat from community system | 1.0000 | (302) |
| Fraction of heat from community Heat pump-Space and Water | 1.0000 | (303a) |
| Factor for control and charging method (Table 4c(3)) for space heating | 1.0000 | (305) |
| Factor for charging method (Table 4c(3)) for water heating | 1.0000 | (305a) |
| Distribution loss factor (Table 12c) for community heating system | 2.0000 | (306) |
| Efficiency of secondary/supplementary heating system, % | 0.0000 | (208) |

Space heating:

Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 297.4030 | 204.0935 | 140.7986 | 48.7552 | 10.1364 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 56.5906 | 179.5221 | 306.2900 | (98) |
| Space heat from Heat pump = (98) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 307a | 594.8060 | 408.1870 | 281.5972 | 97.5104 | 20.2728 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 113.1812 | 359.0441 | 612.5801 | |
| Space heating requirement | | | | | | | | | | | | | |
| | 594.8060 | 408.1870 | 281.5972 | 97.5104 | 20.2728 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 113.1812 | 359.0441 | 612.5801 | (307) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | | | | | | | | | | | 0.0000 | (308) |
| Space heating fuel for secondary/supplementary system | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (309) |

Water heating

Annual water heating requirement

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 218.1196 | 193.1237 | 205.7288 | 186.0140 | 181.4100 | 161.5019 | 155.6566 | 167.1928 | 166.9884 | 187.1038 | 197.9631 | 217.6231 | (64) |
| Water heat from Heat pump = (64) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 310a | 436.2392 | 386.2474 | 411.4577 | 372.0280 | 362.8200 | 323.0037 | 311.3132 | 334.3856 | 333.9767 | 374.2077 | 395.9261 | 435.2462 | |
| Water heating fuel | | | | | | | | | | | | | |
| | 436.2392 | 386.2474 | 411.4577 | 372.0280 | 362.8200 | 323.0037 | 311.3132 | 334.3856 | 333.9767 | 374.2077 | 395.9261 | 435.2462 | (310) |
| Cooling System Energy Efficiency Ratio | | | | | | | | | | | | 2.6000 | (314) |
| Space coolin | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 23.4257 | 29.1004 | 24.8976 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (315) |
| Pumps and Fa | 15.1561 | 13.6894 | 15.1561 | 14.6672 | 15.1561 | 14.6672 | 15.1561 | 15.1561 | 14.6672 | 15.1561 | 14.6672 | 15.1561 | (331) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lighting | 15.7888 | 12.6664 | 11.4047 | 8.3556 | 6.4541 | 5.2730 | 5.8876 | 7.6529 | 9.9404 | 13.0424 | 14.7313 | 16.2276 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333a)m | -4.7234 | -7.6286 | -12.6368 | -16.3230 | -19.4680 | -18.8839 | -18.6180 | -16.5728 | -13.3375 | -9.5078 | -5.5023 | -3.9669 | (333a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335a) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (333b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335b) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - community heating | 2487.1786 | (307) |
| Space heating fuel - secondary | 0.0000 | (309) |
| Water heating fuel - community heating | 4476.8516 | (310) |
| Efficiency of water heater | 0.0000 | (311) |
| Electricity used for heat distribution | 24.8718 | (313) |
| Space cooling fuel | 77.4238 | (321) |
| | | |
| Electricity for pumps and fans: | | |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8820) | | |
| mechanical ventilation fans (SFP = 0.8820) | 178.4505 | (330a) |
| Total electricity for the above, kWh/year | 178.4505 | (331) |
| Electricity for lighting (calculated in Appendix L) | 127.4249 | (332) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -147.1690 | (333) |
| Wind generation | 0.0000 | (334) |
| Hydro-electric generation (Appendix N) | 0.0000 | (335a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (335) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (336) |
| Energy used | 0.0000 | (337) |
| Total delivered energy for all uses | 7200.1604 | (338) |

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12b. Carbon dioxide emissions - Community heating scheme

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (367) |
| Space and Water heating from Heat pump | 2487.1537 | 0.1574 | 139.7952 | (367) |
| Electrical energy for heat distribution (space & water) | 24.8718 | 0.0000 | 10.2151 | (372) |
| Overall CO2 factor for heat network | | | 0.0539 | (386) |
| Total CO2 associated with community systems | | | 375.0412 | (373) |
| Space and water heating | | | 375.0412 | (376) |
| Space cooling | 77.4238 | 0.1140 | 8.8298 | (377) |
| Pumps, fans and electric keep-hot | 178.4505 | 0.1387 | 24.7533 | (378) |
| Energy for lighting | 127.4249 | 0.1443 | 18.3913 | (379) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -147.1690 | 0.1319 | -19.4144 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -19.4144 | (380) |
| Total CO2, kg/year | | | 407.6013 | (383) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 7.3700 | (384) |

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13b. Primary energy - Community heating scheme

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| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (467a) |
| Space and Water heating from Heat pump | 2487.1537 | 1.5826 | 1405.7841 | (467) |
| Electrical energy for heat distribution (space & water) | 24.8718 | 0.0000 | 107.4284 | (472) |
| Overall CO2 factor for heat network | | | 0.5664 | (486) |
| Total CO2 associated with community systems | | | 3944.1570 | (473) |
| Space and water heating | | | 3944.1570 | (476) |
| Space cooling | 77.4238 | 1.4203 | 109.9684 | (477) |
| Pumps, fans and electric keep-hot | 178.4505 | 1.5128 | 269.9599 | (478) |
| Energy for lighting | 127.4249 | 1.5338 | 195.4485 | (479) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -147.1690 | 1.4874 | -218.8985 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -218.8985 | (480) |
| Total Primary energy kWh/year | | | 4300.6353 | (483) |
| Dwelling Primary energy Rate (DPER) | | | 77.8000 | (484) |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

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| | | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | |
| Ground floor | | 55.2800 | (1b) | x 3.0000 | (2b) = | 165.8400 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 55.2800 | | | | | | (4) |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | | 165.8400 | (5) |

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## 2. Ventilation rate

| | | | |
|---|---|---|---|
| | | m3 per hour | |
| Number of open chimneys | 0 * 80 = | 0.0000 | (6a) |
| Number of open flues | 0 * 20 = | 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | 2 * 10 = | 20.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |
| | Air changes per hour | | |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 20.0000 / (5) = | 0.1206 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3706 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.3706 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.4725 | 0.4632 | 0.4540 | 0.4077 | 0.3984 | 0.3521 | 0.3521 | 0.3428 | 0.3706 | 0.3984 | 0.4169 | 0.4355 | (22b) |
| Effective ac | 0.6116 | 0.6073 | 0.6031 | 0.5831 | 0.5794 | 0.5620 | 0.5620 | 0.5588 | 0.5687 | 0.5794 | 0.5869 | 0.5948 | (25) |

## 3. Heat losses and heat loss parameter

| Element | Gross | Openings | NetArea | U-value | A x U | K-value | A x K | |
|---|---|---|---|---|---|---|---|---|
| | m2 | m2 | m2 | W/m2K | W/K | kJ/m2K | kJ/K | |
| Main dwelling | | | | | | | | |
| TER Opaque door | | | 1.8900 | 1.0000 | 1.8900 | | | (26) |
| TER Opening Type | | | 11.9500 | 1.1450 | 13.6832 | | | (27) |
| Exposed Floor | | | 16.6800 | 0.1300 | 2.1684 | | | (28b) |
| Floor over Communal below | | | 34.4600 | 0.1300 | 4.4798 | | | (28b) |
| External Walls | 51.5600 | 11.9500 | 39.6100 | 0.1800 | 7.1298 | | | (29a) |
| Wall to Communal | 6.3000 | 1.8900 | 4.4100 | 0.1800 | 0.7938 | | | (29a) |
| Total net area of external elements Aum(A, m2) | | | 109.0000 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 30.1450 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 3 | | | 15.1500 | 0.0000 | 0.0000 | | | (32) |
| Party Wall to Unit 4 | | | 19.6100 | 0.0000 | 0.0000 | | | (32) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K: 271.7983 (35)

List of Thermal Bridges

| K1 Element | Length | Psi-value | Total |
|---|---|---|---|
| E1 Steel lintel with perforated steel base plate | 8.3000 | 0.0500 | 0.4150 |
| E4 Jamb | 31.2000 | 0.0500 | 1.5600 |
| E7 Party floor between dwellings (in blocks of flats) | 11.0000 | 0.0700 | 0.7700 |
| E16 Corner (normal) | 6.0000 | 0.0900 | 0.5400 |
| E21 Exposed floor (inverted) | 9.1600 | 0.3200 | 2.9312 |
| E20 Exposed floor (normal) | 13.9300 | 0.3200 | 4.4576 |
| E23 Balcony within or between dwellings, balcony support penetrates wall insulation | 6.4320 | 0.0200 | 0.1286 |
| E7 Party floor between dwellings (in blocks of flats) | 2.1000 | 0.0700 | 0.1470 |
| E25 Staggered party wall between dwellings | 6.0000 | 0.0600 | 0.3600 |
| E17 Corner (inverted - internal area greater than external area) | 3.0000 | -0.0900 | -0.2700 |
| P8 Party Wall - Exposed floor (inverted) | 1.5000 | 0.2400 | 0.3600 |

| | | |
|---|---|---|
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | 11.3994 (36) |
| Point Thermal bridges | (36a) = | 0.0000 |
| Total fabric heat loss | (33) + (36) + (36a) = | 41.5444 (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 33.4730 | 33.2358 | 33.0032 | 31.9110 | 31.7067 | 30.7554 | 30.7554 | 30.5792 | 31.1218 | 31.7067 | 32.1201 | 32.5523 | (38) |
| Heat transfer coeff | 75.0175 | 74.7802 | 74.5477 | 73.4555 | 73.2511 | 72.2998 | 72.2998 | 72.1237 | 72.6662 | 73.2511 | 73.6645 | 74.0967 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 73.4545 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.3570 | 1.3528 | 1.3485 | 1.3288 | 1.3251 | 1.3079 | 1.3079 | 1.3047 | 1.3145 | 1.3251 | 1.3326 | 1.3404 | (40) |
| HLP (average) | | | | | | | | | | | | 1.3288 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

## 4. Water heating energy requirements (kWh/year)

| | | |
|---|---|---|
| Assumed occupancy | 1.8456 | (42) |

Hot water usage for mixer showers

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 55.1635 | 54.3345 | 53.1265 | 50.8152 | 49.1095 | 47.2073 | 46.1261 | 47.3250 | 48.6391 | 50.6815 | 53.0425 | 54.9521 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.8453 | 23.4912 | 22.9925 | 22.0730 | 21.3845 | 20.6210 | 20.2086 | 20.7038 | 21.2430 | 22.0600 | 22.9984 | 23.7647 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 33.5304 | 32.3111 | 31.0918 | 29.8725 | 28.6532 | 27.4339 | 27.4339 | 28.6532 | 29.8725 | 31.0918 | 32.3111 | 33.5304 | (42c) |

Average daily hot water use (litres/day): 103.4494 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 112.5392 | 110.1368 | 107.2108 | 102.7607 | 99.1471 | 95.2622 | 93.7687 | 96.6820 | 99.7547 | 103.8333 | 108.3520 | 112.2472 | (44) |
| Energy conte | 178.2346 | 156.8333 | 164.7790 | 140.6742 | 133.4711 | 117.1360 | 113.4051 | 119.7125 | 123.0075 | 140.9008 | 154.3672 | 175.7520 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1718.2732 | |
| Distribution loss (46)m = 0.15 x (45)m | 26.7352 | 23.5250 | 24.7168 | 21.1011 | 20.0207 | 17.5704 | 17.0108 | 17.9569 | 18.4511 | 21.1351 | 23.1551 | 26.3628 | (46) |

| | | |
|---|---|---|
| Water storage loss: | | |
| Store volume | 150.0000 | (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | 1.3938 | (48) |
| Temperature factor from Table 2b | 0.5400 | (49) |
| Enter (49) or (54) in (55) | 0.7527 | (55) |

Total storage loss

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (56) |

If cylinder contains dedicated solar storage

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (57) |
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |

Total heat required for water heating calculated for each month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 224.8295 | 198.9190 | 211.3739 | 185.7660 | 180.0660 | 162.2279 | 160.0000 | 166.3074 | 168.0993 | 187.4957 | 199.4591 | 222.3469 | (62) |
| WWHRS | -25.2184 | -22.3034 | -23.3548 | -19.3387 | -18.0230 | -15.4224 | -14.4560 | -15.3726 | -15.9566 | -18.8111 | -21.3107 | -24.7514 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |

Output from w/h

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 199.6110 | 176.6156 | 188.0190 | 166.4273 | 162.0430 | 146.8055 | 145.5439 | 150.9349 | 152.1427 | 168.6846 | 178.1484 | 197.5955 | (64) |

Total per year (kWh/year) = Sum(64)m = 2032.5714 (64)

12Total per year (kWh/year) 2033 (64)

Electric shower(s)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)

Heat gains from water heating, kWh/month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 96.5389 | 85.8156 | 92.0649 | 82.8476 | 81.6551 | 75.0212 | 74.9831 | 77.0803 | 76.9735 | 84.1254 | 87.4006 | 95.7135 | (65) |

## 5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 92.2779 | 92.2779 | 92.2779 | 92.2779 | 92.2779 | 92.2779 | 92.2779 | 92.2779 | 92.2779 | 92.2779 | 92.2779 | 92.2779 | (66) |

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 81.2433 | 89.9479 | 81.2433 | 83.9514 | 81.2433 | 83.9514 | 81.2433 | 81.2433 | 83.9514 | 81.2433 | 83.9514 | 81.2433 | (67) |

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 160.9069 | 162.5766 | 158.3690 | 149.4115 | 138.1042 | 127.4770 | 120.3774 | 118.7077 | 122.9153 | 131.8728 | 143.1801 | 153.8073 | (68) |

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 32.2278 | 32.2278 | 32.2278 | 32.2278 | 32.2278 | 32.2278 | 32.2278 | 32.2278 | 32.2278 | 32.2278 | 32.2278 | 32.2278 | (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.0000 | 3.0000 | 3.0000 | (70) |

Losses e.g. evaporation (negative values) (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | -73.8224 | -73.8224 | -73.8224 | -73.8224 | -73.8224 | -73.8224 | -73.8224 | -73.8224 | -73.8224 | -73.8224 | -73.8224 | -73.8224 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 129.7566 | 127.7018 | 123.7432 | 115.0662 | 109.7514 | 104.1961 | 100.7837 | 103.6026 | 106.9076 | 113.0718 | 121.3897 | 128.6471 | (72) |

Total internal gains

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 425.5902 | 433.9098 | 417.0389 | 402.1125 | 382.7824 | 366.3079 | 353.0878 | 354.2369 | 364.4577 | 379.8713 | 402.2045 | 417.3811 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Southeast | 1.1100 | 36.7938 | 0.6300 | 0.7000 | 0.7700 | 12.4816 | (77) |
| Southwest | 6.0700 | 36.7938 | 0.6300 | 0.7000 | 0.7700 | 68.2552 | (79) |
| Northwest | 4.7700 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 16.4480 | (81) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 97.1847 | 171.0049 | 248.4880 | 332.2124 | 394.3072 | 401.2215 | 382.7563 | 334.9378 | 277.2472 | 192.9096 | 117.3998 | 82.5261 | (83) |
| Total gains | 522.7749 | 604.9147 | 665.5269 | 734.3249 | 777.0896 | 767.5294 | 735.8441 | 689.1748 | 641.7048 | 572.7808 | 519.6044 | 499.9072 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| tau | 55.6352 | 55.8117 | 55.9858 | 56.8183 | 56.9768 | 57.7265 | 57.7265 | 57.8675 | 57.4354 | 56.9768 | 56.6570 | 56.3266 | |
| alpha | 4.7090 | 4.7208 | 4.7324 | 4.7879 | 4.7985 | 4.8484 | 4.8484 | 4.8578 | 4.8290 | 4.7985 | 4.7771 | 4.7551 | |
| util living area | 0.9904 | 0.9803 | 0.9587 | 0.8958 | 0.7690 | 0.5812 | 0.4281 | 0.4741 | 0.7133 | 0.9219 | 0.9803 | 0.9921 | (86) |
| MIT | 19.7120 | 19.9287 | 20.2228 | 20.5934 | 20.8526 | 20.9706 | 20.9945 | 20.9912 | 20.9229 | 20.5882 | 20.0947 | 19.6842 | (87) |
| Th 2 | 19.7964 | 19.7997 | 19.8030 | 19.8184 | 19.8212 | 19.8347 | 19.8347 | 19.8372 | 19.8295 | 19.8212 | 19.8154 | 19.8093 | (88) |
| util rest of house | 0.9871 | 0.9736 | 0.9446 | 0.8616 | 0.7023 | 0.4849 | 0.3170 | 0.3581 | 0.6181 | 0.8881 | 0.9724 | 0.9894 | (89) |
| MIT 2 | 18.3428 | 18.6179 | 18.9855 | 19.4358 | 19.7102 | 19.8203 | 19.8333 | 19.8346 | 19.7849 | 19.4442 | 18.8415 | 18.3167 | (90) |

Living area fraction fLA = Living area / (4) = 0.6742 (91)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MIT | 19.2659 | 19.5016 | 19.8197 | 20.2162 | 20.4804 | 20.5958 | 20.6162 | 20.6144 | 20.5522 | 20.2155 | 19.6864 | 19.2387 | (92) |

Temperature adjustment 0.0000

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| adjusted MIT | 19.2659 | 19.5016 | 19.8197 | 20.2162 | 20.4804 | 20.5958 | 20.6162 | 20.6144 | 20.5522 | 20.2155 | 19.6864 | 19.2387 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9852 | 0.9716 | 0.9448 | 0.8742 | 0.7413 | 0.5488 | 0.3920 | 0.4364 | 0.6791 | 0.9008 | 0.9713 | 0.9877 | (94) |
| Useful gains | 515.0383 | 587.7258 | 628.7792 | 641.9644 | 576.0255 | 421.2394 | 288.4232 | 300.7438 | 435.8047 | 515.9874 | 504.7139 | 493.7508 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | 1122.7068 | 1091.9122 | 992.9537 | 831.2389 | 643.1733 | 433.4965 | 290.3681 | 303.9556 | 468.8556 | 704.3464 | 927.1711 | 1114.3166 | (97) |
| Space heating kWh | 452.1053 | 338.8133 | 270.9459 | 136.2776 | 49.9579 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 140.1391 | 304.1692 | 461.7010 | (98a) |

Space heating requirement - total per year (kWh/year) 2154.1092

Solar heating kWh

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |

Solar heating contribution - total per year (kWh/year) 0.0000

Space heating kWh

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 452.1053 | 338.8133 | 270.9459 | 136.2776 | 49.9579 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 140.1391 | 304.1692 | 461.7010 | (98c) |

Space heating requirement after solar contribution - total per year (kWh/year) 2154.1092

Space heating per m2 (98c) / (4) = 38.9672 (99)

## 9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction of space heat from main system(s) | | | | | | | | | | | | 1.0000 | (202) |
| Efficiency of main space heating system 1 (in %) | | | | | | | | | | | | 92.3000 | (206) |
| Efficiency of main space heating system 2 (in %) | | | | | | | | | | | | 0.0000 | (207) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 | (208) |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| Space heating requirement | | | | | | | | | | | | | |
| | 452.1053 | 338.8133 | 270.9459 | 136.2776 | 49.9579 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 140.1391 | 304.1692 | 461.7010 | (98) |
| Space heating efficiency (main heating system 1) | | | | | | | | | | | | | |
| | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.3000 | 92.3000 | 92.3000 | (210) |
| Space heating fuel (main heating system) | | | | | | | | | | | | | |
| | 489.8216 | 367.0783 | 293.5492 | 147.6464 | 54.1256 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 151.8300 | 329.5441 | 500.2177 | (211) |
| Space heating efficiency (main heating system 2) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (212) |
| Space heating fuel (main heating system 2) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (213) |
| Space heating fuel (secondary) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (215) |
| Water heating | | | | | | | | | | | | | |
| Water heating requirement | | | | | | | | | | | | | |
| | 199.6110 | 176.6156 | 188.0190 | 166.4273 | 162.0430 | 146.8055 | 145.5439 | 150.9349 | 152.1427 | 168.6846 | 178.1484 | 197.5955 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 | (216) |
| (217)m | 85.8350 | 85.4960 | 84.8784 | 83.6152 | 81.7525 | 79.8000 | 79.8000 | 79.8000 | 79.8000 | 83.6471 | 85.2488 | 85.8966 | (217) |
| Fuel for water heating, kWh/month | | | | | | | | | | | | | |
| | 232.5521 | 206.5777 | 221.5157 | 199.0395 | 198.2116 | 183.9667 | 182.3859 | 189.1415 | 190.6550 | 201.6623 | 208.9747 | 230.0389 | (219) |
| Space cooling fuel requirement | | | | | | | | | | | | | |
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (221) |
| Pumps and Fa | 7.3041 | 6.5973 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | (231) |
| Lighting | 16.8807 | 13.5424 | 12.1934 | 8.9334 | 6.9004 | 5.6377 | 6.2948 | 8.1822 | 10.6279 | 13.9444 | 15.7501 | 17.3499 | (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233a)m | -12.3404 | -18.5566 | -28.4333 | -34.1561 | -38.7904 | -36.9442 | -36.5078 | -33.4895 | -28.5169 | -22.1668 | -13.9761 | -10.5391 | (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233b)m | -3.8477 | -8.3210 | -16.9670 | -26.1216 | -35.1670 | -35.5537 | -35.1228 | -29.4388 | -21.1973 | -12.0922 | -5.1989 | -3.0253 | (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235d) |
| Annual totals kWh/year | | | | | | | | | | | | | |
| Space heating fuel - main system 1 | | | | | | | | | | | | 2333.8128 | (211) |
| Space heating fuel - main system 2 | | | | | | | | | | | | 0.0000 | (213) |
| Space heating fuel - secondary | | | | | | | | | | | | 0.0000 | (215) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 | |
| Water heating fuel used | | | | | | | | | | | | 2444.7216 | (219) |
| Space cooling fuel | | | | | | | | | | | | 0.0000 | (221) |
| Electricity for pumps and fans: | | | | | | | | | | | | | |
| Total electricity for the above, kWh/year | | | | | | | | | | | | 86.0000 | (231) |
| Electricity for lighting (calculated in Appendix L) | | | | | | | | | | | | 136.2373 | (232) |
| Energy saving/generation technologies (Appendices M ,N and Q) | | | | | | | | | | | | | |
| PV generation | | | | | | | | | | | | -546.4705 | (233) |
| Wind generation | | | | | | | | | | | | 0.0000 | (234) |
| Hydro-electric generation (Appendix N) | | | | | | | | | | | | 0.0000 | (235a) |
| Electricity generated - Micro CHP (Appendix N) | | | | | | | | | | | | 0.0000 | (235) |
| Appendix Q - special features | | | | | | | | | | | | | |
| Energy saved or generated | | | | | | | | | | | | -0.0000 | (236) |
| Energy used | | | | | | | | | | | | 0.0000 | (237) |
| Total delivered energy for all uses | | | | | | | | | | | | 4454.3012 | (238) |

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 2333.8128 | 0.2100 | 490.1007 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2444.7216 | 0.2100 | 513.3915 | (264) |
| Space and water heating | | | 1003.4922 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 136.2373 | 0.1443 | 19.6633 | (268) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -314.4173 | 0.1332 | -41.8940 | |
| PV Unit electricity exported | -232.0532 | 0.1252 | -29.0503 | |
| Total | | | -70.9443 | (269) |
| Total CO2, kg/year | | | 964.1404 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 17.4400 | (273) |

13a. Primary energy - Individual heating systems including micro-CHP

| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 2333.8128 | 1.1300 | 2637.2085 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2444.7216 | 1.1300 | 2762.5354 | (278) |
| Space and water heating | | | 5399.7438 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 136.2373 | 1.5338 | 208.9653 | (282) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -314.4173 | 1.4924 | -469.2262 | |
| PV Unit electricity exported | -232.0532 | 0.4595 | -106.6269 | |
| Total | | | -575.8532 | (283) |
| Total Primary energy kWh/year | | | 5162.9568 | (286) |
| Target Primary Energy Rate (TPER) | | | 93.4000 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Property Reference** | Unit 11 | **Issued on Date** | 17/05/2025 |
| **Assessment Reference** | 00001 | **Prop Type Ref** | Unit 11 |
| **Property** | | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 78 C | **DER** | 5.87 | **TER** | 14.89 |
| **Environmental** | 96 A | **% DER < TER** | | | 60.58 |
| **$CO_2$ Emissions (t/year)** | 0.33 | **DFEE** | 36.15 | **TFEE** | 39.78 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 9.13 |
| **% DPER < TPER** | 21.71 | **DPER** | 62.29 | **TPER** | 79.57 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Robert Arnold | **Assessor ID** | BA04-0001 |
| **Client** | | | |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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## 1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 64.4100 | (1b) | x 3.0800 | (2b) = | 198.3828 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 64.4100 | | | | | (4) |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | 198.3828 | (5) |

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## 2. Ventilation rate

---

| | | m3 per hour | |
|---|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 | (6a) |
| Number of open flues | 0 * 20 = | 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | 0 * 10 = | 0.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |

| | Air changes per hour | | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 0.0000 / (5) = | 0.0000 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 3.0000 | (17) |
| Infiltration rate | | 0.1500 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.1500 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.1912 | 0.1875 | 0.1837 | 0.1650 | 0.1612 | 0.1425 | 0.1425 | 0.1388 | 0.1500 | 0.1612 | 0.1687 | 0.1762 | (22b) |

Balanced mechanical ventilation with heat recovery

| | | |
|---|---|---|
| If mechanical ventilation | | 0.5000 (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | | 0.5000 (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | | 81.0000 (23c) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective ac | 0.2862 | 0.2825 | 0.2787 | 0.2600 | 0.2562 | 0.2375 | 0.2375 | 0.2337 | 0.2450 | 0.2562 | 0.2637 | 0.2712 | (25) |

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## 3. Heat losses and heat loss parameter

---

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| Windows | | | 9.4100 | 1.0536 | 9.9148 | | | (27) |
| Front Door | | | 1.8900 | 1.4000 | 2.6460 | | | (26) |
| Glass Door | | | 2.4000 | 1.3258 | 3.1818 | | | (27) |
| External Walls | 37.3500 | 11.8100 | 25.5400 | 0.1500 | 3.8310 | 150.0000 | 3831.0000 | (29a) |
| Wall to Communal Corridor | 27.5200 | 1.8900 | 25.6300 | 0.1300 | 3.3319 | 150.0000 | 3844.5000 | (29a) |
| Wall to Stairs | 26.5300 | | 26.5300 | 0.1100 | 2.9183 | 150.0000 | 3979.5000 | (29a) |
| Total net area of external elements Aum(A, m2) | | | 91.4000 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 25.8238 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 1 | | | 20.5200 | 0.0000 | 0.0000 | 70.0000 | 1436.4000 | (32) |
| Party Wall to Unit 12 | | | 8.8200 | 0.0000 | 0.0000 | 70.0000 | 617.4000 | (32) |
| Party Floor | | | 64.4100 | | | 80.0000 | 5152.8000 | (32d) |
| Party Ceiling | | | 64.4100 | | | 100.0000 | 6441.0000 | (32b) |
| Internal Walls | | | 150.2300 | | | 9.0000 | 1352.0700 | (32c) |

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 26654.6700 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 413.8281 (35)
List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E1 Steel lintel with perforated steel base plate | 6.1400 | 0.0500 | 0.3070 |
| E4 Jamb | 22.1600 | 0.0500 | 1.1080 |
| E7 Party floor between dwellings (in blocks of flats) | 24.2600 | 0.0700 | 1.6982 |
| E18 Party wall between dwellings | 3.0800 | 0.0600 | 0.1848 |
| E17 Corner (inverted - internal area greater than external area) | -0.0900 | -0.0900 | 0.0081 |
| E25 Staggered party wall between dwellings | 3.0800 | 0.0600 | 0.1848 |
| E7 Party floor between dwellings (in blocks of flats) | 17.5520 | 0.0700 | 1.2286 |
| E24 Eaves (insulation at ceiling level - inverted) | 4.7875 | 0.2400 | 1.1490 |
| E23 Balcony within or between dwellings, balcony support penetrates wall insulation | 2.6975 | 0.0200 | 0.0539 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 5.9225 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 31.7463 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 18.7397 | 18.4942 | 18.2487 | 17.0212 | 16.7757 | 15.5483 | 15.5483 | 15.3028 | 16.0392 | 16.7757 | 17.2667 | 17.7577 | (38) |
| Heat transfer coeff | 50.4860 | 50.2405 | 49.9950 | 48.7675 | 48.5220 | 47.2945 | 47.2945 | 47.0490 | 47.7855 | 48.5220 | 49.0130 | 49.5040 | (39) |

Average = Sum(39)m / 12 = 48.7061

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 0.7838 | 0.7800 | 0.7762 | 0.7571 | 0.7533 | 0.7343 | 0.7343 | 0.7305 | 0.7419 | 0.7533 | 0.7610 | 0.7686 | (40) |
| HLP (average) | | | | | | | | | | | | 0.7562 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

---
4. Water heating energy requirements (kWh/year)
---

Assumed occupancy 2.1032 (42)
Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 57.9804 | 57.0927 | 55.7845 | 53.7720 | 51.9690 | 49.4464 | 47.4513 | 49.7837 | 50.9568 | 53.4553 | 56.0572 | 57.9281 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 25.1300 | 24.7506 | 24.2109 | 23.4028 | 22.6744 | 21.6717 | 20.9110 | 21.8412 | 22.3294 | 23.3229 | 24.3558 | 25.1100 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 36.1688 | 34.8535 | 33.5383 | 32.2231 | 30.9079 | 29.5926 | 29.5926 | 30.9079 | 32.2231 | 33.5383 | 34.8535 | 36.1688 | (42c) |

Average daily hot water use (litres/day) 109.6355 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 119.2791 | 116.6968 | 113.5338 | 109.3979 | 105.5512 | 100.7108 | 97.9549 | 102.5328 | 105.5093 | 110.3165 | 115.2666 | 119.2069 | (44) |
| Energy conte | 175.5994 | 154.4135 | 162.2374 | 142.9010 | 136.0134 | 116.4687 | 108.2431 | 120.6830 | 122.3856 | 142.1540 | 155.7866 | 175.0641 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1711.9498 | |
| Distribution loss (46)m = 0.15 x (45)m | 26.3399 | 23.1620 | 24.3356 | 21.4351 | 20.4020 | 17.4703 | 16.2365 | 18.1025 | 18.3578 | 21.3231 | 23.3680 | 26.2596 | (46) |

Water storage loss:
Store volume 110.0000 (47)
  b) If manufacturer declared loss factor is not known :
  Hot water storage loss factor from Table 2 (kWh/litre/day) 0.0152 (51)
  Volume factor from Table 2a 1.0294 (52)
  Temperature factor from Table 2b 0.6000 (53)
Enter (49) or (54) in (55) 1.0327 (55)
Total storage loss

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (56) |

If cylinder contains dedicated solar storage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (57) |
| Primary loss 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |

Total heat required for water heating calculated for each month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 230.8762 | 204.3410 | 217.5142 | 196.3947 | 191.2902 | 169.9623 | 163.5199 | 175.9598 | 175.8792 | 197.4308 | 209.2803 | 230.3409 | (62) |
| WWHRS 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63a) |
| PV diverter -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | 230.8762 | 204.3410 | 217.5142 | 196.3947 | 191.2902 | 169.9623 | 163.5199 | 175.9598 | 175.8792 | 197.4308 | 209.2803 | 230.3409 | (64) |
| | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | | 2362.7896 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2363 | (64) |
| Electric shower(s) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | | 0.0000 | (64a) |

Heat gains from water heating, kWh/month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 102.6083 | 91.2844 | 98.1654 | 90.3095 | 89.4459 | 81.5208 | 80.2123 | 84.3485 | 83.4881 | 91.4876 | 94.5940 | 102.4302 | (65) |

---
5. Internal gains (see Table 5 and 5a)
---

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 105.1595 | 105.1595 | 105.1595 | 105.1595 | 105.1595 | 105.1595 | 105.1595 | 105.1595 | 105.1595 | 105.1595 | 105.1595 | 105.1595 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 94.4738 | 104.5960 | 94.4738 | 97.6229 | 94.4738 | 97.6229 | 94.4738 | 94.4738 | 97.6229 | 94.4738 | 97.6229 | 94.4738 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 183.9166 | 185.8251 | 181.0158 | 170.7774 | 157.8532 | 145.7063 | 137.5914 | 135.6829 | 140.4922 | 150.7306 | 163.6548 | 175.8018 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 33.5160 | 33.5160 | 33.5160 | 33.5160 | 33.5160 | 33.5160 | 33.5160 | 33.5160 | 33.5160 | 33.5160 | 33.5160 | 33.5160 | (69) |
| Pumps, fans 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | -84.1276 | -84.1276 | -84.1276 | -84.1276 | -84.1276 | -84.1276 | -84.1276 | -84.1276 | -84.1276 | -84.1276 | -84.1276 | -84.1276 | (71) |
| Water heating gains (Table 5) | 137.9143 | 135.8399 | 131.9427 | 125.4299 | 120.2230 | 113.2233 | 107.8122 | 113.3717 | 115.9558 | 122.9673 | 131.3806 | 137.6751 | (72) |
| Total internal gains | 470.8526 | 480.8089 | 461.9802 | 448.3780 | 427.0978 | 411.1003 | 394.4252 | 398.0762 | 408.6187 | 422.7195 | 447.2061 | 462.4984 | (73) |

---
6. Solar gains
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| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W |
|---|---|---|---|---|---|---|

---

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northeast | | | 6.8400 | | 11.2829 | | 0.4500 | | 0.7000 | | 0.7700 | | 16.8470 (75) |
| Southeast | | | 2.5700 | | 36.7938 | | 0.4500 | | 0.7000 | | 0.7700 | | 20.6420 (77) |
| Northeast | | | 2.4000 | | 11.2829 | | 0.4500 | | 0.7000 | | 0.7700 | | 5.9112 (75) |
| Solar gains | 43.4002 | 81.4860 | 131.5717 | 196.6792 | 251.0162 | 262.7133 | 247.6605 | 205.0568 | 153.7925 | 95.4732 | 53.3601 | 36.2508 | (83) |
| Total gains | 514.2528 | 562.2949 | 593.5519 | 645.0572 | 678.1140 | 673.8137 | 642.0857 | 603.1330 | 562.4112 | 518.1927 | 500.5662 | 498.7492 | (84) |

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| tau | 146.6560 | 147.3727 | 148.0963 | 151.8240 | 152.5921 | 156.5525 | 156.5525 | 157.3694 | 154.9439 | 152.5921 | 151.0635 | 149.5652 | |
| alpha | 10.7771 | 10.8248 | 10.8731 | 11.1216 | 11.1728 | 11.4368 | 11.4368 | 11.4913 | 11.3296 | 11.1728 | 11.0709 | 10.9710 | |
| util living area | 0.9981 | 0.9940 | 0.9773 | 0.8709 | 0.6631 | 0.4492 | 0.3241 | 0.3588 | 0.5857 | 0.9051 | 0.9910 | 0.9985 | (86) |
| MIT | 20.6218 | 20.7132 | 20.8337 | 20.9675 | 20.9982 | 21.0000 | 21.0000 | 21.0000 | 20.9996 | 20.9590 | 20.7870 | 20.6167 | (87) |
| Th 2 | 20.2674 | 20.2707 | 20.2740 | 20.2906 | 20.2940 | 20.3107 | 20.3107 | 20.3140 | 20.3040 | 20.2940 | 20.2873 | 20.2806 | (88) |
| util rest of house | 0.9971 | 0.9910 | 0.9669 | 0.8340 | 0.6139 | 0.4008 | 0.2733 | 0.3053 | 0.5269 | 0.8667 | 0.9860 | 0.9978 | (89) |
| MIT 2 | 19.8357 | 19.9542 | 20.1050 | 20.2648 | 20.2929 | 20.3107 | 20.3107 | 20.3140 | 20.3038 | 20.2626 | 20.0619 | 19.8407 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.3541 | (91) |
| MIT | 20.1141 | 20.2230 | 20.3631 | 20.5136 | 20.5427 | 20.5548 | 20.5548 | 20.5569 | 20.5502 | 20.5092 | 20.3187 | 20.1155 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 20.1141 | 20.2230 | 20.3631 | 20.5136 | 20.5427 | 20.5548 | 20.5548 | 20.5569 | 20.5502 | 20.5092 | 20.3187 | 20.1155 | (93) |

8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9969 | 0.9908 | 0.9684 | 0.8462 | 0.6313 | 0.4179 | 0.2913 | 0.3243 | 0.5478 | 0.8794 | 0.9863 | 0.9976 | (94) |
| Useful gains | 512.6455 | 557.1127 | 574.7744 | 545.8776 | 428.1130 | 281.6202 | 187.0392 | 195.5796 | 308.0746 | 455.6884 | 493.7176 | 497.5309 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | 798.3902 | 769.8350 | 693.0845 | 566.3687 | 429.0641 | 281.6278 | 187.0393 | 195.5799 | 308.2278 | 480.8147 | 647.8866 | 787.8810 | (97) |
| Space heating kWh | 212.5941 | 142.9493 | 88.0227 | 14.7535 | 0.7076 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 18.6940 | 111.0017 | 216.0204 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 804.7434 | |
| Solar heating kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | 212.5941 | 142.9493 | 88.0227 | 14.7535 | 0.7076 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 18.6940 | 111.0017 | 216.0204 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 804.7434 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 12.4941 | (99) |

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ext. temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | |
| Heat loss rate W | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 444.5684 | 349.9794 | 357.5725 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (100) |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.9988 | 0.9998 | 0.9996 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (101) |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 444.0251 | 349.9188 | 357.4252 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (102) |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 737.2663 | 702.7707 | 658.1855 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 211.1336 | 262.5218 | 223.7657 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (104) |
| Cooled fraction | | | | | | | | | | fC = cooled area / (4) = | | 0.9936 | (105) |
| Intermittency factor (Table 10b) | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | (106) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 52.4474 | 65.2127 | 55.5853 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) |
| Space cooling requirement | | | | | | | | | | | | 173.2454 | (107) |

9b. Energy requirements

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | 0.0000 | (301) |
| Fraction of space heat from community system | | | | | | | | | | | | 1.0000 | (302) |
| Fraction of heat from community Heat pump-Space and Water | | | | | | | | | | | | 1.0000 | (303a) |
| Factor for control and charging method (Table 4c(3)) for space heating | | | | | | | | | | | | 1.0000 | (305) |
| Factor for charging method (Table 4c(3)) for water heating | | | | | | | | | | | | 1.0000 | (305a) |
| Distribution loss factor (Table 12c) for community heating system | | | | | | | | | | | | 2.0000 | (306) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 | (208) |
| Space heating: | | | | | | | | | | | | | |
| Space heating requirement | | | | | | | | | | | | | |
| | 212.5941 | 142.9493 | 88.0227 | 14.7535 | 0.7076 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 18.6940 | 111.0017 | 216.0204 | (98) |
| Space heat from Heat pump = (98) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 307a | 425.1882 | 285.8987 | 176.0454 | 29.5071 | 1.4152 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 37.3880 | 222.0034 | 432.0409 | |
| Space heating requirement | | | | | | | | | | | | | |
| | 425.1882 | 285.8987 | 176.0454 | 29.5071 | 1.4152 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 37.3880 | 222.0034 | 432.0409 | (307) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | | | | | | | | | | | 0.0000 | (308) |
| Space heating fuel for secondary/supplementary system | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (309) |
| Water heating | | | | | | | | | | | | | |
| Annual water heating requirement | | | | | | | | | | | | | |
| | 230.8762 | 204.3410 | 217.5142 | 196.3947 | 191.2902 | 169.9623 | 163.5199 | 175.9598 | 175.8792 | 197.4308 | 209.2803 | 230.3409 | (64) |
| Water heat from Heat pump = (64) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 310a | 461.7525 | 408.6819 | 435.0284 | 392.7893 | 382.5804 | 339.9247 | 327.0398 | 351.9196 | 351.7585 | 394.8616 | 418.5606 | 460.6817 | |
| Water heating fuel | | | | | | | | | | | | | |
| | 461.7525 | 408.6819 | 435.0284 | 392.7893 | 382.5804 | 339.9247 | 327.0398 | 351.9196 | 351.7585 | 394.8616 | 418.5606 | 460.6817 | (310) |
| Cooling System Energy Efficiency Ratio | | | | | | | | | | | | 2.6000 | (314) |
| Space coolin | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 20.1721 | 25.0818 | 21.3790 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (315) |
| Pumps and Fa | 18.1301 | 16.3756 | 18.1301 | 17.5453 | 18.1301 | 17.5453 | 18.1301 | 18.1301 | 17.5453 | 18.1301 | 17.5453 | 18.1301 | (331) |
| Lighting | 19.5734 | 15.7025 | 14.1384 | 10.3584 | 8.0011 | 6.5370 | 7.2989 | 9.4874 | 12.3232 | 16.1687 | 18.2625 | 20.1175 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333a)m | -4.7726 | -7.7384 | -12.8702 | -16.6934 | -19.9718 | -19.3937 | -19.1198 | -16.9899 | -13.6312 | -9.6696 | -5.5693 | -4.0051 | (333a) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335a) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (333b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335b) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - community heating | 1609.4869 | (307) |
| Space heating fuel - secondary | 0.0000 | (309) |
| Water heating fuel - community heating | 4725.5791 | (310) |
| Efficiency of water heater | 0.0000 | (311) |
| Electricity used for heat distribution | 16.0949 | (313) |
| Space cooling fuel | 66.6329 | (321) |
| | | |
| Electricity for pumps and fans: | | |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8820) | | |
| mechanical ventilation fans (SFP = 0.8820) | 213.4678 | (330a) |
| Total electricity for the above, kWh/year | 213.4678 | (331) |
| Electricity for lighting (calculated in Appendix L) | 157.9689 | (332) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -150.4250 | (333) |
| Wind generation | 0.0000 | (334) |
| Hydro-electric generation (Appendix N) | 0.0000 | (335a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (335) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (336) |
| Energy used | 0.0000 | (337) |
| Total delivered energy for all uses | 6622.7106 | (338) |

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12b. Carbon dioxide emissions - Community heating scheme

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (367) |
| Space and Water heating from Heat pump | 2262.5236 | 0.1587 | 91.2217 | (367) |
| Electrical energy for heat distribution (space & water) | 16.0949 | 0.0000 | 9.2072 | (372) |
| Overall CO2 factor for heat network | | | 0.0534 | (386) |
| Total CO2 associated with community systems | | | 338.0362 | (373) |
| Space and water heating | | | 338.0362 | (376) |
| Space cooling | 66.6329 | 0.1140 | 7.5992 | (377) |
| Pumps, fans and electric keep-hot | 213.4678 | 0.1387 | 29.6106 | (378) |
| Energy for lighting | 157.9689 | 0.1443 | 22.7998 | (379) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -150.4250 | 0.1318 | -19.8329 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -19.8329 | (380) |
| Total CO2, kg/year | | | 378.2129 | (383) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 5.8700 | (384) |

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13b. Primary energy - Community heating scheme

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| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (467a) |
| Space and Water heating from Heat pump | 2262.5236 | 1.5875 | 912.4943 | (467) |
| Electrical energy for heat distribution (space & water) | 16.0949 | 0.0000 | 97.4057 | (472) |
| Overall CO2 factor for heat network | | | 0.5645 | (486) |
| Total CO2 associated with community systems | | | 3576.1814 | (473) |
| Space and water heating | | | 3576.1814 | (476) |
| Space cooling | 66.6329 | 1.4203 | 94.6418 | (477) |
| Pumps, fans and electric keep-hot | 213.4678 | 1.5128 | 322.9341 | (478) |
| Energy for lighting | 157.9689 | 1.5338 | 242.2980 | (479) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -150.4250 | 1.4871 | -223.7002 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -223.7002 | (480) |
| Total Primary energy kWh/year | | | 4012.3551 | (483) |
| Dwelling Primary energy Rate (DPER) | | | 62.2900 | (484) |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 64.4100 | (1b) x | 3.0800 | (2b) = | 198.3828 | (1b) - (3b) (4) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 64.4100 | | | | | |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | | 198.3828 | (5) |

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2. Ventilation rate

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m3 per hour

| | | | |
|---|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 | (6a) |
| Number of open flues | 0 * 20 = | 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | 2 * 10 = | 20.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |

| | | Air changes per hour | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 20.0000 / (5) = | 0.1008 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3508 | (18) |
| Number of sides sheltered | | 0 | (19) |

| | | | |
|---|---|---|---|
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.3508 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.4473 | 0.4385 | 0.4297 | 0.3859 | 0.3771 | 0.3333 | 0.3333 | 0.3245 | 0.3508 | 0.3771 | 0.3947 | 0.4122 | (22b) |
| Effective ac | 0.6000 | 0.5961 | 0.5923 | 0.5745 | 0.5711 | 0.5555 | 0.5555 | 0.5527 | 0.5615 | 0.5711 | 0.5779 | 0.5850 | (25) |

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## 3. Heat losses and heat loss parameter

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| Element | Gross | Openings | NetArea | U-value | A x U | K-value | A x K | |
|---|---|---|---|---|---|---|---|---|
| | m2 | m2 | m2 | W/m2K | W/K | kJ/m2K | kJ/K | |
| Main dwelling | | | | | | | | |
| TER Opaque door | | | 1.8900 | 1.0000 | 1.8900 | | | (26) |
| TER Opening Type | | | 11.8100 | 1.1450 | 13.5229 | | | (27) |
| External Walls | 37.3500 | 11.8100 | 25.5400 | 0.1800 | 4.5972 | | | (29a) |
| Wall to Communal Corridor | 27.5200 | 1.8900 | 25.6300 | 0.1800 | 4.6134 | | | (29a) |
| Wall to Stairs | 26.5300 | | 26.5300 | 0.1800 | 4.7754 | | | (29a) |
| Total net area of external elements Aum(A, m2) | | | 91.4000 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 29.3989 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 1 | | | 20.5200 | 0.0000 | 0.0000 | | | (32) |
| Party Wall to Unit 12 | | | 8.8200 | 0.0000 | 0.0000 | | | (32) |

| | |
|---|---|
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | 393.8281 (35) |

List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E1 Steel lintel with perforated steel base plate | 6.1400 | 0.0500 | 0.3070 |
| E4 Jamb | 22.1600 | 0.0500 | 1.1080 |
| E7 Party floor between dwellings (in blocks of flats) | 24.2600 | 0.0700 | 1.6982 |
| E18 Party wall between dwellings | 3.0800 | 0.0600 | 0.1848 |
| E17 Corner (inverted - internal area greater than external area) | -0.0900 | -0.0900 | 0.0081 |
| E25 Staggered party wall between dwellings | 3.0800 | 0.0600 | 0.1848 |
| E7 Party floor between dwellings (in blocks of flats) | 17.5520 | 0.0700 | 1.2286 |
| E24 Eaves (insulation at ceiling level - inverted) | 4.7875 | 0.2400 | 1.1490 |
| E23 Balcony within or between dwellings, balcony support penetrates wall insulation | 2.6975 | 0.0200 | 0.0539 |

| | | |
|---|---|---|
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | 5.9225 (36) |
| Point Thermal bridges | (36a) = | 0.0000 |
| Total fabric heat loss | (33) + (36) + (36a) = | 35.3214 (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 39.2820 | 39.0277 | 38.7784 | 37.6077 | 37.3886 | 36.3689 | 36.3689 | 36.1801 | 36.7617 | 37.3886 | 37.8317 | 38.2950 | (38) |
| Heat transfer coeff | 74.6034 | 74.3491 | 74.0998 | 72.9291 | 72.7100 | 71.6903 | 71.6903 | 71.5014 | 72.0831 | 72.7100 | 73.1531 | 73.6164 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 72.9280 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.1583 | 1.1543 | 1.1504 | 1.1323 | 1.1289 | 1.1130 | 1.1130 | 1.1101 | 1.1191 | 1.1289 | 1.1357 | 1.1429 | (40) |
| HLP (average) | | | | | | | | | | | | 1.1322 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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## 4. Water heating energy requirements (kWh/year)

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Assumed occupancy | | | | | | | | | | | | 2.1032 | (42) |
| Hot water usage for mixer showers | 59.4832 | 58.5893 | 57.2867 | 54.7944 | 52.9551 | 50.9040 | 49.7381 | 51.0308 | 52.4479 | 54.6502 | 57.1961 | 59.2553 | (42a) |
| Hot water usage for baths | 25.7029 | 25.3212 | 24.7837 | 23.7925 | 23.0504 | 22.2274 | 21.7829 | 22.3167 | 22.8979 | 23.7785 | 24.7900 | 25.6161 | (42b) |
| Hot water usage for other uses | 36.1688 | 34.8535 | 33.5383 | 32.2231 | 30.9079 | 29.5926 | 29.5926 | 30.9079 | 32.2231 | 33.5383 | 34.8535 | 36.1688 | (42c) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 111.5529 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 121.3549 | 118.7640 | 115.6087 | 110.8100 | 106.9133 | 102.7240 | 101.1137 | 104.2554 | 107.5690 | 111.9670 | 116.8397 | 121.0401 | (44) |
| Energy conte | 192.1965 | 169.1184 | 177.6862 | 151.6933 | 143.9259 | 126.3112 | 122.2882 | 129.0900 | 132.6433 | 151.9382 | 166.4595 | 189.5196 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1852.8704 | |
| Distribution loss (46)m = 0.15 x (45)m | 28.8295 | 25.3678 | 26.6529 | 22.7540 | 21.5889 | 18.9467 | 18.3432 | 19.3635 | 19.8965 | 22.7907 | 24.9689 | 28.4279 | (46) |

| | |
|---|---|
| Water storage loss: | |
| Store volume | 150.0000 (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | 1.3938 (48) |
| Temperature factor from Table 2b | 0.5400 (49) |
| Enter (49) or (54) in (55) | 0.7527 (55) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total storage loss | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (56) |
| If cylinder contains dedicated solar storage | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (57) |
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | 238.7914 | 211.2041 | 224.2811 | 196.7852 | 190.5208 | 171.4030 | 168.8831 | 175.6849 | 177.7351 | 198.5331 | 211.5514 | 236.1145 | (62) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WWHRS | -27.1932 | -24.0499 | -25.1837 | -20.8531 | -19.4343 | -16.6301 | -15.5881 | -16.5763 | -17.2061 | -20.2841 | -22.9795 | -26.6897 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | | | | | | | | | | | | | |
| | 211.5982 | 187.1542 | 199.0974 | 175.9321 | 171.0865 | 154.7729 | 153.2951 | 159.1086 | 160.5290 | 178.2490 | 188.5719 | 209.4248 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2148.8196 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2149 | (64) |
| Electric shower(s) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | | | | | | | | | | | | | |
| | 101.1813 | 89.9004 | 96.3566 | 86.5115 | 85.1313 | 78.0719 | 77.9368 | 80.1983 | 80.1774 | 87.7954 | 91.4213 | 100.2912 | (65) |

## 5. Internal gains (see Table 5 and 5a)

| Metabolic gains (Table 5), Watts | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 105.1595 | 105.1595 | 105.1595 | 105.1595 | 105.1595 | 105.1595 | 105.1595 | 105.1595 | 105.1595 | 105.1595 | 105.1595 | 105.1595 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 94.4738 | 104.5960 | 94.4738 | 97.6229 | 94.4738 | 97.6229 | 94.4738 | 94.4738 | 97.6229 | 94.4738 | 97.6229 | 94.4738 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 183.9166 | 185.8251 | 181.0158 | 170.7774 | 157.8532 | 145.7063 | 137.5914 | 135.6829 | 140.4922 | 150.7306 | 163.6548 | 175.8018 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 33.5160 | 33.5160 | 33.5160 | 33.5160 | 33.5160 | 33.5160 | 33.5160 | 33.5160 | 33.5160 | 33.5160 | 33.5160 | 33.5160 | (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.0000 | 3.0000 | 3.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | | | | | | | | | | | | | |
| | -84.1276 | -84.1276 | -84.1276 | -84.1276 | -84.1276 | -84.1276 | -84.1276 | -84.1276 | -84.1276 | -84.1276 | -84.1276 | -84.1276 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 135.9963 | 133.7804 | 129.5115 | 120.1549 | 114.4238 | 108.4333 | 104.7537 | 107.7935 | 111.3574 | 118.0045 | 126.9740 | 134.8000 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 471.9346 | 481.7494 | 462.5490 | 446.1030 | 424.2986 | 406.3103 | 391.3667 | 392.4980 | 404.0204 | 420.7568 | 445.7996 | 462.6234 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Northeast | 9.2400 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 31.8615 | (75) |
| Southeast | 2.5700 | 36.7938 | 0.6300 | 0.7000 | 0.7700 | 28.8988 | (77) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 60.7603 | 114.0804 | 184.2004 | 275.3508 | 351.4227 | 367.7987 | 346.7247 | 287.0795 | 215.3095 | 133.6625 | 74.7041 | 50.7511 | (83) |
| Total gains | 532.6949 | 595.8297 | 646.7494 | 721.4538 | 775.7213 | 774.1090 | 738.0914 | 679.5775 | 619.3299 | 554.4193 | 520.5037 | 513.3744 | (84) |

## 7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 94.4493 | 94.7724 | 95.0912 | 96.6178 | 96.9088 | 98.2873 | 98.2873 | 98.5468 | 97.7517 | 96.9088 | 96.3218 | 95.7156 | |
| alpha | 7.2966 | 7.3182 | 7.3394 | 7.4412 | 7.4606 | 7.5525 | 7.5525 | 7.5698 | 7.5168 | 7.4606 | 7.4215 | 7.3810 | |
| util living area | | | | | | | | | | | | | |
| | 0.9988 | 0.9969 | 0.9903 | 0.9501 | 0.8133 | 0.5880 | 0.4270 | 0.4830 | 0.7671 | 0.9716 | 0.9966 | 0.9991 | (86) |
| MIT | 20.1843 | 20.3105 | 20.5035 | 20.7742 | 20.9480 | 20.9958 | 20.9997 | 20.9992 | 20.9744 | 20.7505 | 20.4292 | 20.1712 | (87) |
| Th 2 | 19.9535 | 19.9567 | 19.9599 | 19.9746 | 19.9773 | 19.9902 | 19.9902 | 19.9926 | 19.9852 | 19.9773 | 19.9718 | 19.9659 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9982 | 0.9953 | 0.9850 | 0.9250 | 0.7462 | 0.4979 | 0.3292 | 0.3778 | 0.6719 | 0.9517 | 0.9945 | 0.9986 | (89) |
| MIT 2 | 19.0208 | 19.1844 | 19.4309 | 19.7681 | 19.9435 | 19.9887 | 19.9902 | 19.9924 | 19.9733 | 19.7504 | 19.3482 | 19.0139 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.3541 | (91) |
| MIT | 19.4328 | 19.5832 | 19.8108 | 20.1244 | 20.2992 | 20.3454 | 20.3477 | 20.3490 | 20.3278 | 20.1046 | 19.7310 | 19.4238 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.4328 | 19.5832 | 19.8108 | 20.1244 | 20.2992 | 20.3454 | 20.3477 | 20.3490 | 20.3278 | 20.1046 | 19.7310 | 19.4238 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9978 | 0.9946 | 0.9840 | 0.9293 | 0.7687 | 0.5299 | 0.3639 | 0.4152 | 0.7059 | 0.9548 | 0.9938 | 0.9983 | (94) |
| Useful gains | 531.5202 | 592.5884 | 636.3858 | 670.4480 | 596.3096 | 410.2369 | 268.5878 | 282.1433 | 437.1664 | 529.3456 | 517.2657 | 512.4987 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | | | | | | | | | | | | | |
| | 1128.9601 | 1091.6837 | 986.3256 | 818.5853 | 625.2494 | 411.8864 | 268.6706 | 282.3573 | 448.9215 | 691.0766 | 924.0001 | 1120.7181 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 444.4953 | 335.3920 | 260.3552 | 106.6589 | 21.5312 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 120.3278 | 292.8488 | 452.5153 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 2034.1245 | |
| Solar heating kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | | | | | | | | | | | | | |
| | 444.4953 | 335.3920 | 260.3552 | 106.6589 | 21.5312 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 120.3278 | 292.8488 | 452.5153 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 2034.1245 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 31.5809 | (99) |

## 9a. Energy requirements - Individual heating systems, including micro-CHP

| | | |
|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | 0.0000 | (201) |
| Fraction of space heat from main system(s) | 1.0000 | (202) |
| Efficiency of main space heating system 1 (in %) | 92.3000 | (206) |
| Efficiency of main space heating system 2 (in %) | 0.0000 | (207) |
| Efficiency of secondary/supplementary heating system, % | 0.0000 | (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement | | | | | | | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 444.4953 | 335.3920 | 260.3552 | 106.6589 | 21.5312 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 120.3278 | 292.8488 | 452.5153 (98) |
| Space heating efficiency (main heating system 1) | | | | | | | | | | | | |
| | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.3000 | 92.3000 | 92.3000 (210) |
| Space heating fuel (main heating system) | | | | | | | | | | | | |
| | 481.5767 | 363.3716 | 282.0750 | 115.5567 | 23.3275 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 130.3660 | 317.2793 | 490.2657 (211) |
| Space heating efficiency (main heating system 2) | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (212) |
| Space heating fuel (main heating system 2) | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (213) |
| Space heating fuel (secondary) | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (215) |
| Water heating | | | | | | | | | | | | |
| Water heating requirement | | | | | | | | | | | | |
| | 211.5982 | 187.1542 | 199.0974 | 175.9321 | 171.0865 | 154.7729 | 153.2951 | 159.1086 | 160.5290 | 178.2490 | 188.5719 | 209.4248 (64) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 (216) |
| (217)m | 85.6834 | 85.3523 | 84.6623 | 82.9740 | 80.7144 | 79.8000 | 79.8000 | 79.8000 | 79.8000 | 83.1982 | 85.0431 | 85.7406 (217) |
| Fuel for water heating, kWh/month | | | | | | | | | | | | |
| | 246.9536 | 219.2726 | 235.1664 | 212.0327 | 211.9651 | 193.9510 | 192.0991 | 199.3842 | 201.1641 | 214.2461 | 221.7369 | 244.2540 (219) |
| Space cooling fuel requirement | | | | | | | | | | | | |
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (221) |
| Pumps and Fa | 7.3041 | 6.5973 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 (231) |
| Lighting | 19.6298 | 15.7477 | 14.1791 | 10.3882 | 8.0242 | 6.5558 | 7.3199 | 9.5147 | 12.3586 | 16.2152 | 18.3150 | 20.1754 (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (233a)m | -14.3208 | -21.5022 | -32.8941 | -39.4436 | -44.7238 | -42.5595 | -42.0485 | -38.6033 | -32.9221 | -25.6490 | -16.2054 | -12.2334 (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | |
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (233b)m | -4.5410 | -9.8145 | -20.0044 | -30.7894 | -41.4483 | -41.9121 | -41.4125 | -34.7182 | -25.0029 | -14.2681 | -6.1366 | -3.5713 (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | |
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235d) |

| | |
|---|---|
| Annual totals kWh/year | |
| Space heating fuel - main system 1 | 2203.8185 (211) |
| Space heating fuel - main system 2 | 0.0000 (213) |
| Space heating fuel - secondary | 0.0000 (215) |
| Efficiency of water heater | 79.8000 |
| Water heating fuel used | 2592.2259 (219) |
| Space cooling fuel | 0.0000 (221) |
| Electricity for pumps and fans: | |
| Total electricity for the above, kWh/year | 86.0000 (231) |
| Electricity for lighting (calculated in Appendix L) | 158.4236 (232) |
| Energy saving/generation technologies (Appendices M ,N and Q) | |
| PV generation | -636.7251 (233) |
| Wind generation | 0.0000 (234) |
| Hydro-electric generation (Appendix N) | 0.0000 (235a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 (235) |
| Appendix Q - special features | |
| Energy saved or generated | -0.0000 (236) |
| Energy used | 0.0000 (237) |
| Total delivered energy for all uses | 4403.7429 (238) |

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 2203.8185 | 0.2100 | 462.8019 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2592.2259 | 0.2100 | 544.3674 | (264) |
| Space and water heating | | | 1007.1693 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 158.4236 | 0.1443 | 22.8654 | (268) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -363.1057 | 0.1333 | -48.3953 | |
| PV Unit electricity exported | -273.6194 | 0.1252 | -34.2546 | |
| Total | | | -82.6499 | (269) |
| Total CO2, kg/year | | | 959.3141 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 14.8900 | (273) |

13a. Primary energy - Individual heating systems including micro-CHP

| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 2203.8185 | 1.1300 | 2490.3149 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2592.2259 | 1.1300 | 2929.2152 | (278) |
| Space and water heating | | | 5419.5301 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 158.4236 | 1.5338 | 242.9954 | (282) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -363.1057 | 1.4925 | -541.9396 | |
| PV Unit electricity exported | -273.6194 | 0.4595 | -125.7286 | |
| Total | | | -667.6681 | (283) |
| Total Primary energy kWh/year | | | 5124.9582 | (286) |
| Target Primary Energy Rate (TPER) | | | 79.5700 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Property Reference** | Unit 12 | **Issued on Date** | 17/05/2025 |
| **Assessment Reference** | 00001 | **Prop Type Ref** | Unit 12 |
| **Property** | | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 79 C | **DER** | 5.29 | **TER** | 13.25 |
| **Environmental** | 95 A | **% DER < TER** | | | 60.08 |
| **$CO_2$ Emissions (t/year)** | 0.45 | **DFEE** | 36.64 | **TFEE** | 40.17 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 8.80 |
| **% DPER < TPER** | 20.84 | **DPER** | 55.80 | **TPER** | 70.49 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Robert Arnold | **Assessor ID** | BA04-0001 |
| **Client** | | | |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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## 1. Overall dwelling characteristics

| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 97.1600 | (1b) | x 3.0800 | (2b) = | 299.2528 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 97.1600 | | | | | (4) |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | 299.2528 | (5) |

## 2. Ventilation rate

| | m3 per hour | |
|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 (6a) |
| Number of open flues | 0 * 20 = | 0.0000 (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 (6f) |
| Number of intermittent extract fans | 0 * 10 = | 0.0000 (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 (7c) |
| | Air changes per hour | |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 0.0000 / (5) = | 0.0000 (8) |
| Pressure test | | Yes |
| Pressure Test Method | | Blower Door |
| Measured/design AP50 | | 3.0000 (17) |
| Infiltration rate | | 0.1500 (18) |
| Number of sides sheltered | | 0 (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.1500 (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.1912 | 0.1875 | 0.1837 | 0.1650 | 0.1612 | 0.1425 | 0.1425 | 0.1388 | 0.1500 | 0.1612 | 0.1687 | 0.1762 | (22b) |
| Balanced mechanical ventilation with heat recovery | | | | | | | | | | | | | |
| If mechanical ventilation | | | | | | | | | | | | 0.5000 | (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | | | | | | | | | | | | 0.5000 | (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | | | | | | | | | | | | 80.1000 | (23c) |
| Effective ac | 0.2907 | 0.2870 | 0.2833 | 0.2645 | 0.2607 | 0.2420 | 0.2420 | 0.2382 | 0.2495 | 0.2607 | 0.2682 | 0.2757 | (25) |

## 3. Heat losses and heat loss parameter

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| Windows | | | 11.0200 | 1.0536 | 11.6111 | | | (27) |
| Front Door | | | 1.8900 | 1.4000 | 2.6460 | | | (26) |
| Glass Door | | | 2.2900 | 1.3258 | 3.0360 | | | (27) |
| Heatloss Floor 1 | | | 97.1600 | 0.1000 | 9.7160 | 0.0000 | 0.0000 | (28b) |
| External Walls | 51.6600 | 13.3100 | 38.3500 | 0.1500 | 5.7525 | 150.0000 | 5752.5000 | (29a) |
| Wall to Communal Corridor | 36.6900 | 1.8900 | 34.8000 | 0.1400 | 4.8720 | 150.0000 | 5220.0000 | (29a) |
| Wall to Stairs | 11.0100 | | 11.0100 | 0.1100 | 1.2111 | 150.0000 | 1651.5000 | (29a) |
| Total net area of external elements Aum(A, m2) | | | 196.5200 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | | (26)...(30) + (32) = | 38.8447 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 11 | | | 8.8200 | 0.0000 | 0.0000 | 110.0000 | 970.2000 | (32) |
| Party Wall to Unit 13 | | | 23.6400 | 0.0000 | 0.0000 | 110.0000 | 2600.4000 | (32) |
| Party Ceiling | | | 97.1600 | | | 100.0000 | 9716.0000 | (32b) |
| Internal Walls | | | 239.1600 | | | 9.0000 | 2152.4400 | (32c) |

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 28063.0400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 288.8333 (35)
List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E1 Steel lintel with perforated steel base plate | 7.1500 | 0.0500 | 0.3575 |
| E4 Jamb | 20.6600 | 0.0500 | 1.0330 |
| E7 Party floor between dwellings (in blocks of flats) | 16.2100 | 0.0700 | 1.1347 |
| E18 Party wall between dwellings | 3.0800 | 0.0600 | 0.1848 |
| E16 Corner (normal) | 9.2400 | 0.0900 | 0.8316 |
| E17 Corner (inverted - internal area greater than external area) | 6.1600 | -0.0900 | -0.5544 |
| E20 Exposed floor (normal) | 10.8090 | 0.3200 | 3.4589 |
| E23 Balcony within or between dwellings, balcony support penetrates wall insulation | 5.9650 | 0.0200 | 0.1193 |
| E25 Staggered party wall between dwellings | 3.0800 | 0.0600 | 0.1848 |
| P7 Party Wall - Exposed floor (normal) | 7.6770 | 0.1600 | 1.2283 |
| E7 Party floor between dwellings (in blocks of flats) | 15.4900 | 0.0350 | 0.5422 |
| E3 Sill | 1.0225 | 0.0500 | 0.0511 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 8.5718 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 47.4165 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 28.7126 | 28.3422 | 27.9719 | 26.1203 | 25.7500 | 23.8983 | 23.8983 | 23.5280 | 24.6390 | 25.7500 | 26.4906 | 27.2313 | (38) |
| Heat transfer coeff | 76.1290 | 75.7587 | 75.3884 | 73.5368 | 73.1664 | 71.3148 | 71.3148 | 70.9445 | 72.0555 | 73.1664 | 73.9071 | 74.6477 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 73.4442 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 0.7835 | 0.7797 | 0.7759 | 0.7569 | 0.7531 | 0.7340 | 0.7340 | 0.7302 | 0.7416 | 0.7531 | 0.7607 | 0.7683 | (40) |
| HLP (average) | | | | | | | | | | | | 0.7559 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

---
4. Water heating energy requirements (kWh/year)
---

Assumed occupancy 2.7116 (42)
Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 67.9244 | 66.8845 | 65.3519 | 62.9943 | 60.8820 | 57.9268 | 55.5895 | 58.3220 | 59.6963 | 62.6232 | 65.6714 | 67.8631 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 29.4193 | 28.9752 | 28.3434 | 27.3972 | 26.5446 | 25.3708 | 24.4802 | 25.5692 | 26.1407 | 27.3037 | 28.5130 | 29.3959 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 42.3998 | 40.8580 | 39.3162 | 37.7744 | 36.2326 | 34.6908 | 34.6908 | 36.2326 | 37.7744 | 39.3162 | 40.8580 | 42.3998 | (42c) |

Average daily hot water use (litres/day) 128.4449 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 139.7435 | 136.7177 | 133.0115 | 128.1660 | 123.6591 | 117.9883 | 114.7605 | 120.1237 | 123.6114 | 129.2432 | 135.0424 | 139.6589 | (44) |
| Energy conte | 205.7265 | 180.9051 | 190.0707 | 167.4168 | 159.3473 | 136.4496 | 126.8137 | 141.3878 | 143.3830 | 166.5429 | 182.5143 | 205.0993 | (45) |
| Energy content (annual) | | | | | | | | | | | Total = Sum(45)m = | 2005.6572 | |
| Distribution loss (46)m = 0.15 x (45)m | 30.8590 | 27.1358 | 28.5106 | 25.1125 | 23.9021 | 20.4674 | 19.0221 | 21.2082 | 21.5075 | 24.9814 | 27.3771 | 30.7649 | (46) |
| Water storage loss: | | | | | | | | | | | | | |
| Store volume | | | | | | | | | | | | 110.0000 | (47) |
| b) If manufacturer declared loss factor is not known : | | | | | | | | | | | | | |
| Hot water storage loss factor from Table 2 (kWh/litre/day) | | | | | | | | | | | | 0.0152 | (51) |
| Volume factor from Table 2a | | | | | | | | | | | | 1.0294 | (52) |
| Temperature factor from Table 2b | | | | | | | | | | | | 0.6000 | (53) |
| Enter (49) or (54) in (55) | | | | | | | | | | | | 1.0327 | (55) |
| Total storage loss | 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (56) |
| If cylinder contains dedicated solar storage | 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (57) |
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | 261.0033 | 230.8325 | 245.3475 | 220.9105 | 214.6241 | 189.9433 | 182.0905 | 196.6647 | 196.8767 | 221.8198 | 236.0080 | 260.3761 | (62) |
| WWHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | 261.0033 | 230.8325 | 245.3475 | 220.9105 | 214.6241 | 189.9433 | 182.0905 | 196.6647 | 196.8767 | 221.8198 | 236.0080 | 260.3761 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2656.4970 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2656 | (64) |
| Electric shower(s) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | 112.6255 | 100.0929 | 107.4200 | 98.4610 | 97.2044 | 88.1644 | 86.3870 | 91.2329 | 90.4698 | 99.5970 | 103.4810 | 112.4170 | (65) |

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5. Internal gains (see Table 5 and 5a)
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Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 135.5817 | 135.5817 | 135.5817 | 135.5817 | 135.5817 | 135.5817 | 135.5817 | 135.5817 | 135.5817 | 135.5817 | 135.5817 | 135.5817 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 136.8204 | 151.4797 | 136.8204 | 141.3810 | 136.8204 | 141.3810 | 136.8204 | 136.8204 | 141.3810 | 136.8204 | 141.3810 | 136.8204 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 251.6530 | 254.2644 | 247.6838 | 233.6746 | 215.9904 | 199.3698 | 188.2662 | 185.6548 | 192.2354 | 206.2446 | 223.9288 | 240.5494 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 36.5582 | 36.5582 | 36.5582 | 36.5582 | 36.5582 | 36.5582 | 36.5582 | 36.5582 | 36.5582 | 36.5582 | 36.5582 | 36.5582 | (69) |
| Pumps, fans | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | -108.4654 | -108.4654 | -108.4654 | -108.4654 | -108.4654 | -108.4654 | -108.4654 | -108.4654 | -108.4654 | -108.4654 | -108.4654 | -108.4654 | (71) |
| Water heating gains (Table 5) | 151.3784 | 148.9478 | 144.3817 | 136.7514 | 130.6511 | 122.4506 | 116.1116 | 122.6249 | 125.6525 | 133.8669 | 143.7235 | 151.0981 | (72) |
| Total internal gains | 603.5263 | 618.3664 | 592.5604 | 575.4816 | 547.1364 | 526.8759 | 504.8726 | 508.7746 | 522.9434 | 540.6064 | 572.7079 | 592.1424 | (73) |

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6. Solar gains
---

| [Jan] | Area | Solar flux | g | FF | Access | Gains |
|---|---|---|---|---|---|---|

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | m2 | Table 6a W/m2 | Specific data or Table 6b | Specific data or Table 6c | | factor Table 6d | | | W | |
| Southeast | | | | 11.0200 | 36.7938 | 0.4500 | 0.7000 | | 0.7700 | | | 88.5116 | (77) |
| Southeast | | | | 2.2900 | 36.7938 | 0.4500 | 0.7000 | | 0.7700 | | | 18.3931 | (77) |
| Solar gains | 106.9047 | 182.0983 | 249.1548 | 308.7149 | 345.7864 | 343.2859 | 330.9642 | 303.3072 | 269.7820 | 201.2574 | 128.0472 | 91.4882 | (83) |
| Total gains | 710.4310 | 800.4647 | 841.7152 | 884.1964 | 892.9228 | 870.1618 | 835.8368 | 812.0817 | 792.7254 | 741.8638 | 700.7551 | 683.6305 | (84) |

7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 102.3957 | 102.8963 | 103.4017 | 106.0053 | 106.5419 | 109.3082 | 109.3082 | 109.8787 | 108.1846 | 106.5419 | 105.4742 | 104.4277 | |
| alpha | 7.8264 | 7.8598 | 7.8934 | 8.0670 | 8.1028 | 8.2872 | 8.2872 | 8.3252 | 8.2123 | 8.1028 | 8.0316 | 7.9618 | |
| util living area | 0.9953 | 0.9871 | 0.9676 | 0.8925 | 0.7401 | 0.5233 | 0.3753 | 0.4017 | 0.6220 | 0.9011 | 0.9848 | 0.9964 | (86) |
| MIT | 20.4105 | 20.5509 | 20.7085 | 20.8944 | 20.9795 | 20.9989 | 20.9999 | 20.9999 | 20.9957 | 20.9029 | 20.6463 | 20.3998 | (87) |
| Th 2 | 20.2676 | 20.2709 | 20.2743 | 20.2909 | 20.2942 | 20.3109 | 20.3109 | 20.3142 | 20.3042 | 20.2942 | 20.2875 | 20.2809 | (88) |
| util rest of house | 0.9937 | 0.9830 | 0.9573 | 0.8642 | 0.6915 | 0.4676 | 0.3166 | 0.3419 | 0.5617 | 0.8691 | 0.9791 | 0.9951 | (89) |
| MIT 2 | 19.5844 | 19.7643 | 19.9620 | 20.1918 | 20.2790 | 20.3104 | 20.3109 | 20.3142 | 20.3018 | 20.2073 | 19.8992 | 19.5818 | (90) |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.4493 | (91) |
| MIT | 19.9556 | 20.1177 | 20.2973 | 20.5074 | 20.5937 | 20.6197 | 20.6204 | 20.6223 | 20.6136 | 20.5198 | 20.2348 | 19.9493 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.9556 | 20.1177 | 20.2973 | 20.5074 | 20.5937 | 20.6197 | 20.6204 | 20.6223 | 20.6136 | 20.5198 | 20.2348 | 19.9493 | (93) |

8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9929 | 0.9819 | 0.9577 | 0.8734 | 0.7126 | 0.4926 | 0.3430 | 0.3688 | 0.5888 | 0.8801 | 0.9786 | 0.9944 | (94) |
| Useful gains | 705.3752 | 785.9836 | 806.0927 | 772.2516 | 636.3182 | 428.6694 | 286.6909 | 299.4994 | 466.7303 | 652.9502 | 685.7411 | 679.7825 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | 1191.8419 | 1152.8742 | 1040.1587 | 853.5735 | 650.7177 | 429.2934 | 286.7175 | 299.5463 | 469.3373 | 725.7954 | 970.7569 | 1175.6495 | (97) |
| Space heating kWh | 361.9313 | 246.5505 | 174.1451 | 58.5518 | 10.7132 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 54.1968 | 205.2114 | 368.9251 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 1480.2251 | |
| Solar heating kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | 361.9313 | 246.5505 | 174.1451 | 58.5518 | 10.7132 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 54.1968 | 205.2114 | 368.9251 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 1480.2251 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 15.2349 | (99) |

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ext. temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | |
| Heat loss rate W | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 670.3591 | 527.7295 | 539.1780 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (100) |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.9820 | 0.9952 | 0.9934 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (101) |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 658.3202 | 525.2079 | 535.6073 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (102) |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 942.0431 | 905.7417 | 880.1030 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 204.2804 | 283.1172 | 256.3049 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (104) |
| Cooled fraction | | | | | | | | | fC = cooled area / (4) = | | | 0.9984 | (105) |
| Intermittency factor (Table 10b) | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | (106) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 50.9860 | 70.6627 | 63.9707 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) |
| Space cooling requirement | | | | | | | | | | | | 185.6194 | (107) |

9b. Energy requirements

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | 0.0000 | (301) |
| Fraction of space heat from community system | | | | | | | | | | | | 1.0000 | (302) |
| Fraction of heat from community Heat pump-Space and Water | | | | | | | | | | | | 1.0000 | (303a) |
| Factor for control and charging method (Table 4c(3)) for space heating | | | | | | | | | | | | 1.0000 | (305) |
| Factor for charging method (Table 4c(3)) for water heating | | | | | | | | | | | | 1.0000 | (305a) |
| Distribution loss factor (Table 12c) for community heating system | | | | | | | | | | | | 2.0000 | (306) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 | (208) |
| Space heating: | | | | | | | | | | | | | |
| Space heating requirement | | | | | | | | | | | | | |
| | 361.9313 | 246.5505 | 174.1451 | 58.5518 | 10.7132 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 54.1968 | 205.2114 | 368.9251 | (98) |
| Space heat from Heat pump = (98) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 307a | 723.8625 | 493.1010 | 348.2902 | 117.1036 | 21.4264 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 108.3936 | 410.4227 | 737.8502 | |
| Space heating requirement | | | | | | | | | | | | | |
| | 723.8625 | 493.1010 | 348.2902 | 117.1036 | 21.4264 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 108.3936 | 410.4227 | 737.8502 | (307) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | | | | | | | | | | | 0.0000 | (308) |
| Space heating fuel for secondary/supplementary system | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (309) |
| Water heating | | | | | | | | | | | | | |
| Annual water heating requirement | | | | | | | | | | | | | |
| | 261.0033 | 230.8325 | 245.3475 | 220.9105 | 214.6241 | 189.9433 | 182.0905 | 196.6647 | 196.8767 | 221.8198 | 236.0080 | 260.3761 | (64) |
| Water heat from Heat pump = (64) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 310a | 522.0067 | 461.6651 | 490.6950 | 441.8209 | 429.2482 | 379.8865 | 364.1810 | 393.3293 | 393.7534 | 443.6395 | 472.0160 | 520.7523 | |
| Water heating fuel | | | | | | | | | | | | | |
| | 522.0067 | 461.6651 | 490.6950 | 441.8209 | 429.2482 | 379.8865 | 364.1810 | 393.3293 | 393.7534 | 443.6395 | 472.0160 | 520.7523 | (310) |
| Cooling System Energy Efficiency Ratio | | | | | | | | | | | | 2.6000 | (314) |
| Space coolin | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 19.6100 | 27.1780 | 24.6041 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (315) |
| Pumps and Fa | 26.4804 | 23.9178 | 26.4804 | 25.6262 | 26.4804 | 25.6262 | 26.4804 | 26.4804 | 25.6262 | 26.4804 | 25.6262 | 26.4804 | (331) |
| Lighting | 31.8771 | 25.5730 | 23.0257 | 16.8696 | 13.0306 | 10.6461 | 11.8869 | 15.4510 | 20.0694 | 26.3321 | 29.7421 | 32.7631 | (332) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (333a)m | -4.8770 | -7.9732 | -13.3727 | -17.4962 | -21.0693 | -20.5066 | -20.2149 | -17.8972 | -14.2668 | -10.0168 | -5.7120 | -4.0863 (333a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (334a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (334a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (335a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (335a) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (333b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (333b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (334b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (334b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (335b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (335b) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - community heating | 2960.4502 | (307) |
| Space heating fuel - secondary | 0.0000 | (309) |
| Water heating fuel - community heating | 5312.9940 | (310) |
| Efficiency of water heater | 0.0000 | (311) |
| Electricity used for heat distribution | 29.6045 | (313) |
| Space cooling fuel | 71.3921 | (321) |
| | | |
| Electricity for pumps and fans: | | |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8540) | | |
| mechanical ventilation fans (SFP = 0.8540) | 311.7855 | (330a) |
| Total electricity for the above, kWh/year | 311.7855 | (331) |
| Electricity for lighting (calculated in Appendix L) | 257.2666 | (332) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -157.4888 | (333) |
| Wind generation | 0.0000 | (334) |
| Hydro-electric generation (Appendix N) | 0.0000 | (335a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (335) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (336) |
| Energy used | 0.0000 | (337) |
| Total delivered energy for all uses | 8756.3996 | (338) |

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12b. Carbon dioxide emissions - Community heating scheme

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (367) |
| Space and Water heating from Heat pump | 2954.8015 | 0.1577 | 166.6904 | (367) |
| Electrical energy for heat distribution (space & water) | 29.6045 | 0.0000 | 12.1520 | (372) |
| Overall CO2 factor for heat network | | | 0.0539 | (386) |
| Total CO2 associated with community systems | | | 446.1511 | (373) |
| Space and water heating | | | 446.1511 | (376) |
| Space cooling | 71.3921 | 0.1138 | 8.1256 | (377) |
| Pumps, fans and electric keep-hot | 311.7855 | 0.1387 | 43.2485 | (378) |
| Energy for lighting | 257.2666 | 0.1443 | 37.1315 | (379) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -157.4888 | 0.1317 | -20.7403 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -20.7403 | (380) |
| Total CO2, kg/year | | | 513.9164 | (383) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 5.2900 | (384) |

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13b. Primary energy - Community heating scheme

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| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (467a) |
| Space and Water heating from Heat pump | 2954.8015 | 1.5836 | 1674.3787 | (467) |
| Electrical energy for heat distribution (space & water) | 29.6045 | 0.0000 | 127.6879 | (472) |
| Overall CO2 factor for heat network | | | 0.5666 | (486) |
| Total CO2 associated with community systems | | | 4687.9707 | (473) |
| Space and water heating | | | 4687.9707 | (476) |
| Space cooling | 71.3921 | 1.4195 | 101.3446 | (477) |
| Pumps, fans and electric keep-hot | 311.7855 | 1.5128 | 471.6691 | (478) |
| Energy for lighting | 257.2666 | 1.5338 | 394.6041 | (479) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -157.4888 | 1.4865 | -234.1149 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -234.1149 | (480) |
| Total Primary energy kWh/year | | | 5421.4735 | (483) |
| Dwelling Primary energy Rate (DPER) | | | 55.8000 | (484) |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

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| | | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | |
| Ground floor | | 97.1600 (1b) | x | 3.0800 (2b) | = | 299.2528 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 97.1600 | | | | | | (4) |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = | 299.2528 | (5) |

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2. Ventilation rate

| | | | |
|---|---|---|---|
| | | m3 per hour | |
| Number of open chimneys | 0 * 80 = | 0.0000 | (6a) |
| Number of open flues | 0 * 20 = | 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | 3 * 10 = | 30.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |
| | Air changes per hour | | |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 30.0000 / (5) = | 0.1002 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3502 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.3502 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.4466 | 0.4378 | 0.4291 | 0.3853 | 0.3765 | 0.3327 | 0.3327 | 0.3240 | 0.3502 | 0.3765 | 0.3940 | 0.4115 | (22b) |
| Effective ac | 0.5997 | 0.5958 | 0.5920 | 0.5742 | 0.5709 | 0.5554 | 0.5554 | 0.5525 | 0.5613 | 0.5709 | 0.5776 | 0.5847 | (25) |

## 3. Heat losses and heat loss parameter

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| TER Opaque door | | | 1.8900 | 1.0000 | 1.8900 | | | (26) |
| TER Opening Type | | | 13.3100 | 1.1450 | 15.2405 | | | (27) |
| Heatloss Floor 1 | | | 97.1600 | 0.1300 | 12.6308 | | | (28b) |
| External Walls | 51.6600 | 13.3100 | 38.3500 | 0.1800 | 6.9030 | | | (29a) |
| Wall to Communal Corridor | 36.6900 | 1.8900 | 34.8000 | 0.1800 | 6.2640 | | | (29a) |
| Wall to Stairs | 11.0100 | | 11.0100 | 0.1800 | 1.9818 | | | (29a) |
| Total net area of external elements Aum(A, m2) | | | 196.5200 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | | (26)...(30) + (32) = | 44.9101 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 11 | | | 8.8200 | 0.0000 | 0.0000 | | | (32) |
| Party Wall to Unit 13 | | | 23.6400 | 0.0000 | 0.0000 | | | (32) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 268.8333 (35)

List of Thermal Bridges

| K1 Element | Length | Psi-value | Total |
|---|---|---|---|
| E1 Steel lintel with perforated steel base plate | 7.1500 | 0.0500 | 0.3575 |
| E4 Jamb | 20.6600 | 0.0500 | 1.0330 |
| E7 Party floor between dwellings (in blocks of flats) | 16.2100 | 0.0700 | 1.1347 |
| E18 Party wall between dwellings | 3.0800 | 0.0600 | 0.1848 |
| E16 Corner (normal) | 9.2400 | 0.0900 | 0.8316 |
| E17 Corner (inverted - internal area greater than external area) | 6.1600 | -0.0900 | -0.5544 |
| E20 Exposed floor (normal) | 10.8090 | 0.3200 | 3.4589 |
| E23 Balcony within or between dwellings, balcony support penetrates wall insulation | 5.9650 | 0.0200 | 0.1193 |
| E25 Staggered party wall between dwellings | 3.0800 | 0.0600 | 0.1848 |
| P7 Party Wall - Exposed floor (normal) | 7.6770 | 0.1600 | 1.2283 |
| E7 Party floor between dwellings (in blocks of flats) | 15.4900 | 0.0700 | 1.0843 |
| E3 Sill | 1.0225 | 0.0500 | 0.0511 |

| | | |
|---|---|---|
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | 9.1139 (36) |
| Point Thermal bridges | (36a) = | 0.0000 |
| Total fabric heat loss | (33) + (36) + (36a) = | 54.0240 (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 59.2236 | 58.8412 | 58.4664 | 56.7060 | 56.3767 | 54.8434 | 54.8434 | 54.5595 | 55.4340 | 56.3767 | 57.0430 | 57.7395 | (38) |
| Heat transfer coeff | 113.2476 | 112.8652 | 112.4904 | 110.7300 | 110.4006 | 108.8674 | 108.8674 | 108.5835 | 109.4580 | 110.4006 | 111.0669 | 111.7635 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 110.7284 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.1656 | 1.1616 | 1.1578 | 1.1397 | 1.1363 | 1.1205 | 1.1205 | 1.1176 | 1.1266 | 1.1363 | 1.1431 | 1.1503 | (40) |
| HLP (average) | | | | | | | | | | | | 1.1397 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

## 4. Water heating energy requirements (kWh/year)

| | | |
|---|---|---|
| Assumed occupancy | 2.7116 | (42) |

Hot water usage for mixer showers

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 69.6850 | 68.6377 | 67.1117 | 64.1920 | 62.0372 | 59.6343 | 58.2685 | 59.7830 | 61.4431 | 64.0231 | 67.0056 | 69.4180 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 30.0900 | 29.6432 | 29.0139 | 27.8535 | 26.9847 | 26.0213 | 25.5009 | 26.1258 | 26.8062 | 27.8371 | 29.0213 | 29.9883 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 42.3998 | 40.8580 | 39.3162 | 37.7744 | 36.2326 | 34.6908 | 34.6908 | 36.2326 | 37.7744 | 39.3162 | 40.8580 | 42.3998 | (42c) |

| | |
|---|---|
| Average daily hot water use (litres/day) | 130.6907 (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 142.1748 | 139.1389 | 135.4418 | 129.8199 | 125.2545 | 120.3464 | 118.4602 | 122.1414 | 126.0238 | 131.1764 | 136.8849 | 141.8061 | (44) |
| Energy conte | 225.1702 | 198.1320 | 208.1690 | 177.7170 | 168.6167 | 147.9800 | 143.2674 | 151.2366 | 155.3999 | 178.0052 | 195.0177 | 222.0341 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 2170.7456 | |

Distribution loss (46)m = 0.15 x (45)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 33.7755 | 29.7198 | 31.2253 | 26.6575 | 25.2925 | 22.1970 | 21.4901 | 22.6855 | 23.3100 | 26.7008 | 29.2527 | 33.3051 | (46) |

| | |
|---|---|
| Water storage loss: | |
| Store volume | 150.0000 (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | 1.3938 (48) |
| Temperature factor from Table 2b | 0.5400 (49) |
| Enter (49) or (54) in (55) | 0.7527 (55) |

Total storage loss

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (56) |

If cylinder contains dedicated solar storage

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (57) |
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |

Total heat required for water heating calculated for each month

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 271.7651 | 240.2177 | 254.7639 | 222.8088 | 215.2116 | 193.0718 | 189.8623 | 197.8315 | 200.4917 | 224.6001 | 240.1095 | 268.6290 | (62) |
| WWHRS | -31.8571 | -28.1746 | -29.5029 | -24.4295 | -22.7674 | -19.4823 | -18.2615 | -19.4193 | -20.1571 | -23.7630 | -26.9206 | -31.2671 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |

Output from w/h

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 239.9080 | 212.0430 | 225.2610 | 198.3793 | 192.4441 | 173.5895 | 171.6008 | 178.4122 | 180.3346 | 200.8371 | 213.1889 | 237.3619 | (64) |

Total per year (kWh/year) = Sum(64)m = 2423.3606 (64)

12Total per year (kWh/year) 2423 (64)

Electric shower(s)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)

Heat gains from water heating, kWh/month

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 112.1450 | 99.5475 | 106.4921 | 95.1644 | 93.3410 | 85.2768 | 84.9123 | 87.5621 | 87.7439 | 96.4626 | 100.9169 | 111.1023 | (65) |

## 5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 135.5817 | 135.5817 | 135.5817 | 135.5817 | 135.5817 | 135.5817 | 135.5817 | 135.5817 | 135.5817 | 135.5817 | 135.5817 | 135.5817 | (66) |

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 136.8204 | 151.4797 | 136.8204 | 141.3810 | 136.8204 | 141.3810 | 136.8204 | 136.8204 | 141.3810 | 136.8204 | 141.3810 | 136.8204 | (67) |

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 251.6530 | 254.2644 | 247.6838 | 233.6746 | 215.9904 | 199.3698 | 188.2662 | 185.6548 | 192.2354 | 206.2446 | 223.9288 | 240.5494 | (68) |

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 36.5582 | 36.5582 | 36.5582 | 36.5582 | 36.5582 | 36.5582 | 36.5582 | 36.5582 | 36.5582 | 36.5582 | 36.5582 | 36.5582 | (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.0000 | 3.0000 | 3.0000 | (70) |

Losses e.g. evaporation (negative values) (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | -108.4654 | -108.4654 | -108.4654 | -108.4654 | -108.4654 | -108.4654 | -108.4654 | -108.4654 | -108.4654 | -108.4654 | -108.4654 | -108.4654 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 150.7325 | 148.1361 | 143.1346 | 132.1727 | 125.4583 | 118.4400 | 114.1295 | 117.6910 | 121.8666 | 129.6541 | 140.1623 | 149.3310 | (72) |

Total internal gains

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 605.8805 | 620.5547 | 594.3133 | 573.9029 | 544.9436 | 522.8654 | 502.8905 | 503.8407 | 519.1575 | 539.3936 | 572.1467 | 593.3753 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Southeast | 13.3100 | 36.7938 | 0.6300 | 0.7000 | 0.7700 | 149.6666 | (77) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 149.6666 | 254.9376 | 348.8167 | 432.2009 | 484.1010 | 480.6002 | 463.3499 | 424.6301 | 377.6948 | 281.7604 | 179.2661 | 128.0834 | (83) |
| Total gains | 755.5471 | 875.4923 | 943.1300 | 1006.1037 | 1029.0446 | 1003.4656 | 966.2404 | 928.4707 | 896.8523 | 821.1540 | 751.4128 | 721.4587 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| tau | 64.0677 | 64.2848 | 64.4989 | 65.5243 | 65.7198 | 66.6454 | 66.6454 | 66.8197 | 66.2858 | 65.7198 | 65.3256 | 64.9184 | |
| alpha | 5.2712 | 5.2857 | 5.2999 | 5.3683 | 5.3813 | 5.4430 | 5.4430 | 5.4546 | 5.4191 | 5.3813 | 5.3550 | 5.3279 | |
| util living area | 0.9952 | 0.9890 | 0.9761 | 0.9362 | 0.8423 | 0.6621 | 0.4902 | 0.5294 | 0.7637 | 0.9468 | 0.9890 | 0.9962 | (86) |
| MIT | 19.8168 | 20.0114 | 20.2611 | 20.5849 | 20.8331 | 20.9662 | 20.9944 | 20.9916 | 20.9265 | 20.6131 | 20.1653 | 19.7933 | (87) |
| Th 2 | 19.9476 | 19.9508 | 19.9539 | 19.9686 | 19.9713 | 19.9841 | 19.9841 | 19.9865 | 19.9792 | 19.9713 | 19.9658 | 19.9600 | (88) |
| util rest of house | 0.9936 | 0.9852 | 0.9676 | 0.9132 | 0.7889 | 0.5707 | 0.3801 | 0.4173 | 0.6795 | 0.9228 | 0.9846 | 0.9949 | (89) |
| MIT 2 | 18.5865 | 18.8358 | 19.1522 | 19.5579 | 19.8356 | 19.9660 | 19.9825 | 19.9838 | 19.9334 | 19.6006 | 19.0439 | 18.5656 | (90) |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.4493 | (91) |
| MIT | 19.1393 | 19.3639 | 19.6504 | 20.0193 | 20.2837 | 20.4153 | 20.4371 | 20.4366 | 20.3795 | 20.0555 | 19.5477 | 19.1172 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.1393 | 19.3639 | 19.6504 | 20.0193 | 20.2837 | 20.4153 | 20.4371 | 20.4366 | 20.3795 | 20.0555 | 19.5477 | 19.1172 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9918 | 0.9824 | 0.9646 | 0.9145 | 0.8066 | 0.6109 | 0.4298 | 0.4679 | 0.7147 | 0.9252 | 0.9822 | 0.9934 | (94) |
| Useful gains | 749.3556 | 860.1121 | 909.7080 | 920.1158 | 830.0022 | 613.0214 | 415.2548 | 434.4209 | 640.9626 | 759.7122 | 738.0333 | 716.7162 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | 1680.5099 | 1632.4734 | 1479.2918 | 1231.2373 | 947.6478 | 633.1015 | 417.7362 | 438.3080 | 687.3456 | 1043.8903 | 1382.5249 | 1667.1945 | (97) |
| Space heating kWh | 692.7789 | 519.0268 | 423.7704 | 224.0074 | 87.5283 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 211.4285 | 464.0340 | 707.1559 | (98a) |

Space heating requirement - total per year (kWh/year) 3329.7302

Solar heating kWh

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |

Solar heating contribution - total per year (kWh/year) 0.0000

Space heating kWh

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 692.7789 | 519.0268 | 423.7704 | 224.0074 | 87.5283 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 211.4285 | 464.0340 | 707.1559 | (98c) |

Space heating requirement after solar contribution - total per year (kWh/year) 3329.7302

Space heating per m2 (98c) / (4) = 34.2706 (99)

## 9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)

Fraction of space heat from main system(s) 1.0000 (202)

Efficiency of main space heating system 1 (in %) 92.3000 (206)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Efficiency of main space heating system 2 (in %) | | | | | | | | | | | | 0.0000 | (207) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 | (208) |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| Space heating requirement | | | | | | | | | | | | | |
| | 692.7789 | 519.0268 | 423.7704 | 224.0074 | 87.5283 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 211.4285 | 464.0340 | 707.1559 | (98) |
| Space heating efficiency (main heating system 1) | | | | | | | | | | | | | |
| | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.3000 | 92.3000 | 92.3000 | (210) |
| Space heating fuel (main heating system) | | | | | | | | | | | | | |
| | 750.5730 | 562.3259 | 459.1229 | 242.6949 | 94.8303 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 229.0666 | 502.7454 | 766.1494 | (211) |
| Space heating efficiency (main heating system 2) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (212) |
| Space heating fuel (main heating system 2) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (213) |
| Space heating fuel (secondary) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (215) |
| Water heating | | | | | | | | | | | | | |
| Water heating requirement | | | | | | | | | | | | | |
| | 239.9080 | 212.0430 | 225.2610 | 198.3793 | 192.4441 | 173.5895 | 171.6008 | 178.4122 | 180.3346 | 200.8371 | 213.1889 | 237.3619 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 | (216) |
| (217)m | 86.2965 | 85.9872 | 85.4550 | 84.3329 | 82.4113 | 79.8000 | 79.8000 | 79.8000 | 79.8000 | 84.1752 | 85.7554 | 86.3525 | (217) |
| Fuel for water heating, kWh/month | | | | | | | | | | | | | |
| | 278.0043 | 246.5984 | 263.6020 | 235.2335 | 233.5168 | 217.5308 | 215.0386 | 223.5742 | 225.9833 | 238.5941 | 248.6013 | 274.8754 | (219) |
| Space cooling fuel requirement | | | | | | | | | | | | | |
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (221) |
| Pumps and Fa | 7.3041 | 6.5973 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | (231) |
| Lighting | 28.4286 | 22.8065 | 20.5347 | 15.0446 | 11.6209 | 9.4944 | 10.6009 | 13.7795 | 17.8982 | 23.4834 | 26.5245 | 29.2187 | (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233a)m | -21.2456 | -31.7029 | -48.1900 | -57.3843 | -64.6856 | -61.3864 | -60.6254 | -55.8342 | -47.8890 | -37.6302 | -23.9668 | -18.1688 | (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233b)m | -7.2067 | -15.5372 | -31.6054 | -48.5595 | -65.3018 | -66.0357 | -65.2724 | -54.7685 | -39.4886 | -22.5833 | -9.7352 | -5.6720 | (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235d) |
| Annual totals kWh/year | | | | | | | | | | | | | |
| Space heating fuel - main system 1 | | | | | | | | | | | | 3607.5084 | (211) |
| Space heating fuel - main system 2 | | | | | | | | | | | | 0.0000 | (213) |
| Space heating fuel - secondary | | | | | | | | | | | | 0.0000 | (215) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 | |
| Water heating fuel used | | | | | | | | | | | | 2901.1524 | (219) |
| Space cooling fuel | | | | | | | | | | | | 0.0000 | (221) |
| Electricity for pumps and fans: | | | | | | | | | | | | | |
| Total electricity for the above, kWh/year | | | | | | | | | | | | 86.0000 | (231) |
| Electricity for lighting (calculated in Appendix L) | | | | | | | | | | | | 229.4348 | (232) |
| Energy saving/generation technologies (Appendices M ,N and Q) | | | | | | | | | | | | | |
| PV generation | | | | | | | | | | | | -960.4753 | (233) |
| Wind generation | | | | | | | | | | | | 0.0000 | (234) |
| Hydro-electric generation (Appendix N) | | | | | | | | | | | | 0.0000 | (235a) |
| Electricity generated - Micro CHP (Appendix N) | | | | | | | | | | | | 0.0000 | (235) |
| Appendix Q - special features | | | | | | | | | | | | | |
| Energy saved or generated | | | | | | | | | | | | -0.0000 | (236) |
| Energy used | | | | | | | | | | | | 0.0000 | (237) |
| Total delivered energy for all uses | | | | | | | | | | | | 5863.6203 | (238) |

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 3607.5084 | 0.2100 | 757.5768 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2901.1524 | 0.2100 | 609.2420 | (264) |
| Space and water heating | | | 1366.8188 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 229.4348 | 0.1443 | 33.1145 | (268) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -528.7090 | 0.1334 | -70.5429 | |
| PV Unit electricity exported | -431.7662 | 0.1252 | -54.0702 | |
| Total | | | -124.6131 | (269) |
| Total CO2, kg/year | | | 1287.2494 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 13.2500 | (273) |

13a. Primary energy - Individual heating systems including micro-CHP

| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 3607.5084 | 1.1300 | 4076.4845 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2901.1524 | 1.1300 | 3278.3022 | (278) |
| Space and water heating | | | 7354.7866 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 229.4348 | 1.5338 | 351.9148 | (282) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -528.7090 | 1.4930 | -789.3887 | |
| PV Unit electricity exported | -431.7662 | 0.4596 | -198.4608 | |
| Total | | | -987.8495 | (283) |
| Total Primary energy kWh/year | | | 6848.9528 | (286) |
| Target Primary Energy Rate (TPER) | | | 70.4900 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Property Reference** | Unit 13 | **Issued on Date** | 17/05/2025 |
| **Assessment Reference** | 00001 | **Prop Type Ref** | Unit 13 |
| **Property** | | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 79 C | **DER** | 5.41 | **TER** | 14.05 |
| **Environmental** | 96 A | **% DER < TER** | | | 61.49 |
| **$CO_2$ Emissions (t/year)** | 0.38 | **DFEE** | 34.69 | **TFEE** | 39.36 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 11.86 |
| **% DPER < TPER** | 23.51 | **DPER** | 57.36 | **TPER** | 74.99 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Robert Arnold | **Assessor ID** | BA04-0001 |
| **Client** | | | |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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## 1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 78.8300 (1b) | x | 3.0800 (2b) | = | 242.7964 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 78.8300 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = | 242.7964 | (5) |

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## 2. Ventilation rate

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| | | m3 per hour | |
|---|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 | (6a) |
| Number of open flues | 0 * 20 = | 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | 0 * 10 = | 0.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |

| | | Air changes per hour | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 0.0000 / (5) = | 0.0000 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 3.0000 | (17) |
| Infiltration rate | | 0.1500 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.1500 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.1912 | 0.1875 | 0.1837 | 0.1650 | 0.1612 | 0.1425 | 0.1425 | 0.1388 | 0.1500 | 0.1612 | 0.1687 | 0.1762 | (22b) |

Balanced mechanical ventilation with heat recovery

| | | |
|---|---|---|
| If mechanical ventilation | 0.5000 | (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | 0.5000 | (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | 81.0000 | (23c) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective ac | 0.2862 | 0.2825 | 0.2787 | 0.2600 | 0.2562 | 0.2375 | 0.2375 | 0.2337 | 0.2450 | 0.2562 | 0.2637 | 0.2712 | (25) |

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## 3. Heat losses and heat loss parameter

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| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| Windows | | | 6.9300 | 1.0536 | 7.3017 | | | (27) |
| Door | | | 1.8900 | 1.4000 | 2.6460 | | | (26) |
| Glass Door | | | 2.2900 | 1.3258 | 3.0360 | | | (27) |
| Heatloss Floor | | | 78.8300 | 0.1000 | 7.8830 | 0.0000 | 0.0000 | (28b) |
| External Walls | 37.8900 | 9.2200 | 28.6700 | 0.1500 | 4.3005 | 150.0000 | 4300.5000 | (29a) |
| Wall to Communal Corridor | 27.8500 | 1.8900 | 25.9600 | 0.1400 | 3.6344 | 150.0000 | 3894.0000 | (29a) |
| External Wall 3 | 27.1100 | | 27.1100 | 0.1100 | 2.9821 | 150.0000 | 4066.5000 | (29a) |
| Total net area of external elements Aum(A, m2) | | | 171.6800 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 31.7837 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 12 | | | 23.6400 | 0.0000 | 0.0000 | 110.0000 | 2600.4000 | (32) |
| Party Ceiling | | | 78.8300 | | | 100.0000 | 7883.0000 | (32b) |
| Internal Walls | | | 189.6700 | | | 9.0000 | 1707.0300 | (32c) |

| | | |
|---|---|---|
| Heat capacity Cm = Sum(A x k) | (28)...(30) + (32) + (32a)...(32e) = 24451.4300 | (34) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 310.1792 (35)
List of Thermal Bridges

| | K1 Element | Length | Psi-value | Total |
|---|---|---|---|---|
| E1 | Steel lintel with perforated steel base plate | 4.4200 | 0.0500 | 0.2210 |
| E3 | Sill | 1.5100 | 0.0500 | 0.0755 |
| E4 | Jamb | 12.0600 | 0.0500 | 0.6030 |
| E7 | Party floor between dwellings (in blocks of flats) | 12.3000 | 0.0700 | 0.8610 |
| E18 | Party wall between dwellings | 3.0800 | 0.0600 | 0.1848 |
| E20 | Exposed floor (normal) | 7.1570 | 0.3200 | 2.2902 |
| E16 | Corner (normal) | 9.2400 | 0.0900 | 0.8316 |
| E17 | Corner (inverted - internal area greater than external area) | 6.1600 | -0.0900 | -0.5544 |
| E23 | Balcony within or between dwellings, balcony support penetrates wall insulation | 5.1470 | 0.0200 | 0.1029 |
| E7 | Party floor between dwellings (in blocks of flats) | 17.1850 | 0.0350 | 0.6015 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 5.2172 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 37.0009 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 22.9352 | 22.6347 | 22.3342 | 20.8319 | 20.5315 | 19.0292 | 19.0292 | 18.7287 | 19.6301 | 20.5315 | 21.1324 | 21.7333 | (38) |
| Heat transfer coeff | 59.9360 | 59.6356 | 59.3351 | 57.8328 | 57.5323 | 56.0300 | 56.0300 | 55.7296 | 56.6310 | 57.5323 | 58.1333 | 58.7342 | (39) |

Average = Sum(39)m / 12 = 57.7577

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 0.7603 | 0.7565 | 0.7527 | 0.7336 | 0.7298 | 0.7108 | 0.7108 | 0.7070 | 0.7184 | 0.7298 | 0.7375 | 0.7451 | (40) |
| HLP (average) | | | | | | | | | | | | 0.7327 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

---
4. Water heating energy requirements (kWh/year)
---

Assumed occupancy 2.4403 (42)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hot water usage for mixer showers | 63.4896 | 62.5176 | 61.0851 | 58.8815 | 56.9070 | 54.1448 | 51.9601 | 54.5142 | 55.7988 | 58.5346 | 61.3838 | 63.4324 | (42a) |
| Hot water usage for baths | 27.5064 | 27.0911 | 26.5004 | 25.6158 | 24.8186 | 23.7211 | 22.8885 | 23.9066 | 24.4410 | 25.5284 | 26.6590 | 27.4845 | (42b) |
| Hot water usage for other uses | 39.6210 | 38.1802 | 36.7394 | 35.2987 | 33.8579 | 32.4172 | 32.4172 | 33.8579 | 35.2987 | 36.7394 | 38.1802 | 39.6210 | (42c) |

Average daily hot water use (litres/day) 120.0565 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 130.6170 | 127.7890 | 124.3250 | 119.7960 | 115.5835 | 110.2831 | 107.2657 | 112.2787 | 115.5384 | 120.8025 | 126.2230 | 130.5379 | (44) |
| Energy conte | 192.2908 | 169.0907 | 177.6579 | 156.4835 | 148.9411 | 127.5387 | 118.5318 | 132.1541 | 134.0188 | 155.6662 | 170.5946 | 191.7045 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1874.6725 | |
| Distribution loss (46)m = 0.15 x (45)m | 28.8436 | 25.3636 | 26.6487 | 23.4725 | 22.3412 | 19.1308 | 17.7798 | 19.8231 | 20.1028 | 23.3499 | 25.5892 | 28.7557 | (46) |
| Water storage loss: | | | | | | | | | | | | | |
| Store volume | | | | | | | | | | | | 110.0000 | (47) |
| b) If manufacturer declared loss factor is not known : | | | | | | | | | | | | | |
| Hot water storage loss factor from Table 2 (kWh/litre/day) | | | | | | | | | | | | 0.0152 | (51) |
| Volume factor from Table 2a | | | | | | | | | | | | 1.0294 | (52) |
| Temperature factor from Table 2b | | | | | | | | | | | | 0.6000 | (53) |
| Enter (49) or (54) in (55) | | | | | | | | | | | | 1.0327 | (55) |
| Total storage loss | 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (56) |
| If cylinder contains dedicated solar storage | 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (57) |
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | 247.5676 | 219.0181 | 232.9347 | 209.9772 | 204.2179 | 181.0324 | 173.8086 | 187.4309 | 187.5125 | 210.9430 | 224.0883 | 246.9813 | (62) |
| WWHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | 247.5676 | 219.0181 | 232.9347 | 209.9772 | 204.2179 | 181.0324 | 173.8086 | 187.4309 | 187.5125 | 210.9430 | 224.0883 | 246.9813 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2525.5123 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2526 | (64) |
| Electric shower(s) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | 108.1581 | 96.1646 | 103.2927 | 94.8257 | 93.7444 | 85.2016 | 83.6333 | 88.1627 | 87.3562 | 95.9805 | 99.5176 | 107.9632 | (65) |

---
5. Internal gains (see Table 5 and 5a)
---

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 122.0143 | 122.0143 | 122.0143 | 122.0143 | 122.0143 | 122.0143 | 122.0143 | 122.0143 | 122.0143 | 122.0143 | 122.0143 | 122.0143 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 122.1657 | 135.2549 | 122.1657 | 126.2379 | 122.1657 | 126.2379 | 122.1657 | 122.1657 | 126.2379 | 122.1657 | 126.2379 | 122.1657 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 216.9779 | 219.2294 | 213.5556 | 201.4767 | 186.2292 | 171.8987 | 162.3251 | 160.0735 | 165.7474 | 177.8263 | 193.0738 | 207.4042 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 35.2014 | 35.2014 | 35.2014 | 35.2014 | 35.2014 | 35.2014 | 35.2014 | 35.2014 | 35.2014 | 35.2014 | 35.2014 | 35.2014 | (69) |
| Pumps, fans | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | -97.6115 | -97.6115 | -97.6115 | -97.6115 | -97.6115 | -97.6115 | -97.6115 | -97.6115 | -97.6115 | -97.6115 | -97.6115 | -97.6115 | (71) |
| Water heating gains (Table 5) | 145.3738 | 143.1021 | 138.8343 | 131.7024 | 126.0005 | 118.3355 | 112.4103 | 118.4982 | 121.3280 | 129.0060 | 138.2189 | 145.1118 | (72) |
| Total internal gains | 544.1217 | 557.1907 | 534.1599 | 519.0212 | 493.9997 | 476.0764 | 456.5054 | 460.3418 | 472.9176 | 488.6023 | 517.1349 | 534.2861 | (73) |

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6. Solar gains
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| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W |
|---|---|---|---|---|---|---|

---

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southeast | | | 6.9300 | | 36.7938 | | 0.4500 | | 0.7000 | | 0.7700 | | 55.6611 (77) |
| Southeast | | | 2.2900 | | 36.7938 | | 0.4500 | | 0.7000 | | 0.7700 | | 18.3931 (77) |
| Solar gains | 74.0542 | 126.1417 | 172.5926 | 213.8506 | 239.5305 | 237.7983 | 229.2630 | 210.1046 | 186.8813 | 139.4135 | 88.6999 | 63.3750 (83) | |
| Total gains | 618.1759 | 683.3324 | 706.7525 | 732.8718 | 733.5302 | 713.8747 | 685.7683 | 670.4464 | 659.7989 | 628.0157 | 605.8348 | 597.6610 (84) | |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| tau | 113.3219 | 113.8929 | 114.4696 | 117.4431 | 118.0565 | 121.2218 | 121.2218 | 121.8754 | 119.9355 | 118.0565 | 116.8361 | 115.6407 | |
| alpha | 8.5548 | 8.5929 | 8.6313 | 8.8295 | 8.8704 | 9.0815 | 9.0815 | 9.1250 | 8.9957 | 8.8704 | 8.7891 | 8.7094 | |
| util living area | 0.9937 | 0.9839 | 0.9615 | 0.8763 | 0.7168 | 0.5018 | 0.3595 | 0.3823 | 0.5901 | 0.8756 | 0.9788 | 0.9950 | (86) |
| MIT | 20.5303 | 20.6501 | 20.7801 | 20.9298 | 20.9887 | 20.9996 | 21.0000 | 21.0000 | 20.9982 | 20.9408 | 20.7378 | 20.5225 | (87) |
| Th 2 | 20.2879 | 20.2912 | 20.2945 | 20.3112 | 20.3146 | 20.3313 | 20.3313 | 20.3347 | 20.3246 | 20.3146 | 20.3079 | 20.3012 | (88) |
| util rest of house | 0.9915 | 0.9785 | 0.9492 | 0.8453 | 0.6687 | 0.4497 | 0.3049 | 0.3271 | 0.5334 | 0.8390 | 0.9708 | 0.9932 | (89) |
| MIT 2 | 19.7495 | 19.9024 | 20.0640 | 20.2478 | 20.3066 | 20.3311 | 20.3313 | 20.3347 | 20.3237 | 20.2644 | 20.0268 | 19.7509 | (90) |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.3344 | (91) |
| MIT | 20.0106 | 20.1524 | 20.3035 | 20.4759 | 20.5347 | 20.5547 | 20.5549 | 20.5571 | 20.5493 | 20.4906 | 20.2645 | 20.0089 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 20.0106 | 20.1524 | 20.3035 | 20.4759 | 20.5347 | 20.5547 | 20.5549 | 20.5571 | 20.5493 | 20.4906 | 20.2645 | 20.0089 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9904 | 0.9772 | 0.9494 | 0.8531 | 0.6845 | 0.4671 | 0.3231 | 0.3455 | 0.5523 | 0.8491 | 0.9703 | 0.9922 | (94) |
| Useful gains | 612.2691 | 667.7754 | 670.9645 | 625.2451 | 502.0879 | 333.4617 | 221.5889 | 231.6667 | 364.4277 | 533.2231 | 587.8126 | 593.0058 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | 941.6317 | 909.5875 | 819.0303 | 669.4650 | 508.2816 | 333.6395 | 221.5941 | 231.6761 | 365.2276 | 569.0310 | 765.2964 | 928.5229 | (97) |
| Space heating kWh | 245.0458 | 162.4977 | 110.1609 | 31.8383 | 4.6081 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 26.6410 | 127.7884 | 249.6247 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 958.2049 | |
| Solar heating kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | 245.0458 | 162.4977 | 110.1609 | 31.8383 | 4.6081 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 26.6410 | 127.7884 | 249.6247 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 958.2049 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 12.1553 | (99) |

## 8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ext. temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | |
| Heat loss rate W | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 526.6823 | 414.6222 | 423.5447 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (100) |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.9892 | 0.9976 | 0.9967 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (101) |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 520.9873 | 413.6219 | 422.1443 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (102) |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 764.3883 | 735.0557 | 718.8419 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 175.2487 | 239.1468 | 220.7430 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (104) |
| Cooled fraction | | | | | | | | | fC = cooled area / (4) = | | | 0.9895 | (105) |
| Intermittency factor (Table 10b) | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | (106) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 43.3509 | 59.1572 | 54.6047 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) |
| Space cooling requirement | | | | | | | | | | | | 157.1128 | (107) |

## 9b. Energy requirements

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | 0.0000 | (301) |
| Fraction of space heat from community system | | | | | | | | | | | | 1.0000 | (302) |
| Fraction of heat from community Heat pump-Space and Water | | | | | | | | | | | | 1.0000 | (303a) |
| Factor for control and charging method (Table 4c(3)) for space heating | | | | | | | | | | | | 1.0000 | (305) |
| Factor for charging method (Table 4c(3)) for water heating | | | | | | | | | | | | 1.0000 | (305a) |
| Distribution loss factor (Table 12c) for community heating system | | | | | | | | | | | | 2.0000 | (306) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 | (208) |
| Space heating: | | | | | | | | | | | | | |
| Space heating requirement | 245.0458 | 162.4977 | 110.1609 | 31.8383 | 4.6081 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 26.6410 | 127.7884 | 249.6247 | (98) |
| Space heat from Heat pump = (98) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 307a | 490.0915 | 324.9954 | 220.3219 | 63.6766 | 9.2162 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 53.2821 | 255.5767 | 499.2494 | |
| Space heating requirement | 490.0915 | 324.9954 | 220.3219 | 63.6766 | 9.2162 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 53.2821 | 255.5767 | 499.2494 | (307) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | | | | | | | | | | | 0.0000 | (308) |
| Space heating fuel for secondary/supplementary system | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (309) |
| Water heating | | | | | | | | | | | | | |
| Annual water heating requirement | 247.5676 | 219.0181 | 232.9347 | 209.9772 | 204.2179 | 181.0324 | 173.8086 | 187.4309 | 187.5125 | 210.9430 | 224.0883 | 246.9813 | (64) |
| Water heat from Heat pump = (64) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 310a | 495.1351 | 438.0362 | 465.8694 | 419.9543 | 408.4358 | 362.0648 | 347.6172 | 374.8618 | 375.0249 | 421.8860 | 448.1765 | 493.9626 | |
| Water heating fuel | 495.1351 | 438.0362 | 465.8694 | 419.9543 | 408.4358 | 362.0648 | 347.6172 | 374.8618 | 375.0249 | 421.8860 | 448.1765 | 493.9626 | (310) |
| Cooling System Energy Efficiency Ratio | | | | | | | | | | | | 2.6000 | (314) |
| Space coolin | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 16.6734 | 22.7528 | 21.0018 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (315) |
| Pumps and Fa | 22.1891 | 20.0418 | 22.1891 | 21.4733 | 22.1891 | 21.4733 | 22.1891 | 22.1891 | 21.4733 | 22.1891 | 21.4733 | 22.1891 | (331) |
| Lighting | 27.0213 | 21.6775 | 19.5182 | 14.2999 | 11.0456 | 9.0244 | 10.0762 | 13.0974 | 17.0123 | 22.3210 | 25.2115 | 27.7723 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333a)m | -4.8312 | -7.8694 | -13.1490 | -17.1358 | -20.5735 | -20.0026 | -19.7200 | -17.4899 | -13.9840 | -9.8636 | -5.6494 | -4.0507 | (333a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (334a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335a) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (333b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335b) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - community heating | 1916.4099 | (307) |
| Space heating fuel - secondary | 0.0000 | (309) |
| Water heating fuel - community heating | 5051.0246 | (310) |
| Efficiency of water heater | 0.0000 | (311) |
| Electricity used for heat distribution | 19.1641 | (313) |
| Space cooling fuel | 60.4280 | (321) |
| | | |
| Electricity for pumps and fans: | | |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8820) | | |
| mechanical ventilation fans (SFP = 0.8820) | 261.2586 | (330a) |
| Total electricity for the above, kWh/year | 261.2586 | (331) |
| Electricity for lighting (calculated in Appendix L) | 218.0777 | (332) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -154.3190 | (333) |
| Wind generation | 0.0000 | (334) |
| Hydro-electric generation (Appendix N) | 0.0000 | (335a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (335) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (336) |
| Energy used | 0.0000 | (337) |
| Total delivered energy for all uses | 7352.8799 | (338) |

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12b. Carbon dioxide emissions - Community heating scheme

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (367) |
| Space and Water heating from Heat pump | 2488.3695 | 0.1582 | 108.2614 | (367) |
| Electrical energy for heat distribution (space & water) | 19.1641 | 0.0000 | 10.1451 | (372) |
| Overall CO2 factor for heat network | | | 0.0535 | (386) |
| Total CO2 associated with community systems | | | 372.4692 | (373) |
| Space and water heating | | | 372.4692 | (376) |
| Space cooling | 60.4280 | 0.1138 | 6.8786 | (377) |
| Pumps, fans and electric keep-hot | 261.2586 | 0.1387 | 36.2398 | (378) |
| Energy for lighting | 218.0777 | 0.1443 | 31.4753 | (379) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -154.3190 | 0.1318 | -20.3334 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -20.3334 | (380) |
| Total CO2, kg/year | | | 426.7295 | (383) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 5.4100 | (384) |

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13b. Primary energy - Community heating scheme

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| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (467a) |
| Space and Water heating from Heat pump | 2488.3695 | 1.5855 | 1085.1999 | (467) |
| Electrical energy for heat distribution (space & water) | 19.1641 | 0.0000 | 107.1997 | (472) |
| Overall CO2 factor for heat network | | | 0.5649 | (486) |
| Total CO2 associated with community systems | | | 3935.7616 | (473) |
| Space and water heating | | | 3935.7616 | (476) |
| Space cooling | 60.4280 | 1.4196 | 85.7834 | (477) |
| Pumps, fans and electric keep-hot | 261.2586 | 1.5128 | 395.2321 | (478) |
| Energy for lighting | 218.0777 | 1.5338 | 334.4948 | (479) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -154.3190 | 1.4868 | -229.4425 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -229.4425 | (480) |
| Total Primary energy kWh/year | | | 4521.8293 | (483) |
| Dwelling Primary energy Rate (DPER) | | | 57.3600 | (484) |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

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| | | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | |
| Ground floor | | 78.8300 | (1b) | x 3.0800 | (2b) = | 242.7964 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 78.8300 | | | | | | (4) |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | | 242.7964 | (5) |

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2. Ventilation rate

---

m3 per hour

| | | |
|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 (6a) |
| Number of open flues | 0 * 20 = | 0.0000 (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 (6f) |
| Number of intermittent extract fans | 3 * 10 = | 30.0000 (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 (7c) |

| | | Air changes per hour | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 30.0000 / (5) = | 0.1236 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3736 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.3736 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.4763 | 0.4670 | 0.4576 | 0.4109 | 0.4016 | 0.3549 | 0.3549 | 0.3455 | 0.3736 | 0.4016 | 0.4203 | 0.4389 | (22b) |
| Effective ac | 0.6134 | 0.6090 | 0.6047 | 0.5844 | 0.5806 | 0.5630 | 0.5630 | 0.5597 | 0.5698 | 0.5806 | 0.5883 | 0.5963 | (25) |

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## 3. Heat losses and heat loss parameter

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| Element | Gross | Openings | NetArea | U-value | A x U | K-value | A x K | |
|---|---|---|---|---|---|---|---|---|
| | m2 | m2 | m2 | W/m2K | W/K | kJ/m2K | kJ/K | |
| Main dwelling | | | | | | | | |
| TER Opaque door | | | 1.8900 | 1.0000 | 1.8900 | | | (26) |
| TER Opening Type | | | 9.2200 | 1.1450 | 10.5573 | | | (27) |
| Heatloss Floor | | | 78.8300 | 0.1300 | 10.2479 | | | (28b) |
| External Walls | 37.8900 | 9.2200 | 28.6700 | 0.1800 | 5.1606 | | | (29a) |
| Wall to Communal Corridor | 27.8500 | 1.8900 | 25.9600 | 0.1800 | 4.6728 | | | (29a) |
| External Wall 3 | 27.1100 | | 27.1100 | 0.1800 | 4.8798 | | | (29a) |
| Total net area of external elements Aum(A, m2) | | | 171.6800 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 37.4084 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 12 | | | 23.6400 | 0.0000 | 0.0000 | | | (32) |

| | |
|---|---|
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | 290.1792 (35) |

List of Thermal Bridges

| K1 Element | Length | Psi-value | Total |
|---|---|---|---|
| E1 Steel lintel with perforated steel base plate | 4.4200 | 0.0500 | 0.2210 |
| E3 Sill | 1.5100 | 0.0500 | 0.0755 |
| E4 Jamb | 12.0600 | 0.0500 | 0.6030 |
| E7 Party floor between dwellings (in blocks of flats) | 12.3000 | 0.0700 | 0.8610 |
| E18 Party wall between dwellings | 3.0800 | 0.0600 | 0.1848 |
| E20 Exposed floor (normal) | 7.1570 | 0.3200 | 2.2902 |
| E16 Corner (normal) | 9.2400 | 0.0900 | 0.8316 |
| E17 Corner (inverted - internal area greater than external area) | 6.1600 | -0.0900 | -0.5544 |
| E23 Balcony within or between dwellings, balcony support penetrates wall insulation | 5.1470 | 0.0200 | 0.1029 |
| E7 Party floor between dwellings (in blocks of flats) | 17.1850 | 0.0700 | 1.2029 |

| | | |
|---|---|---|
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | 5.8186 (36) |
| Point Thermal bridges | (36a) = | 0.0000 |
| Total fabric heat loss | (33) + (36) + (36a) = | 43.2270 (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 49.1494 | 48.7965 | 48.4506 | 46.8259 | 46.5219 | 45.1068 | 45.1068 | 44.8447 | 45.6519 | 46.5219 | 47.1368 | 47.7797 | (38) |
| Heat transfer coeff | 92.3764 | 92.0235 | 91.6776 | 90.0528 | 89.7489 | 88.3338 | 88.3338 | 88.0717 | 88.8788 | 89.7489 | 90.3638 | 91.0067 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 90.0514 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.1718 | 1.1674 | 1.1630 | 1.1424 | 1.1385 | 1.1206 | 1.1206 | 1.1172 | 1.1275 | 1.1385 | 1.1463 | 1.1545 | (40) |
| HLP (average) | | | | | | | | | | | | 1.1423 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

---

## 4. Water heating energy requirements (kWh/year)

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| | |
|---|---|
| Assumed occupancy | 2.4403 (42) |

Hot water usage for mixer showers

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 65.1353 | 64.1564 | 62.7300 | 60.0009 | 57.9869 | 55.7408 | 54.4642 | 55.8798 | 57.4315 | 59.8431 | 62.6309 | 64.8857 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 28.1335 | 27.7157 | 27.1273 | 26.0425 | 25.2301 | 24.3294 | 23.8428 | 24.4271 | 25.0632 | 26.0271 | 27.1343 | 28.0384 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 39.6210 | 38.1802 | 36.7394 | 35.2987 | 33.8579 | 32.4172 | 32.4172 | 33.8579 | 35.2987 | 36.7394 | 38.1802 | 39.6210 | (42c) |

| | |
|---|---|
| Average daily hot water use (litres/day) | 122.1558 (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 132.8898 | 130.0523 | 126.5968 | 121.3420 | 117.0749 | 112.4874 | 110.7242 | 114.1648 | 117.7935 | 122.6096 | 127.9454 | 132.5451 | (44) |
| Energy conte | 210.4649 | 185.1928 | 194.5746 | 166.1112 | 157.6053 | 138.3163 | 133.9113 | 141.3599 | 145.2511 | 166.3801 | 182.2816 | 207.5336 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 2028.9828 | |

Distribution loss (46)m = 0.15 x (45)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 31.5697 | 27.7789 | 29.1862 | 24.9167 | 23.6408 | 20.7475 | 20.0867 | 21.2040 | 21.7877 | 24.9570 | 27.3422 | 31.1300 | (46) |

| | |
|---|---|
| Water storage loss: | |
| Store volume | 150.0000 (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | 1.3938 (48) |
| Temperature factor from Table 2b | 0.5400 (49) |
| Enter (49) or (54) in (55) | 0.7527 (55) |

Total storage loss

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (56) |

If cylinder contains dedicated solar storage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (57) |
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |

Total heat required for water heating calculated for each month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 257.0598 | 227.2785 | 241.1695 | 211.2030 | 204.2002 | 183.4082 | 180.5062 | 187.9548 | 190.3430 | 212.9750 | 227.3735 | 254.1285 | (62) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WWHRS | -29.7771 | -26.3351 | -27.5766 | -22.8345 | -21.2810 | -18.2103 | -17.0692 | -18.1514 | -18.8411 | -22.2115 | -25.1630 | -29.2257 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | | | | | | | | | | | | | |
| | 227.2827 | 200.9434 | 213.5928 | 188.3685 | 182.9193 | 165.1979 | 163.4370 | 169.8034 | 171.5019 | 190.7635 | 202.2105 | 224.9028 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2300.9236 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2301 | (64) |
| Electric shower(s) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | | | | | |
| | | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | | | | | | | | | | | | | |
| | 107.2555 | 95.2452 | 101.9720 | 91.3054 | 89.6797 | 82.0637 | 81.8014 | 84.2781 | 84.3695 | 92.5973 | 96.6821 | 106.2808 | (65) |

## 5. Internal gains (see Table 5 and 5a)

| Metabolic gains (Table 5), Watts | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 122.0143 | 122.0143 | 122.0143 | 122.0143 | 122.0143 | 122.0143 | 122.0143 | 122.0143 | 122.0143 | 122.0143 | 122.0143 | 122.0143 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 122.1657 | 135.2549 | 122.1657 | 126.2379 | 122.1657 | 126.2379 | 122.1657 | 122.1657 | 126.2379 | 122.1657 | 126.2379 | 122.1657 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 216.9779 | 219.2294 | 213.5556 | 201.4767 | 186.2292 | 171.8987 | 162.3251 | 160.0735 | 165.7474 | 177.8263 | 193.0738 | 207.4042 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 35.2014 | 35.2014 | 35.2014 | 35.2014 | 35.2014 | 35.2014 | 35.2014 | 35.2014 | 35.2014 | 35.2014 | 35.2014 | 35.2014 | (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.0000 | 3.0000 | 3.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | | | | | | | | | | | | | |
| | -97.6115 | -97.6115 | -97.6115 | -97.6115 | -97.6115 | -97.6115 | -97.6115 | -97.6115 | -97.6115 | -97.6115 | -97.6115 | -97.6115 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 144.1606 | 141.7339 | 137.0591 | 126.8131 | 120.5372 | 113.9773 | 109.9482 | 113.2770 | 117.1798 | 124.4587 | 134.2807 | 142.8506 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 545.9085 | 558.8225 | 535.3847 | 517.1320 | 491.5364 | 471.7182 | 454.0432 | 455.1205 | 468.7694 | 487.0550 | 516.1967 | 535.0249 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Southeast | 9.2200 | 36.7938 | 0.6300 | 0.7000 | 0.7700 | 103.6759 | (77) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 103.6759 | 176.5984 | 241.6296 | 299.3908 | 335.3427 | 332.9177 | 320.9681 | 294.1465 | 261.6338 | 195.1789 | 124.1798 | 88.7250 | (83) |
| Total gains | 649.5844 | 735.4209 | 777.0143 | 816.5228 | 826.8791 | 804.6359 | 775.0114 | 749.2670 | 730.4032 | 682.2339 | 640.3765 | 623.7498 | (84) |

## 7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, ni1,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 68.7851 | 69.0489 | 69.3094 | 70.5599 | 70.7989 | 71.9331 | 71.9331 | 72.1471 | 71.4919 | 70.7989 | 70.3171 | 69.8203 | |
| alpha | 5.5857 | 5.6033 | 5.6206 | 5.7040 | 5.7199 | 5.7955 | 5.7955 | 5.8098 | 5.7661 | 5.7199 | 5.6878 | 5.6547 | |
| util living area | | | | | | | | | | | | | |
| | 0.9954 | 0.9900 | 0.9791 | 0.9435 | 0.8551 | 0.6729 | 0.4969 | 0.5336 | 0.7688 | 0.9490 | 0.9893 | 0.9963 | (86) |
| MIT | 19.9226 | 20.0934 | 20.3154 | 20.6143 | 20.8458 | 20.9710 | 20.9957 | 20.9936 | 20.9373 | 20.6543 | 20.2484 | 19.9059 | (87) |
| Th 2 | 19.9426 | 19.9462 | 19.9497 | 19.9664 | 19.9695 | 19.9841 | 19.9841 | 19.9868 | 19.9785 | 19.9695 | 19.9632 | 19.9566 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9936 | 0.9863 | 0.9710 | 0.9213 | 0.8016 | 0.5793 | 0.3848 | 0.4200 | 0.6824 | 0.9244 | 0.9846 | 0.9949 | (89) |
| MIT 2 | 18.7091 | 18.9283 | 19.2104 | 19.5877 | 19.8464 | 19.9693 | 19.9829 | 19.9849 | 19.9411 | 19.6434 | 19.1393 | 18.6982 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.3344 | (91) |
| MIT | 19.1148 | 19.3179 | 19.5799 | 19.9310 | 20.1806 | 20.3043 | 20.3216 | 20.3222 | 20.2742 | 19.9814 | 19.5101 | 19.1020 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.1148 | 19.3179 | 19.5799 | 19.9310 | 20.1806 | 20.3043 | 20.3216 | 20.3222 | 20.2742 | 19.9814 | 19.5101 | 19.1020 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9918 | 0.9833 | 0.9674 | 0.9204 | 0.8138 | 0.6100 | 0.4225 | 0.4582 | 0.7093 | 0.9247 | 0.9819 | 0.9933 | (94) |
| Useful gains | 644.2307 | 723.1582 | 751.7137 | 751.5584 | 672.8771 | 490.8383 | 327.4233 | 343.3514 | 518.0851 | 630.8903 | 628.7574 | 619.5564 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | | | | | | | | | | | | | |
| | 1368.5422 | 1326.7850 | 1199.1358 | 993.3746 | 761.1236 | 503.8789 | 328.7411 | 345.4335 | 548.7583 | 841.9737 | 1121.4279 | 1356.1829 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 538.8877 | 405.6372 | 332.8820 | 174.1077 | 65.6554 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 157.0461 | 354.7228 | 548.0502 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 2576.9891 | |
| Solar heating kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | | | | | | | | | | | | | |
| | 538.8877 | 405.6372 | 332.8820 | 174.1077 | 65.6554 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 157.0461 | 354.7228 | 548.0502 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 2576.9891 | |
| Space heating per m2 | | | | | | | | | | (98c) / (4) = | | 32.6905 | (99) |

## 9a. Energy requirements - Individual heating systems, including micro-CHP

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | 0.0000 | (201) |
| Fraction of space heat from main system(s) | | | | | | | | | | | | 1.0000 | (202) |
| Efficiency of main space heating system 1 (in %) | | | | | | | | | | | | 92.3000 | (206) |
| Efficiency of main space heating system 2 (in %) | | | | | | | | | | | | 0.0000 | (207) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 | (208) |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| Space heating requirement | | | | | | | | | | | | | |
| | 538.8877 | 405.6372 | 332.8820 | 174.1077 | 65.6554 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 157.0461 | 354.7228 | 548.0502 | (98) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating efficiency (main heating system 1) | | | | | | | | | | | | | |
| | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.3000 | 92.3000 | 92.3000 | (210) |
| Space heating fuel (main heating system) | | | | | | | | | | | | | |
| | 583.8437 | 439.4769 | 360.6523 | 188.6324 | 71.1326 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 170.1474 | 384.3151 | 593.7705 | (211) |
| Space heating efficiency (main heating system 2) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (212) |
| Space heating fuel (main heating system 2) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (213) |
| Space heating fuel (secondary) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (215) |
| Water heating | | | | | | | | | | | | | |
| Water heating requirement | | | | | | | | | | | | | |
| | 227.2827 | 200.9434 | 213.5928 | 188.3685 | 182.9193 | 165.1979 | 163.4370 | 169.8034 | 171.5019 | 190.7635 | 202.2105 | 224.9028 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 | (216) |
| (217)m | 85.9252 | 85.6018 | 85.0508 | 83.8836 | 81.9950 | 79.8000 | 79.8000 | 79.8000 | 79.8000 | 83.6270 | 85.3068 | 85.9786 | (217) |
| Fuel for water heating, kWh/month | | | | | | | | | | | | | |
| | 264.5121 | 234.7420 | 251.1355 | 224.5593 | 223.0859 | 207.0149 | 204.8082 | 212.7862 | 214.9147 | 228.1122 | 237.0391 | 261.5801 | (219) |
| Space cooling fuel requirement | | | | | | | | | | | | | |
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (221) |
| Pumps and Fa | 7.3041 | 6.5973 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | (231) |
| Lighting | 25.3836 | 20.3637 | 18.3352 | 13.4332 | 10.3762 | 8.4774 | 9.4655 | 12.3036 | 15.9812 | 20.9682 | 23.6835 | 26.0891 | (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233a)m | -17.4246 | -26.1023 | -39.8307 | -47.6244 | -53.8629 | -51.1922 | -50.5725 | -46.4992 | -39.7565 | -31.0801 | -19.6960 | -14.8910 | (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233b)m | -5.6599 | -12.2255 | -24.9106 | -38.3323 | -51.6013 | -52.1907 | -51.5736 | -43.2374 | -31.1367 | -17.7736 | -7.6478 | -4.4520 | (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235d) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - main system 1 | 2791.9709 | (211) |
| Space heating fuel - main system 2 | 0.0000 | (213) |
| Space heating fuel - secondary | 0.0000 | (215) |
| Efficiency of water heater | 79.8000 | |
| Water heating fuel used | 2764.2904 | (219) |
| Space cooling fuel | 0.0000 | (221) |
| Electricity for pumps and fans: | | |
| Total electricity for the above, kWh/year | 86.0000 | (231) |
| Electricity for lighting (calculated in Appendix L) | 204.8604 | (232) |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -779.2741 | (233) |
| Wind generation | 0.0000 | (234) |
| Hydro-electric generation (Appendix N) | 0.0000 | (235a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (235) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (236) |
| Energy used | 0.0000 | (237) |
| Total delivered energy for all uses | 5067.8476 | (238) |

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 2791.9709 | 0.2100 | 586.3139 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2764.2904 | 0.2100 | 580.5010 | (264) |
| Space and water heating | | | 1166.8149 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 204.8604 | 0.1443 | 29.5677 | (268) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -438.5324 | 0.1333 | -58.4739 | |
| PV Unit electricity exported | -340.7416 | 0.1252 | -42.6584 | |
| Total | | | -101.1323 | (269) |
| Total CO2, kg/year | | | 1107.1795 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 14.0500 | (273) |

13a. Primary energy - Individual heating systems including micro-CHP

| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 2791.9709 | 1.1300 | 3154.9271 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2764.2904 | 1.1300 | 3123.6482 | (278) |
| Space and water heating | | | 6278.5752 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 204.8604 | 1.5338 | 314.2217 | (282) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -438.5324 | 1.4927 | -654.6109 | |
| PV Unit electricity exported | -340.7416 | 0.4595 | -156.5739 | |
| Total | | | -811.1848 | (283) |
| Total Primary energy kWh/year | | | 5911.7129 | (286) |
| Target Primary Energy Rate (TPER) | | | 74.9900 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Property Reference** | Unit 14 | **Issued on Date** | 17/05/2025 |
| **Assessment Reference** | 00001 | **Prop Type Ref** | Unit 14 |
| **Property** | | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 76 C | **DER** | 7.19 | **TER** | 17.56 |
| **Environmental** | 95 A | **% DER < TER** | | | 59.05 |
| **$CO_2$ Emissions (t/year)** | 0.34 | **DFEE** | 43.75 | **TFEE** | 46.91 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 6.72 |
| **% DPER < TPER** | 19.17 | **DPER** | 76.08 | **TPER** | 94.12 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Robert Arnold | **Assessor ID** | BA04-0001 |
| **Client** | | | |

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SAP 10 WORKSHEET FOR New Build (As Designed)  (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 52.2800 | (1b) | x 3.0800 | (2b) = | 161.0224 | (1b) - (3b) (4) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 52.2800 | | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | 161.0224 | (5) |

---

2. Ventilation rate

---

| | m3 per hour | |
|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 (6a) |
| Number of open flues | 0 * 20 = | 0.0000 (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 (6f) |
| Number of intermittent extract fans | 0 * 10 = | 0.0000 (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 (7c) |

| | Air changes per hour | |
|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 0.0000 / (5) = | 0.0000 (8) |
| Pressure test | | Yes |
| Pressure Test Method | | Blower Door |
| Measured/design AP50 | | 3.0000 (17) |
| Infiltration rate | | 0.1500 (18) |
| Number of sides sheltered | | 0 (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.1500 (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.1912 | 0.1875 | 0.1837 | 0.1650 | 0.1612 | 0.1425 | 0.1425 | 0.1388 | 0.1500 | 0.1612 | 0.1687 | 0.1762 | (22b) |
| Balanced mechanical ventilation with heat recovery | | | | | | | | | | | | | |
| If mechanical ventilation | | | | | | | | | | | | 0.5000 | (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | | | | | | | | | | | | 0.5000 | (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | | | | | | | | | | | | 81.0000 | (23c) |
| Effective ac | 0.2862 | 0.2825 | 0.2787 | 0.2600 | 0.2562 | 0.2375 | 0.2375 | 0.2337 | 0.2450 | 0.2562 | 0.2637 | 0.2712 | (25) |

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3. Heat losses and heat loss parameter

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| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| Windows | | | 11.9300 | 1.0536 | 12.5699 | | | (27) |
| Door | | | 1.8900 | 1.4000 | 2.6460 | | | (26) |
| Glass Door | | | 2.4000 | 1.3258 | 3.1818 | | | (27) |
| Heatloss Floor | | | 52.2800 | 0.1000 | 5.2280 | 0.0000 | 0.0000 | (28b) |
| External Walls | 51.7900 | 14.3300 | 37.4600 | 0.1500 | 5.6190 | 150.0000 | 5619.0000 | (29a) |
| Wall to Communal | 22.7900 | 1.8900 | 20.9000 | 0.1400 | 2.9260 | 150.0000 | 3135.0000 | (29a) |
| Total net area of external elements Aum(A, m2) | | | 126.8600 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 32.1707 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 16 | | | 20.6600 | 0.0000 | 0.0000 | 110.0000 | 2272.6000 | (32) |
| Party Ceiling 1 | | | 52.2800 | | | 100.0000 | 5228.0000 | (32b) |
| Internal Walls | | | 73.6200 | | | 9.0000 | 662.5800 | (32c) |
| Heat capacity Cm = Sum(A x k) | | | | | (28)...(30) + (32) + (32a)...(32e) = | | 16917.1800 | (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | | | | | | | 323.5880 | (35) |

List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E1 Steel lintel with perforated steel base plate | 6.3400 | 0.0500 | 0.3170 |
| E4 Jamb | 18.0800 | 0.0500 | 0.9040 |
| E7 Party floor between dwellings (in blocks of flats) | 11.1890 | 0.0700 | 0.7832 |
| E16 Corner (normal) | 12.3200 | 0.0900 | 1.1088 |
| E7 Party floor between dwellings (in blocks of flats) | 7.4090 | 0.0350 | 0.2593 |
| E17 Corner (inverted - internal area greater than external area) | 3.0800 | -0.0900 | -0.2772 |
| E20 Exposed floor (normal) | 11.1890 | 0.3200 | 3.5805 |
| E25 Staggered party wall between dwellings | 6.1600 | -0.0900 | -0.5544 |
| P7 Party Wall - Exposed floor (normal) | 6.7100 | 0.1600 | 1.0736 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 7.1948 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 39.3656 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 15.2106 | 15.0113 | 14.8120 | 13.8157 | 13.6165 | 12.6201 | 12.6201 | 12.4209 | 13.0187 | 13.6165 | 14.0150 | 14.4135 | (38) |
| Heat transfer coeff | 54.5761 | 54.3769 | 54.1776 | 53.1813 | 52.9820 | 51.9857 | 51.9857 | 51.7864 | 52.3842 | 52.9820 | 53.3806 | 53.7791 | (39) |

Average = Sum(39)m / 12 = 53.1315

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.0439 | 1.0401 | 1.0363 | 1.0172 | 1.0134 | 0.9944 | 0.9944 | 0.9906 | 1.0020 | 1.0134 | 1.0211 | 1.0287 | (40) |
| HLP (average) | | | | | | | | | | | | 1.0163 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

## 4. Water heating energy requirements (kWh/year)

Assumed occupancy 1.7573 (42)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hot water usage for mixer showers | 52.3278 | 51.5267 | 50.3461 | 48.5298 | 46.9025 | 44.6259 | 42.8252 | 44.9303 | 45.9891 | 48.2439 | 50.5922 | 52.2807 | (42a) |
| Hot water usage for baths | 22.6918 | 22.3492 | 21.8619 | 21.1322 | 20.4745 | 19.5691 | 18.8822 | 19.7221 | 20.1630 | 21.0600 | 21.9928 | 22.6738 | (42b) |
| Hot water usage for other uses | 32.6268 | 31.4404 | 30.2540 | 29.0675 | 27.8811 | 26.6947 | 26.6947 | 27.8811 | 29.0675 | 30.2540 | 31.4404 | 32.6268 | (42c) |

Average daily hot water use (litres/day) 98.9436 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 107.6465 | 105.3163 | 102.4620 | 98.7295 | 95.2581 | 90.8896 | 88.4021 | 92.5335 | 95.2195 | 99.5579 | 104.0253 | 107.5813 | (44) |
| Energy conte | 158.4742 | 139.3548 | 146.4160 | 128.9654 | 122.7496 | 105.1108 | 97.6869 | 108.9137 | 110.4499 | 128.2905 | 140.5937 | 157.9910 | (45) |

Energy content (annual) Total = Sum(45)m = 1544.9966

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Distribution loss (46)m = 0.15 x (45)m | 23.7711 | 20.9032 | 21.9624 | 19.3448 | 18.4124 | 15.7666 | 14.6530 | 16.3371 | 16.5675 | 19.2436 | 21.0891 | 23.6986 | (46) |

Water storage loss:
Store volume 110.0000 (47)
b) If manufacturer declared loss factor is not known :
Hot water storage loss factor from Table 2 (kWh/litre/day) 0.0152 (51)
Volume factor from Table 2a 1.0294 (52)
Temperature factor from Table 2b 0.6000 (53)
Enter (49) or (54) in (55) 1.0327 (55)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total storage loss | 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (56) |
| If cylinder contains dedicated solar storage | 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (57) |
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | 213.7510 | 189.2823 | 201.6928 | 182.4591 | 178.0264 | 158.6045 | 152.9637 | 164.1905 | 163.9436 | 183.5673 | 194.0874 | 213.2678 | (62) |
| WWHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | 213.7510 | 189.2823 | 201.6928 | 182.4591 | 178.0264 | 158.6045 | 152.9637 | 164.1905 | 163.9436 | 183.5673 | 194.0874 | 213.2678 | (64) |

Total per year (kWh/year) = Sum(64)m = 2195.8364 (64)

12Total per year (kWh/year) 2196 (64)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Electric shower(s) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Heat gains from water heating, kWh/month | 96.9141 | 86.2774 | 92.9048 | 85.6759 | 85.0357 | 77.7443 | 76.7023 | 80.4352 | 79.5195 | 86.8780 | 89.5424 | 96.7534 | (65) |

## 5. Internal gains (see Table 5 and 5a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Metabolic gains (Table 5), Watts | | | | | | | | | | | | | |
| (66)m | 87.8665 | 87.8665 | 87.8665 | 87.8665 | 87.8665 | 87.8665 | 87.8665 | 87.8665 | 87.8665 | 87.8665 | 87.8665 | 87.8665 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 77.2476 | 85.5242 | 77.2476 | 79.8225 | 77.2476 | 79.8225 | 77.2476 | 77.2476 | 79.8225 | 77.2476 | 79.8225 | 77.2476 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 153.1521 | 154.7413 | 150.7365 | 142.2106 | 131.4483 | 121.3333 | 114.5758 | 112.9866 | 116.9914 | 125.5172 | 136.2795 | 146.3946 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 31.7867 | 31.7867 | 31.7867 | 31.7867 | 31.7867 | 31.7867 | 31.7867 | 31.7867 | 31.7867 | 31.7867 | 31.7867 | 31.7867 | (69) |
| Pumps, fans | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | -70.2932 | -70.2932 | -70.2932 | -70.2932 | -70.2932 | -70.2932 | -70.2932 | -70.2932 | -70.2932 | -70.2932 | -70.2932 | -70.2932 | (71) |
| Water heating gains (Table 5) | 130.2609 | 128.3890 | 124.8720 | 118.9944 | 114.2953 | 107.9782 | 103.0946 | 108.1119 | 110.4438 | 116.7715 | 124.3644 | 130.0450 | (72) |
| Total internal gains | 410.0205 | 418.0144 | 402.2160 | 390.3875 | 372.3512 | 358.4940 | 344.2780 | 347.7060 | 356.6177 | 368.8963 | 389.8264 | 403.0471 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Southeast | 6.2900 | 36.7938 | 0.4500 | 0.7000 | 0.7700 | 50.5207 | (77) |
| Southwest | 5.6400 | 36.7938 | 0.4500 | 0.7000 | 0.7700 | 45.3000 | (79) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southeast | | | 2.4000 | | 36.7938 | | 0.4500 | | 0.7000 | | 0.7700 | | 19.2766 (77) |
| Solar gains | 115.0973 | 196.0532 | 268.2486 | 332.3730 | 372.2854 | 369.5933 | 356.3274 | 326.5509 | 290.4565 | 216.6806 | 137.8600 | 98.4993 | (83) |
| Total gains | 525.1178 | 614.0677 | 670.4646 | 722.7605 | 744.6367 | 728.0873 | 700.6053 | 674.2569 | 647.0742 | 585.5769 | 527.6864 | 501.5464 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| tau | 86.1039 | 86.4194 | 86.7372 | 88.3622 | 88.6945 | 90.3944 | 90.3944 | 90.7422 | 89.7067 | 88.6945 | 88.0324 | 87.3800 | |
| alpha | 6.7403 | 6.7613 | 6.7825 | 6.8908 | 6.9130 | 7.0263 | 7.0263 | 7.0495 | 6.9804 | 6.9130 | 6.8688 | 6.8253 | |
| util living area | 0.9895 | 0.9710 | 0.9294 | 0.8173 | 0.6483 | 0.4559 | 0.3264 | 0.3532 | 0.5543 | 0.8455 | 0.9702 | 0.9919 | (86) |
| MIT | 20.3379 | 20.5279 | 20.7252 | 20.9104 | 20.9831 | 20.9987 | 20.9999 | 20.9998 | 20.9953 | 20.9051 | 20.6099 | 20.3123 | (87) |
| Th 2 | 20.0469 | 20.0500 | 20.0532 | 20.0690 | 20.0722 | 20.0880 | 20.0880 | 20.0912 | 20.0817 | 20.0722 | 20.0658 | 20.0595 | (88) |
| util rest of house | 0.9856 | 0.9611 | 0.9075 | 0.7737 | 0.5889 | 0.3915 | 0.2588 | 0.2835 | 0.4827 | 0.7972 | 0.9582 | 0.9888 | (89) |
| MIT 2 | 19.3057 | 19.5432 | 19.7800 | 19.9933 | 20.0611 | 20.0875 | 20.0880 | 20.0912 | 20.0794 | 19.9959 | 19.6600 | 19.2837 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.6429 | (91) |
| MIT | 19.9693 | 20.1762 | 20.3877 | 20.5829 | 20.6538 | 20.6733 | 20.6742 | 20.6753 | 20.6682 | 20.5804 | 20.2707 | 19.9450 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.9693 | 20.1762 | 20.3877 | 20.5829 | 20.6538 | 20.6733 | 20.6742 | 20.6753 | 20.6682 | 20.5804 | 20.2707 | 19.9450 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9852 | 0.9626 | 0.9159 | 0.7986 | 0.6265 | 0.4329 | 0.3023 | 0.3283 | 0.5287 | 0.8249 | 0.9612 | 0.9884 | (94) |
| Useful gains | 517.3676 | 591.1042 | 614.0728 | 577.1728 | 466.5429 | 315.2211 | 211.7696 | 221.3462 | 342.0983 | 483.0469 | 507.2054 | 495.7184 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | 855.1690 | 830.6743 | 752.3998 | 621.3108 | 474.3911 | 315.7261 | 211.8026 | 221.4042 | 344.0716 | 528.7818 | 703.0590 | 846.7513 | (97) |
| Space heating kWh | 251.3243 | 160.9911 | 102.9153 | 31.7794 | 5.8391 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 34.0267 | 141.0146 | 261.1685 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 989.0589 | |
| Solar heating kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | 251.3243 | 160.9911 | 102.9153 | 31.7794 | 5.8391 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 34.0267 | 141.0146 | 261.1685 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 989.0589 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 18.9185 | (99) |

## 8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ext. temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | |
| Heat loss rate W | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 488.6656 | 384.6942 | 393.5769 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (100) |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.9884 | 0.9964 | 0.9949 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (101) |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 482.9797 | 383.3247 | 391.5667 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (102) |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 809.4012 | 779.4004 | 749.1499 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 235.0235 | 294.6804 | 266.0419 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (104) |
| Cooled fraction | | | | | | | | | | fC = cooled area / (4) = | | 0.9946 | (105) |
| Intermittency factor (Table 10b) | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | (106) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 58.4412 | 73.2755 | 66.1543 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) |
| Space cooling requirement | | | | | | | | | | | | 197.8710 | (107) |

## 9b. Energy requirements

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | 0.0000 | (301) |
| Fraction of space heat from community system | | | | | | | | | | | | 1.0000 | (302) |
| Fraction of heat from community Heat pump-Space and Water | | | | | | | | | | | | 1.0000 | (303a) |
| Factor for control and charging method (Table 4c(3)) for space heating | | | | | | | | | | | | 1.0000 | (305) |
| Factor for charging method (Table 4c(3)) for water heating | | | | | | | | | | | | 1.0000 | (305a) |
| Distribution loss factor (Table 12c) for community heating system | | | | | | | | | | | | 2.0000 | (306) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 | (208) |
| Space heating: | | | | | | | | | | | | | |
| Space heating requirement | 251.3243 | 160.9911 | 102.9153 | 31.7794 | 5.8391 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 34.0267 | 141.0146 | 261.1685 | (98) |
| Space heat from Heat pump = (98) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 307a | 502.6485 | 321.9823 | 205.8306 | 63.5587 | 11.6781 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 68.0535 | 282.0292 | 522.3369 | |
| Space heating requirement | 502.6485 | 321.9823 | 205.8306 | 63.5587 | 11.6781 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 68.0535 | 282.0292 | 522.3369 | (307) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | | | | | | | | | | | 0.0000 | (308) |
| Space heating fuel for secondary/supplementary system | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (309) |
| Water heating | | | | | | | | | | | | | |
| Annual water heating requirement | 213.7510 | 189.2823 | 201.6928 | 182.4591 | 178.0264 | 158.6045 | 152.9637 | 164.1905 | 163.9436 | 183.5673 | 194.0874 | 213.2678 | (64) |
| Water heat from Heat pump = (64) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 310a | 427.5020 | 378.5645 | 403.3857 | 364.9181 | 356.0529 | 317.2090 | 305.9275 | 328.3809 | 327.8872 | 367.1346 | 388.1748 | 426.5356 | |
| Water heating fuel | 427.5020 | 378.5645 | 403.3857 | 364.9181 | 356.0529 | 317.2090 | 305.9275 | 328.3809 | 327.8872 | 367.1346 | 388.1748 | 426.5356 | (310) |
| Cooling System Energy Efficiency Ratio | | | | | | | | | | | | 2.6000 | (314) |
| Space coolin | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 22.4774 | 28.1829 | 25.4439 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (315) |
| Pumps and Fa | 14.7158 | 13.2917 | 14.7158 | 14.2411 | 14.7158 | 14.2411 | 14.7158 | 14.7158 | 14.2411 | 14.7158 | 14.2411 | 14.7158 | (331) |
| Lighting | 14.9351 | 11.9815 | 10.7880 | 7.9038 | 6.1051 | 4.9879 | 5.5693 | 7.2391 | 9.4029 | 12.3372 | 13.9348 | 15.3502 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333a)m | -3.8295 | -6.2169 | -10.3539 | -13.4503 | -16.1127 | -15.6554 | -15.4340 | -13.7036 | -10.9800 | -7.7750 | -4.4712 | -3.2130 | (333a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334a) |

Electricity generated by hydro-electric generators (Appendix M) (negative quantity)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (335a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335a) |

Electricity generated by PVs (Appendix M) (negative quantity)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (333b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (333b) |

Electricity generated by wind turbines (Appendix M) (negative quantity)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (334b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334b) |

Electricity generated by hydro-electric generators (Appendix M) (negative quantity)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (335b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335b) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - community heating | 1978.1178 | (307) |
| Space heating fuel - secondary | 0.0000 | (309) |
| Water heating fuel - community heating | 4391.6727 | (310) |
| Efficiency of water heater | 0.0000 | (311) |
| Electricity used for heat distribution | 19.7812 | (313) |
| Space cooling fuel | 76.1042 | (321) |
| | | |
| Electricity for pumps and fans: | | |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8820) | | |
| mechanical ventilation fans (SFP = 0.8820) | 173.2665 | (330a) |
| Total electricity for the above, kWh/year | 173.2665 | (331) |
| Electricity for lighting (calculated in Appendix L) | 120.5349 | (332) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -121.1956 | (333) |
| Wind generation | 0.0000 | (334) |
| Hydro-electric generation (Appendix N) | 0.0000 | (335a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (335) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (336) |
| Energy used | 0.0000 | (337) |
| Total delivered energy for all uses | 6618.5006 | (338) |

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12b. Carbon dioxide emissions - Community heating scheme

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (367) |
| Space and Water heating from Heat pump | 2274.9252 | 0.1580 | 111.6264 | (367) |
| Electrical energy for heat distribution (space & water) | 19.7812 | 0.0000 | 9.3058 | (372) |
| Overall CO2 factor for heat network | | | 0.0536 | (386) |
| Total CO2 associated with community systems | | | 341.6563 | (373) |
| Space and water heating | | | 341.6563 | (376) |
| Space cooling | 76.1042 | 0.1140 | 8.6753 | (377) |
| Pumps, fans and electric keep-hot | 173.2665 | 0.1387 | 24.0342 | (378) |
| Energy for lighting | 120.5349 | 0.1443 | 17.3969 | (379) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -121.1956 | 0.1318 | -15.9758 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -15.9758 | (380) |
| Total CO2, kg/year | | | 375.7869 | (383) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 7.1900 | (384) |

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13b. Primary energy - Community heating scheme

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| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (467a) |
| Space and Water heating from Heat pump | 2274.9252 | 1.5849 | 1119.6770 | (467) |
| Electrical energy for heat distribution (space & water) | 19.7812 | 0.0000 | 98.1197 | (472) |
| Overall CO2 factor for heat network | | | 0.5655 | (486) |
| Total CO2 associated with community systems | | | 3602.3938 | (473) |
| Space and water heating | | | 3602.3938 | (476) |
| Space cooling | 76.1042 | 1.4202 | 108.0801 | (477) |
| Pumps, fans and electric keep-hot | 173.2665 | 1.5128 | 262.1176 | (478) |
| Energy for lighting | 120.5349 | 1.5338 | 184.8804 | (479) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -121.1956 | 1.4870 | -180.2199 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -180.2199 | (480) |
| Total Primary energy kWh/year | | | 3977.2521 | (483) |
| Dwelling Primary energy Rate (DPER) | | | 76.0800 | (484) |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 52.2800 | (1b) | x 3.0800 | (2b) = | 161.0224 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 52.2800 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | | 161.0224 | (5) |

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2. Ventilation rate

---

| | m3 per hour | |
|---|---|---|
| Number of open chimneys | 0 * 80 = 0.0000 | (6a) |

| | | |
|---|---|---|
| Number of open flues | 0 * 20 = | 0.0000 (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 (6f) |
| Number of intermittent extract fans | 2 * 10 = | 20.0000 (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 (7c) |

| | | Air changes per hour | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 20.0000 / (5) = | 0.1242 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3742 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.3742 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.4771 | 0.4678 | 0.4584 | 0.4116 | 0.4023 | 0.3555 | 0.3555 | 0.3461 | 0.3742 | 0.4023 | 0.4210 | 0.4397 | (22b) |
| Effective ac | 0.6138 | 0.6094 | 0.6051 | 0.5847 | 0.5809 | 0.5632 | 0.5632 | 0.5599 | 0.5700 | 0.5809 | 0.5886 | 0.5967 | (25) |

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## 3. Heat losses and heat loss parameter

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| Element | Gross | Openings | NetArea | U-value | A x U | K-value | A x K | |
|---|---|---|---|---|---|---|---|---|
| | m2 | m2 | m2 | W/m2K | W/K | kJ/m2K | kJ/K | |
| Main dwelling | | | | | | | | |
| TER Opaque door | | | 1.8900 | 1.0000 | 1.8900 | | | (26) |
| TER Opening Type | | | 11.1900 | 1.1450 | 12.8130 | | | (27) |
| Heatloss Floor | | | 52.2800 | 0.1300 | 6.7964 | | | (28b) |
| External Walls | 51.7900 | 11.1900 | 40.6000 | 0.1800 | 7.3080 | | | (29a) |
| Wall to Communal | 22.7900 | 1.8900 | 20.9000 | 0.1800 | 3.7620 | | | (29a) |
| Total net area of external elements Aum(A, m2) | | | 126.8600 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 32.5694 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 16 | | | 20.6600 | 0.0000 | 0.0000 | | | (32) |

| | | |
|---|---|---|
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | 303.5880 | (35) |

List of Thermal Bridges

| K1 Element | Length | Psi-value | Total |
|---|---|---|---|
| E1 Steel lintel with perforated steel base plate | 6.3400 | 0.0500 | 0.3170 |
| E4 Jamb | 18.0800 | 0.0500 | 0.9040 |
| E7 Party floor between dwellings (in blocks of flats) | 11.1890 | 0.0700 | 0.7832 |
| E16 Corner (normal) | 12.3200 | 0.0900 | 1.1088 |
| E7 Party floor between dwellings (in blocks of flats) | 7.4090 | 0.0700 | 0.5186 |
| E17 Corner (inverted - internal area greater than external area) | 3.0800 | -0.0900 | -0.2772 |
| E20 Exposed floor (normal) | 11.1890 | 0.3200 | 3.5805 |
| E25 Staggered party wall between dwellings | 6.1600 | 0.0600 | 0.3696 |
| P7 Party Wall - Exposed floor (normal) | 6.7100 | 0.1600 | 1.0736 |

| | | | |
|---|---|---|---|
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | 8.3781 | (36) |
| Point Thermal bridges | (36a) = | 0.0000 | |
| Total fabric heat loss | (33) + (36) + (36a) = | 40.9475 | (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 32.6167 | 32.3819 | 32.1517 | 31.0704 | 30.8681 | 29.9264 | 29.9264 | 29.7520 | 30.2891 | 30.8681 | 31.2774 | 31.7052 | (38) |
| Heat transfer coeff | 73.5642 | 73.3294 | 73.0992 | 72.0179 | 71.8156 | 70.8739 | 70.8739 | 70.6995 | 71.2366 | 71.8156 | 72.2249 | 72.6527 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 72.0170 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.4071 | 1.4026 | 1.3982 | 1.3775 | 1.3737 | 1.3557 | 1.3557 | 1.3523 | 1.3626 | 1.3737 | 1.3815 | 1.3897 | (40) |
| HLP (average) | | | | | | | | | | | | 1.3775 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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## 4. Water heating energy requirements (kWh/year)

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| | | |
|---|---|---|
| Assumed occupancy | 1.7573 | (42) |

Hot water usage for mixer showers

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 53.6842 | 52.8774 | 51.7018 | 49.4524 | 47.7925 | 45.9413 | 44.8891 | 46.0558 | 47.3348 | 49.3224 | 51.6200 | 53.4785 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.2092 | 22.8645 | 22.3791 | 21.4841 | 20.8140 | 20.0709 | 19.6695 | 20.1515 | 20.6763 | 21.4714 | 22.3848 | 23.1307 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.6268 | 31.4404 | 30.2540 | 29.0675 | 27.8811 | 26.6947 | 26.6947 | 27.8811 | 29.0675 | 30.2540 | 31.4404 | 32.6268 | (42c) |

| | | |
|---|---|---|
| Average daily hot water use (litres/day) | 100.6743 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 109.5202 | 107.1823 | 104.3348 | 100.0041 | 96.4876 | 92.7069 | 91.2533 | 94.0884 | 97.0786 | 101.0478 | 105.4453 | 109.2360 | (44) |
| Energy conte | 173.4532 | 152.6261 | 160.3588 | 136.9006 | 129.8908 | 113.9939 | 110.3629 | 116.5011 | 119.7076 | 137.1209 | 150.2261 | 171.0372 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1672.1793 | |
| Distribution loss (46)m = 0.15 x (45)m | 26.0180 | 22.8939 | 24.0538 | 20.5351 | 19.4836 | 17.0991 | 16.5544 | 17.4752 | 17.9561 | 20.5681 | 22.5339 | 25.6556 | (46) |

| | | |
|---|---|---|
| Water storage loss: | | |
| Store volume | 150.0000 | (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | 1.3938 | (48) |
| Temperature factor from Table 2b | 0.5400 | (49) |
| Enter (49) or (54) in (55) | 0.7527 | (55) |

Total storage loss

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (56) |

If cylinder contains dedicated solar storage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (57) |
| Primary loss 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |

Total heat required for water heating calculated for each month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 220.0481 | 194.7119 | 206.9537 | 181.9924 | 176.4857 | 159.0858 | 156.9578 | 163.0960 | 164.7995 | 183.7158 | 195.3180 | 217.6321 | (62) |
| WWHRS -24.5422 | -21.7053 | -22.7285 | -18.8201 | -17.5397 | -15.0088 | -14.0684 | -14.9603 | -15.5287 | -18.3066 | -20.7392 | -24.0877 | (63a) |
| PV diverter -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | 195.5059 | 173.0066 | 184.2251 | 163.1723 | 158.9460 | 144.0769 | 142.8895 | 148.1357 | 149.2708 | 165.4091 | 174.5788 | 193.5444 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 1992.7612 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 1993 | (64) |
| Electric shower(s) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | 94.9491 | 84.4168 | 90.5952 | 81.5929 | 80.4646 | 73.9764 | 73.9716 | 76.0126 | 75.8763 | 82.8686 | 86.0237 | 94.1458 | (65) |

## 5. Internal gains (see Table 5 and 5a)

| Metabolic gains (Table 5), Watts | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 87.8665 | 87.8665 | 87.8665 | 87.8665 | 87.8665 | 87.8665 | 87.8665 | 87.8665 | 87.8665 | 87.8665 | 87.8665 | 87.8665 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 77.3670 | 85.6563 | 77.3670 | 79.9459 | 77.3670 | 79.9459 | 77.3670 | 77.3670 | 79.9459 | 77.3670 | 79.9459 | 77.3670 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 153.1521 | 154.7413 | 150.7365 | 142.2106 | 131.4483 | 121.3333 | 114.5758 | 112.9866 | 116.9914 | 125.5172 | 136.2795 | 146.3946 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 31.7867 | 31.7867 | 31.7867 | 31.7867 | 31.7867 | 31.7867 | 31.7867 | 31.7867 | 31.7867 | 31.7867 | 31.7867 | 31.7867 | (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.0000 | 3.0000 | 3.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | -70.2932 | -70.2932 | -70.2932 | -70.2932 | -70.2932 | -70.2932 | -70.2932 | -70.2932 | -70.2932 | -70.2932 | -70.2932 | -70.2932 | (71) |
| Water heating gains (Table 5) | 127.6198 | 125.6202 | 121.7678 | 113.3235 | 108.1514 | 102.7451 | 99.4242 | 102.1674 | 105.3837 | 111.3825 | 119.4773 | 126.5400 | (72) |
| Total internal gains | 410.4987 | 418.3777 | 402.2311 | 387.8400 | 369.3266 | 353.3842 | 340.7269 | 341.8809 | 351.6809 | 366.6267 | 388.0626 | 402.6615 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Southeast | 6.7800 | 36.7938 | 0.6300 | 0.7000 | 0.7700 | 76.2389 | (77) |
| Southwest | 4.4100 | 36.7938 | 0.6300 | 0.7000 | 0.7700 | 49.5890 | (79) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 125.8279 | 214.3315 | 293.2576 | 363.3604 | 406.9940 | 404.0508 | 389.5481 | 356.9955 | 317.5360 | 236.8819 | 150.7128 | 107.6825 | (83) |
| Total gains | 536.3266 | 632.7092 | 695.4888 | 751.2004 | 776.3206 | 757.4350 | 730.2750 | 698.8764 | 669.2169 | 603.5086 | 538.7755 | 510.3440 | (84) |

## 7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a) | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 59.9309 | 60.1229 | 60.3122 | 61.2177 | 61.3902 | 62.2059 | 62.2059 | 62.3593 | 61.8891 | 61.3902 | 61.0423 | 60.6828 | |
| alpha | 4.9954 | 5.0082 | 5.0208 | 5.0812 | 5.0927 | 5.1471 | 5.1471 | 5.1573 | 5.1259 | 5.0927 | 5.0695 | 5.0455 | |
| util living area | 0.9910 | 0.9791 | 0.9550 | 0.8909 | 0.7673 | 0.5809 | 0.4239 | 0.4605 | 0.6873 | 0.9108 | 0.9798 | 0.9928 | (86) |
| MIT | 19.8249 | 20.0534 | 20.3319 | 20.6576 | 20.8776 | 20.9769 | 20.9962 | 20.9942 | 20.9464 | 20.6659 | 20.1944 | 19.7934 | (87) |
| Th 2 | 19.7579 | 19.7613 | 19.7647 | 19.7806 | 19.7836 | 19.7975 | 19.7975 | 19.8001 | 19.7921 | 19.7836 | 19.7775 | 19.7713 | (88) |
| util rest of house | 0.9875 | 0.9714 | 0.9384 | 0.8527 | 0.6961 | 0.4801 | 0.3098 | 0.3430 | 0.5867 | 0.8706 | 0.9709 | 0.9900 | (89) |
| MIT 2 | 18.4437 | 18.7327 | 19.0780 | 19.4697 | 19.6963 | 19.7873 | 19.7967 | 19.7987 | 19.7641 | 19.4920 | 18.9251 | 18.4134 | (90) |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.6429 | (91) |
| MIT | 19.3316 | 19.5818 | 19.8841 | 20.2334 | 20.4557 | 20.5521 | 20.5678 | 20.5673 | 20.5242 | 20.2467 | 19.7411 | 19.3006 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.3316 | 19.5818 | 19.8841 | 20.2334 | 20.4557 | 20.5521 | 20.5678 | 20.5673 | 20.5242 | 20.2467 | 19.7411 | 19.3006 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9859 | 0.9700 | 0.9402 | 0.8682 | 0.7372 | 0.5445 | 0.3833 | 0.4187 | 0.6497 | 0.8877 | 0.9705 | 0.9886 | (94) |
| Useful gains | 528.7903 | 613.7217 | 653.9179 | 652.1818 | 572.3034 | 412.3996 | 279.9382 | 292.6338 | 434.7826 | 535.7524 | 522.8942 | 504.5457 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | 1105.7914 | 1076.6049 | 978.3689 | 816.2081 | 628.7973 | 421.8477 | 281.2143 | 294.6245 | 457.6363 | 692.7832 | 913.0015 | 1097.0977 | (97) |
| Space heating kWh | 429.2888 | 311.0575 | 241.3915 | 118.0989 | 42.0314 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 116.8309 | 280.8773 | 440.8587 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 1980.4351 | |
| Solar heating kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | 429.2888 | 311.0575 | 241.3915 | 118.0989 | 42.0314 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 116.8309 | 280.8773 | 440.8587 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 1980.4351 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 37.8813 | (99) |

## 9a. Energy requirements - Individual heating systems, including micro-CHP

| | | |
|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | 0.0000 | (201) |
| Fraction of space heat from main system(s) | 1.0000 | (202) |
| Efficiency of main space heating system 1 (in %) | 92.3000 | (206) |
| Efficiency of main space heating system 2 (in %) | 0.0000 | (207) |
| Efficiency of secondary/supplementary heating system, % | 0.0000 | (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement | 429.2888 | 311.0575 | 241.3915 | 118.0989 | 42.0314 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 116.8309 | 280.8773 | 440.8587 | (98) |
| Space heating efficiency (main heating system 1) | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.3000 | 92.3000 | 92.3000 | (210) |

Space heating fuel (main heating system)
465.1016 337.0071 261.5293 127.9512 45.5379 0.0000 0.0000 0.0000 0.0000 126.5774 304.3091 477.6367 (211)
Space heating efficiency (main heating system 2)
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (212)
Space heating fuel (main heating system 2)
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (213)
Space heating fuel (secondary)
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (215)

Water heating
Water heating requirement
195.5059 173.0066 184.2251 163.1723 158.9460 144.0769 142.8895 148.1357 149.2708 165.4091 174.5788 193.5444 (64)
Efficiency of water heater 79.8000 (216)
(217)m 85.7730 85.3593 84.6668 83.3468 81.5281 79.8000 79.8000 79.8000 79.8000 83.2945 85.1203 85.8462 (217)
Fuel for water heating, kWh/month
227.9341 202.6805 217.5883 195.7751 194.9586 180.5475 179.0595 185.6338 187.0561 198.5835 205.0966 225.4548 (219)
Space cooling fuel requirement
(221)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (221)
Pumps and Fa 7.3041 6.5973 7.3041 7.0685 7.3041 7.0685 7.3041 7.3041 7.0685 7.3041 7.0685 7.3041 (231)
Lighting 16.0753 12.8962 11.6116 8.5072 6.5712 5.3687 5.9945 7.7918 10.1208 13.2790 14.9986 16.5221 (232)
Electricity generated by PVs (Appendix M) (negative quantity)
(233a)m -11.6882 -17.5855 -26.9608 -32.4080 -36.8262 -35.0842 -34.6728 -31.7976 -27.0616 -21.0182 -13.2417 -9.9813 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)
(234a)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)
(235a)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)
(235c)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)
(233b)m -3.6214 -7.8335 -15.9756 -24.5984 -33.1176 -33.4793 -33.0705 -27.7156 -19.9546 -11.3816 -4.8927 -2.8470 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)
(234b)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)
(235b)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)
(235d)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (235d)
Annual totals kWh/year
Space heating fuel - main system 1 2145.6501 (211)
Space heating fuel - main system 2 0.0000 (213)
Space heating fuel - secondary 0.0000 (215)
Efficiency of water heater 79.8000
Water heating fuel used 2400.3684 (219)
Space cooling fuel 0.0000 (221)

Electricity for pumps and fans:
Total electricity for the above, kWh/year 86.0000 (231)
Electricity for lighting (calculated in Appendix L) 129.7371 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV generation -516.8140 (233)
Wind generation 0.0000 (234)
Hydro-electric generation (Appendix N) 0.0000 (235a)
Electricity generated - Micro CHP (Appendix N) 0.0000 (235)
Appendix Q - special features
Energy saved or generated -0.0000 (236)
Energy used 0.0000 (237)
Total delivered energy for all uses 4244.9416 (238)

---
12a. Carbon dioxide emissions - Individual heating systems including micro-CHP
---

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 2145.6501 | 0.2100 | 450.5865 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2400.3684 | 0.2100 | 504.0774 | (264) |
| Space and water heating | | | 954.6639 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 129.7371 | 0.1443 | 18.7251 | (268) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -298.3262 | 0.1332 | -39.7458 | |
| PV Unit electricity exported | -218.4878 | 0.1252 | -27.3519 | |
| Total | | | -67.0977 | (269) |
| Total CO2, kg/year | | | 918.2205 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 17.5600 | (273) |

---
13a. Primary energy - Individual heating systems including micro-CHP
---

| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 2145.6501 | 1.1300 | 2424.5846 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2400.3684 | 1.1300 | 2712.4163 | (278) |
| Space and water heating | | | 5137.0010 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 129.7371 | 1.5338 | 198.9951 | (282) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -298.3262 | 1.4923 | -445.1969 | |
| PV Unit electricity exported | -218.4878 | 0.4595 | -100.3929 | |
| Total | | | -545.5897 | (283) |
| Total Primary energy kWh/year | | | 4920.5071 | (286) |
| Target Primary Energy Rate (TPER) | | | 94.1200 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Property Reference** | Unit 15 | **Issued on Date** | 17/05/2025 |
| **Assessment Reference** | 00001 | **Prop Type Ref** | Unit 15 |
| **Property** | | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 77 C | **DER** | 6.36 | **TER** | 16.87 |
| **Environmental** | 95 A | **% DER < TER** | | | 62.30 |
| **$CO_2$ Emissions (t/year)** | 0.39 | **DFEE** | 43.48 | **TFEE** | 50.18 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 13.36 |
| **% DPER < TPER** | 25.64 | **DPER** | 67.06 | **TPER** | 90.19 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Robert Arnold | **Assessor ID** | BA04-0001 |
| **Client** | | | |

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SAP 10 WORKSHEET FOR New Build (As Designed)  (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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## 1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 70.8100 | (1b) | x 3.0800 | (2b) = | 218.0948 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 70.8100 | | | | | (4) |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | 218.0948 | (5) |

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## 2. Ventilation rate

---

| | | m3 per hour | |
|---|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 | (6a) |
| Number of open flues | 0 * 20 = | 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | 0 * 10 = | 0.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |

| | Air changes per hour | | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 0.0000 / (5) = | 0.0000 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 3.0000 | (17) |
| Infiltration rate | | 0.1500 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.1500 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.1912 | 0.1875 | 0.1837 | 0.1650 | 0.1612 | 0.1425 | 0.1425 | 0.1388 | 0.1500 | 0.1612 | 0.1687 | 0.1762 | (22b) |
| Balanced mechanical ventilation with heat recovery | | | | | | | | | | | | | |
| If mechanical ventilation | | | | | | | | | | | | 0.5000 | (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | | | | | | | | | | | | 0.5000 | (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | | | | | | | | | | | | 81.0000 | (23c) |
| Effective ac | 0.2862 | 0.2825 | 0.2787 | 0.2600 | 0.2562 | 0.2375 | 0.2375 | 0.2337 | 0.2450 | 0.2562 | 0.2637 | 0.2712 | (25) |

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## 3. Heat losses and heat loss parameter

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| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| Windows | | | 8.3400 | 1.0536 | 8.7874 | | | (27) |
| Front Door | | | 1.8900 | 1.4000 | 2.6460 | | | (26) |
| Glass Door | | | 2.4000 | 1.3258 | 3.1818 | | | (27) |
| Heatloss Floor 1 | | | 70.8100 | 0.1000 | 7.0810 | 0.0000 | 0.0000 | (28b) |
| External Walls | 39.1400 | 10.7400 | 28.4000 | 0.1500 | 4.2600 | 150.0000 | 4260.0000 | (29a) |
| Wall to Communal Corridor | 54.9700 | 1.8900 | 53.0800 | 0.1400 | 7.4312 | 150.0000 | 7962.0000 | (29a) |
| Total net area of external elements Aum(A, m2) | | | 164.9200 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | | (26)...(30) + (32) = | 33.3874 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 17 | | | 22.0600 | 0.0000 | 0.0000 | 110.0000 | 2426.6000 | (32) |
| Party Ceiling | | | 70.8100 | | | 100.0000 | 7081.0000 | (32b) |
| Internal Walls | | | 163.0200 | | | 9.0000 | 1467.1800 | (32c) |
| Heat capacity Cm = Sum(A x k) | | | | (28)...(30) + (32) + (32a)...(32e) = | | | 23196.7800 | (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | | | | | | | 327.5919 | (35) |

List of Thermal Bridges

| | K1 Element | Length | Psi-value | Total |
|---|---|---|---|---|
| E1 | Steel lintel with perforated steel base plate | 6.0200 | 0.0500 | 0.3010 |
| E3 | Sill | 1.0225 | 0.0500 | 0.0511 |
| E4 | Jamb | 16.1400 | 0.0500 | 0.8070 |
| E7 | Party floor between dwellings (in blocks of flats) | 13.7120 | 0.0350 | 0.4799 |
| E18 | Party wall between dwellings | 3.0000 | 0.0300 | 0.0900 |
| E7 | Party floor between dwellings (in blocks of flats) | 17.8540 | 0.0350 | 0.6249 |
| E16 | Corner (normal) | 6.0000 | 0.0900 | 0.5400 |
| E17 | Corner (inverted - internal area greater than external area) | 6.0000 | -0.0900 | -0.5400 |
| E23 | Balcony within or between dwellings, balcony support penetrates wall insulation | 5.2620 | 0.0200 | 0.1052 |
| E15 | Flat roof with parapet | 4.4350 | 0.5600 | 2.4836 |
| E24 | Eaves (insulation at ceiling level - inverted) | 5.8220 | 0.1200 | 0.6986 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 5.6414 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 39.0288 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 20.6018 | 20.3319 | 20.0620 | 18.7125 | 18.4426 | 17.0932 | 17.0932 | 16.8233 | 17.6330 | 18.4426 | 18.9824 | 19.5222 | (38) |
| Heat transfer coeff | 59.6306 | 59.3607 | 59.0908 | 57.7413 | 57.4714 | 56.1220 | 56.1220 | 55.8521 | 56.6618 | 57.4714 | 58.0112 | 58.5510 | (39) |

Average = Sum(39)m / 12 = 57.6739

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 0.8421 | 0.8383 | 0.8345 | 0.8154 | 0.8116 | 0.7926 | 0.7926 | 0.7888 | 0.8002 | 0.8116 | 0.8193 | 0.8269 | (40) |
| HLP (average) | | | | | | | | | | | | 0.8145 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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4. Water heating energy requirements (kWh/year)

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Assumed occupancy 2.2656 (42)

Hot water usage for mixer showers

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 60.6351 | 59.7068 | 58.3387 | 56.2341 | 54.3485 | 51.7105 | 49.6239 | 52.0632 | 53.2900 | 55.9029 | 58.6239 | 60.5805 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 26.2751 | 25.8785 | 25.3142 | 24.4692 | 23.7076 | 22.6593 | 21.8639 | 22.8365 | 23.3469 | 24.3857 | 25.4657 | 26.2542 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 37.8323 | 36.4566 | 35.0809 | 33.7051 | 32.3294 | 30.9537 | 30.9537 | 32.3294 | 33.7051 | 35.0809 | 36.4566 | 37.8323 | (42c) |

Average daily hot water use (litres/day) 114.6571 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 124.7425 | 122.0419 | 118.7338 | 114.4084 | 110.3855 | 105.3234 | 102.4416 | 107.2291 | 110.3421 | 115.3694 | 120.5462 | 124.6670 | (44) |
| Energy conte | 183.6425 | 161.4860 | 169.6681 | 149.4460 | 142.2429 | 121.8030 | 113.2009 | 126.2106 | 127.9913 | 148.6652 | 162.9222 | 183.0826 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1790.3616 | |
| Distribution loss (46)m = 0.15 x (45)m | 27.5464 | 24.2229 | 25.4502 | 22.4169 | 21.3364 | 18.2705 | 16.9801 | 18.9316 | 19.1987 | 22.2998 | 24.4383 | 27.4624 | (46) |

Water storage loss:

Store volume 110.0000 (47)

b) If manufacturer declared loss factor is not known :

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.0152 (51)

Volume factor from Table 2a 1.0294 (52)

Temperature factor from Table 2b 0.6000 (53)

Enter (49) or (54) in (55) 1.0327 (55)

Total storage loss

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (56) |

If cylinder contains dedicated solar storage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (57) |
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |

Total heat required for water heating calculated for each month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 238.9194 | 211.4135 | 224.9449 | 202.9397 | 197.5197 | 175.2967 | 168.4777 | 181.4874 | 181.4850 | 203.9420 | 216.4159 | 238.3594 | (62) |
| WWHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |

Output from w/h

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 238.9194 | 211.4135 | 224.9449 | 202.9397 | 197.5197 | 175.2967 | 168.4777 | 181.4874 | 181.4850 | 203.9420 | 216.4159 | 238.3594 | (64) |
| | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | | 2441.2014 | (64) |

12Total per year (kWh/year) 2441 (64)

Electric shower(s)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)

Heat gains from water heating, kWh/month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 105.2826 | 93.6361 | 100.6361 | 92.4857 | 91.5172 | 83.2944 | 81.8608 | 86.1865 | 85.3521 | 93.6526 | 96.9666 | 105.0964 | (65) |

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5. Internal gains (see Table 5 and 5a)

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Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 113.2814 | 113.2814 | 113.2814 | 113.2814 | 113.2814 | 113.2814 | 113.2814 | 113.2814 | 113.2814 | 113.2814 | 113.2814 | 113.2814 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 105.9540 | 117.3062 | 105.9540 | 109.4858 | 105.9540 | 109.4858 | 105.9540 | 105.9540 | 109.4858 | 105.9540 | 109.4858 | 105.9540 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 199.1801 | 201.2470 | 196.0385 | 184.9504 | 170.9536 | 157.7986 | 149.0102 | 146.9434 | 152.1518 | 163.2400 | 177.2368 | 190.3918 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 34.3281 | 34.3281 | 34.3281 | 34.3281 | 34.3281 | 34.3281 | 34.3281 | 34.3281 | 34.3281 | 34.3281 | 34.3281 | 34.3281 | (69) |
| Pumps, fans | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | -90.6251 | -90.6251 | -90.6251 | -90.6251 | -90.6251 | -90.6251 | -90.6251 | -90.6251 | -90.6251 | -90.6251 | -90.6251 | -90.6251 | (71) |
| Water heating gains (Table 5) | 141.5089 | 139.3394 | 135.2636 | 128.4524 | 123.0070 | 115.6867 | 110.0279 | 115.8420 | 118.5445 | 125.8772 | 134.6758 | 141.2586 | (72) |
| Total internal gains | 503.6274 | 514.8770 | 494.2405 | 479.8730 | 456.8990 | 439.9555 | 421.9766 | 425.7238 | 437.1665 | 452.0555 | 478.3828 | 494.5888 | (73) |

---

6. Solar gains

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| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W |
|---|---|---|---|---|---|---|

---

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northwest | | | 8.3400 | | 11.2829 | | 0.4500 | | 0.7000 | | 0.7700 | | 20.5415 (81) |
| Northwest | | | 2.4000 | | 11.2829 | | 0.4500 | | 0.7000 | | 0.7700 | | 5.9112 (81) |
| Solar gains | 26.4527 | 53.8453 | 97.0121 | 159.3217 | 214.1596 | 228.3168 | 213.5857 | 170.2730 | 118.2107 | 65.8032 | 33.2844 | 21.6026 (83) | |
| Total gains | 530.0801 | 568.7223 | 591.2526 | 639.1947 | 671.0587 | 668.2724 | 635.5623 | 595.9968 | 555.3773 | 517.8587 | 511.6671 | 516.1914 (84) | |

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| tau | 108.0578 | 108.5491 | 109.0449 | 111.5934 | 112.1174 | 114.8133 | 114.8133 | 115.3681 | 113.7196 | 112.1174 | 111.0742 | 110.0502 | |
| alpha | 8.2039 | 8.2366 | 8.2697 | 8.4396 | 8.4745 | 8.6542 | 8.6542 | 8.6912 | 8.5813 | 8.4745 | 8.4049 | 8.3367 | |
| util living area | 0.9973 | 0.9943 | 0.9851 | 0.9293 | 0.7698 | 0.5363 | 0.3885 | 0.4309 | 0.6933 | 0.9467 | 0.9919 | 0.9978 | (86) |
| MIT | 20.4053 | 20.5030 | 20.6503 | 20.8662 | 20.9771 | 20.9990 | 20.9999 | 20.9999 | 20.9924 | 20.8626 | 20.6183 | 20.4021 | (87) |
| Th 2 | 20.2170 | 20.2203 | 20.2235 | 20.2400 | 20.2433 | 20.2598 | 20.2598 | 20.2631 | 20.2532 | 20.2433 | 20.2367 | 20.2301 | (88) |
| util rest of house | 0.9963 | 0.9921 | 0.9790 | 0.9045 | 0.7170 | 0.4749 | 0.3232 | 0.3620 | 0.6234 | 0.9222 | 0.9882 | 0.9969 | (89) |
| MIT 2 | 19.5293 | 19.6560 | 19.8440 | 20.1143 | 20.2271 | 20.2593 | 20.2598 | 20.2631 | 20.2492 | 20.1175 | 19.8163 | 19.5359 | (90) |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.5146 | (91) |
| MIT | 19.9801 | 20.0919 | 20.2590 | 20.5012 | 20.6131 | 20.6400 | 20.6407 | 20.6422 | 20.6317 | 20.5009 | 20.2290 | 19.9817 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.9801 | 20.0919 | 20.2590 | 20.5012 | 20.6131 | 20.6400 | 20.6407 | 20.6422 | 20.6317 | 20.5009 | 20.2290 | 19.9817 | (93) |

8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9959 | 0.9916 | 0.9793 | 0.9138 | 0.7435 | 0.5065 | 0.3568 | 0.3975 | 0.6594 | 0.9315 | 0.9881 | 0.9965 | (94) |
| Useful gains | 527.8863 | 563.9418 | 579.0372 | 584.0788 | 498.9217 | 338.5056 | 226.7510 | 236.8905 | 366.2251 | 482.3672 | 505.5922 | 514.4076 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | 935.0135 | 901.8014 | 813.0272 | 669.8713 | 512.2478 | 338.9758 | 226.7706 | 236.9375 | 370.0966 | 569.0188 | 761.6298 | 924.0335 | (97) |
| Space heating kWh | 302.9026 | 227.0417 | 174.0885 | 61.7706 | 9.9146 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 64.4688 | 184.3470 | 304.7617 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 1329.2954 | |
| Solar heating kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | 302.9026 | 227.0417 | 174.0885 | 61.7706 | 9.9146 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 64.4688 | 184.3470 | 304.7617 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 1329.2954 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 18.7727 | (99) |

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ext. temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | |
| Heat loss rate W | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 527.5465 | 415.3026 | 424.4758 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (100) |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.9815 | 0.9949 | 0.9906 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (101) |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 517.7718 | 413.1989 | 420.4962 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (102) |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 723.1869 | 687.9132 | 642.9150 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 147.8988 | 204.3874 | 165.4796 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (104) |
| Cooled fraction | | | | | | | | | fC = cooled area / (4) = | | | 0.9886 | (105) |
| Intermittency factor (Table 10b) | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | (106) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 36.5518 | 50.5124 | 40.8967 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) |
| Space cooling requirement | | | | | | | | | | | | 127.9608 | (107) |

9b. Energy requirements

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | 0.0000 | (301) |
| Fraction of space heat from community system | | | | | | | | | | | | 1.0000 | (302) |
| Fraction of heat from community Heat pump-Space and Water | | | | | | | | | | | | 1.0000 | (303a) |
| Factor for control and charging method (Table 4c(3)) for space heating | | | | | | | | | | | | 1.0000 | (305) |
| Factor for charging method (Table 4c(3)) for water heating | | | | | | | | | | | | 1.0000 | (305a) |
| Distribution loss factor (Table 12c) for community heating system | | | | | | | | | | | | 2.0000 | (306) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 | (208) |
| Space heating: | | | | | | | | | | | | | |
| Space heating requirement | 302.9026 | 227.0417 | 174.0885 | 61.7706 | 9.9146 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 64.4688 | 184.3470 | 304.7617 | (98) |
| Space heat from Heat pump = (98) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 307a | 605.8052 | 454.0833 | 348.1771 | 123.5411 | 19.8292 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 128.9375 | 368.6940 | 609.5233 | |
| Space heating requirement | 605.8052 | 454.0833 | 348.1771 | 123.5411 | 19.8292 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 128.9375 | 368.6940 | 609.5233 | (307) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | | | | | | | | | | | 0.0000 | (308) |
| Space heating fuel for secondary/supplementary system | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (309) |
| Water heating | | | | | | | | | | | | | |
| Annual water heating requirement | 238.9194 | 211.4135 | 224.9449 | 202.9397 | 197.5197 | 175.2967 | 168.4777 | 181.4874 | 181.4850 | 203.9420 | 216.4159 | 238.3594 | (64) |
| Water heat from Heat pump = (64) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 310a | 477.8387 | 422.8270 | 449.8899 | 405.8794 | 395.0394 | 350.5934 | 336.9555 | 362.9749 | 362.9700 | 407.8839 | 432.8317 | 476.7189 | |
| Water heating fuel | 477.8387 | 422.8270 | 449.8899 | 405.8794 | 395.0394 | 350.5934 | 336.9555 | 362.9749 | 362.9700 | 407.8839 | 432.8317 | 476.7189 | (310) |
| Cooling System Energy Efficiency Ratio | | | | | | | | | | | | 2.6000 | (314) |
| Space coolin | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 14.0584 | 19.4278 | 15.7295 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (315) |
| Pumps and Fa | 19.9316 | 18.0028 | 19.9316 | 19.2887 | 19.9316 | 19.2887 | 19.9316 | 19.9316 | 19.2887 | 19.9316 | 19.2887 | 19.9316 | (331) |
| Lighting | 22.6850 | 18.1987 | 16.3859 | 12.0050 | 9.2730 | 7.5762 | 8.4592 | 10.9956 | 14.2821 | 18.7390 | 21.1656 | 23.3155 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333a)m | -4.8010 | -7.8019 | -13.0054 | -16.9078 | -20.2632 | -19.6886 | -19.4102 | -17.2317 | -13.8017 | -9.7634 | -5.6081 | -4.0272 | (333a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (334a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335a) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (333b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335b) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - community heating | 2658.5908 | (307) |
| Space heating fuel - secondary | 0.0000 | (309) |
| Water heating fuel - community heating | 4882.4027 | (310) |
| Efficiency of water heater | 0.0000 | (311) |
| Electricity used for heat distribution | 26.5859 | (313) |
| Space cooling fuel | 49.2157 | (321) |
| | | |
| Electricity for pumps and fans: | | |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8820) | | |
| mechanical ventilation fans (SFP = 0.8820) | 234.6787 | (330a) |
| Total electricity for the above, kWh/year | 234.6787 | (331) |
| Electricity for lighting (calculated in Appendix L) | 183.0809 | (332) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -152.3102 | (333) |
| Wind generation | 0.0000 | (334) |
| Hydro-electric generation (Appendix N) | 0.0000 | (335a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (335) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (336) |
| Energy used | 0.0000 | (337) |
| Total delivered energy for all uses | 7855.6586 | (338) |

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12b. Carbon dioxide emissions - Community heating scheme

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (367) |
| Space and Water heating from Heat pump | 2693.2120 | 0.1570 | 149.1125 | (367) |
| Electrical energy for heat distribution (space & water) | 26.5859 | 0.0000 | 11.0502 | (372) |
| Overall CO2 factor for heat network | | | 0.0538 | (386) |
| Total CO2 associated with community systems | | | 405.6995 | (373) |
| Space and water heating | | | 405.6995 | (376) |
| Space cooling | 49.2157 | 0.1139 | 5.6052 | (377) |
| Pumps, fans and electric keep-hot | 234.6787 | 0.1387 | 32.5528 | (378) |
| Energy for lighting | 183.0809 | 0.1443 | 26.4242 | (379) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -152.3102 | 0.1318 | -20.0753 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -20.0753 | (380) |
| Total CO2, kg/year | | | 450.2065 | (383) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 6.3600 | (384) |

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13b. Primary energy - Community heating scheme

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| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (467a) |
| Space and Water heating from Heat pump | 2693.2120 | 1.5814 | 1501.5439 | (467) |
| Electrical energy for heat distribution (space & water) | 26.5859 | 0.0000 | 116.2884 | (472) |
| Overall CO2 factor for heat network | | | 0.5662 | (486) |
| Total CO2 associated with community systems | | | 4269.4441 | (473) |
| Space and water heating | | | 4269.4441 | (476) |
| Space cooling | 49.2157 | 1.4198 | 69.8771 | (477) |
| Pumps, fans and electric keep-hot | 234.6787 | 1.5128 | 355.0220 | (478) |
| Energy for lighting | 183.0809 | 1.5338 | 280.8155 | (479) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -152.3102 | 1.4870 | -226.4804 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -226.4804 | (480) |
| Total Primary energy kWh/year | | | 4748.6784 | (483) |
| Dwelling Primary energy Rate (DPER) | | | 67.0600 | (484) |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

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| | | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | |
| Ground floor | | 70.8100 | (1b) | x 3.0800 | (2b) = | 218.0948 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 70.8100 | | | | | | (4) |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | | 218.0948 | (5) |

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2. Ventilation rate

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m3 per hour

| | | |
|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 (6a) |
| Number of open flues | 0 * 20 = | 0.0000 (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 (6f) |
| Number of intermittent extract fans | 3 * 10 = | 30.0000 (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 (7c) |

| | | Air changes per hour | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 30.0000 / (5) = | 0.1376 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3876 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.3876 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.4941 | 0.4844 | 0.4748 | 0.4263 | 0.4166 | 0.3682 | 0.3682 | 0.3585 | 0.3876 | 0.4166 | 0.4360 | 0.4554 | (22b) |
| Effective ac | 0.6221 | 0.6173 | 0.6127 | 0.5909 | 0.5868 | 0.5678 | 0.5678 | 0.5643 | 0.5751 | 0.5868 | 0.5950 | 0.6037 | (25) |

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## 3. Heat losses and heat loss parameter

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| Element | Gross | Openings | NetArea | U-value | A x U | K-value | A x K | |
|---|---|---|---|---|---|---|---|---|
| | m2 | m2 | m2 | W/m2K | W/K | kJ/m2K | kJ/K | |
| Main dwelling | | | | | | | | |
| TER Opaque door | | | 1.8900 | 1.0000 | 1.8900 | | | (26) |
| TER Opening Type | | | 10.7400 | 1.1450 | 12.2977 | | | (27) |
| Heatloss Floor 1 | | | 70.8100 | 0.1300 | 9.2053 | | | (28b) |
| External Walls | 39.1400 | 10.7400 | 28.4000 | 0.1800 | 5.1120 | | | (29a) |
| Wall to Communal Corridor | 54.9700 | 1.8900 | 53.0800 | 0.1800 | 9.5544 | | | (29a) |
| Total net area of external elements Aum(A, m2) | | | 164.9200 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 38.0594 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 17 | | | 22.0600 | 0.0000 | 0.0000 | | | (32) |

| | | |
|---|---|---|
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | 307.5919 | (35) |

List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E1 Steel lintel with perforated steel base plate | 6.0200 | 0.0500 | 0.3010 |
| E3 Sill | 1.0225 | 0.0500 | 0.0511 |
| E4 Jamb | 16.1400 | 0.0500 | 0.8070 |
| E7 Party floor between dwellings (in blocks of flats) | 13.7120 | 0.0700 | 0.9598 |
| E18 Party wall between dwellings | 3.0000 | 0.0600 | 0.1800 |
| E7 Party floor between dwellings (in blocks of flats) | 17.8540 | 0.0700 | 1.2498 |
| E16 Corner (normal) | 6.0000 | 0.0900 | 0.5400 |
| E17 Corner (inverted - internal area greater than external area) | 6.0000 | -0.0900 | -0.5400 |
| E23 Balcony within or between dwellings, balcony support penetrates wall insulation | 5.2620 | 0.0200 | 0.1052 |
| E15 Flat roof with parapet | 4.4350 | 0.5600 | 2.4836 |
| E24 Eaves (insulation at ceiling level - inverted) | 5.8220 | 0.2400 | 1.3973 |

| | | |
|---|---|---|
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | 7.5349 (36) |
| Point Thermal bridges | (36a) = | 0.0000 |
| Total fabric heat loss | (33) + (36) + (36a) = | 45.5943 (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 44.7721 | 44.4310 | 44.0965 | 42.5257 | 42.2318 | 40.8637 | 40.8637 | 40.6103 | 41.3906 | 42.2318 | 42.8263 | 43.4479 | (38) |
| Heat transfer coeff | 90.3664 | 90.0252 | 89.6908 | 88.1200 | 87.8261 | 86.4579 | 86.4579 | 86.2046 | 86.9849 | 87.8261 | 88.4206 | 89.0422 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 88.1186 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.2762 | 1.2714 | 1.2666 | 1.2445 | 1.2403 | 1.2210 | 1.2210 | 1.2174 | 1.2284 | 1.2403 | 1.2487 | 1.2575 | (40) |
| HLP (average) | | | | | | | | | | | | 1.2444 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

---

## 4. Water heating energy requirements (kWh/year)

---

| | | |
|---|---|---|
| Assumed occupancy | 2.2656 | (42) |

Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 62.2068 | 61.2719 | 59.9097 | 57.3033 | 55.3798 | 53.2347 | 52.0155 | 53.3674 | 54.8494 | 57.1525 | 59.8150 | 61.9684 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 26.8742 | 26.4751 | 25.9130 | 24.8767 | 24.1007 | 23.2403 | 22.7755 | 23.3337 | 23.9413 | 24.8620 | 25.9197 | 26.7833 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 37.8323 | 36.4566 | 35.0809 | 33.7051 | 32.3294 | 30.9537 | 30.9537 | 32.3294 | 33.7051 | 35.0809 | 36.4566 | 37.8323 | (42c) |

| | | |
|---|---|---|
| Average daily hot water use (litres/day) | 116.6622 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 126.9133 | 124.2036 | 120.9036 | 115.8851 | 111.8099 | 107.4287 | 105.7447 | 109.0305 | 112.4959 | 117.0954 | 122.1912 | 126.5841 | (44) |
| Energy conte | 200.9996 | 176.8642 | 185.8243 | 158.6409 | 150.5177 | 132.0962 | 127.8891 | 135.0025 | 138.7187 | 158.8974 | 174.0838 | 198.2001 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1937.7343 | |

Distribution loss (46)m = 0.15 x (45)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 30.1499 | 26.5296 | 27.8736 | 23.7961 | 22.5776 | 19.8144 | 19.1834 | 20.2504 | 20.8078 | 23.8346 | 26.1126 | 29.7300 | (46) |

| | | |
|---|---|---|
| Water storage loss: | | |
| Store volume | 150.0000 | (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | 1.3938 | (48) |
| Temperature factor from Table 2b | 0.5400 | (49) |
| Enter (49) or (54) in (55) | 0.7527 | (55) |

Total storage loss

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (56) |

If cylinder contains dedicated solar storage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (57) |
| Primary loss 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |

Total heat required for water heating calculated for each month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 247.5945 | 218.9500 | 232.4192 | 203.7328 | 197.1126 | 177.1880 | 174.4840 | 181.5974 | 183.8105 | 205.4923 | 219.1756 | 244.7950 | (62) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WWHRS | -28.4383 | -25.1511 | -26.3368 | -21.8079 | -20.3242 | -17.3915 | -16.3018 | -17.3353 | -17.9940 | -21.2129 | -24.0316 | -27.9117 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | | | | | | | | | | | | | |
| | 219.1561 | 193.7989 | 206.0824 | 181.9249 | 176.7884 | 159.7964 | 158.1822 | 164.2621 | 165.8165 | 184.2794 | 195.1440 | 216.8833 | (64) |
| | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | | 2222.1145 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2222 | (64) |
| Electric shower(s) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | | | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | | | | | | | | | | | | | |
| | 104.1083 | 92.4759 | 99.0625 | 88.8216 | 87.3230 | 79.9954 | 79.7990 | 82.1643 | 82.1974 | 90.1093 | 93.9563 | 103.1774 | (65) |

## 5. Internal gains (see Table 5 and 5a)

| Metabolic gains (Table 5), Watts | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 113.2814 | 113.2814 | 113.2814 | 113.2814 | 113.2814 | 113.2814 | 113.2814 | 113.2814 | 113.2814 | 113.2814 | 113.2814 | 113.2814 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 105.9540 | 117.3062 | 105.9540 | 109.4858 | 105.9540 | 109.4858 | 105.9540 | 105.9540 | 109.4858 | 105.9540 | 109.4858 | 105.9540 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 199.1801 | 201.2470 | 196.0385 | 184.9504 | 170.9536 | 157.7986 | 149.0102 | 146.9434 | 152.1518 | 163.2400 | 177.2368 | 190.3918 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 34.3281 | 34.3281 | 34.3281 | 34.3281 | 34.3281 | 34.3281 | 34.3281 | 34.3281 | 34.3281 | 34.3281 | 34.3281 | 34.3281 | (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.0000 | 3.0000 | 3.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | | | | | | | | | | | | | |
| | -90.6251 | -90.6251 | -90.6251 | -90.6251 | -90.6251 | -90.6251 | -90.6251 | -90.6251 | -90.6251 | -90.6251 | -90.6251 | -90.6251 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 139.9305 | 137.6130 | 133.1485 | 123.3633 | 117.3697 | 111.1048 | 107.2568 | 110.4358 | 114.1631 | 121.1147 | 130.4949 | 138.6794 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 505.0490 | 516.1506 | 495.1255 | 477.7839 | 454.2617 | 435.3736 | 419.2054 | 420.3176 | 432.7851 | 450.2930 | 477.2019 | 495.0095 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Northwest | 10.7400 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 37.0338 | (81) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 37.0338 | 75.3834 | 135.8169 | 223.0504 | 299.8235 | 319.6436 | 299.0200 | 238.3822 | 165.4950 | 92.1245 | 46.5981 | 30.2437 | (83) |
| Total gains | 542.0828 | 591.5340 | 630.9424 | 700.8343 | 754.0852 | 755.0172 | 718.2254 | 658.6998 | 598.2802 | 542.4175 | 523.8000 | 525.2532 | (84) |

## 7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, ni1,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 66.9514 | 67.2052 | 67.4558 | 68.6582 | 68.8880 | 69.9781 | 69.9781 | 70.1838 | 69.5541 | 68.8880 | 68.4248 | 67.9471 | |
| alpha | 5.4634 | 5.4803 | 5.4971 | 5.5772 | 5.5925 | 5.6652 | 5.6652 | 5.6789 | 5.6369 | 5.5925 | 5.5617 | 5.5298 | |
| util living area | | | | | | | | | | | | | |
| | 0.9976 | 0.9956 | 0.9903 | 0.9648 | 0.8800 | 0.6944 | 0.5228 | 0.5881 | 0.8507 | 0.9772 | 0.9950 | 0.9980 | (86) |
| MIT | 19.7836 | 19.9183 | 20.1499 | 20.5076 | 20.8065 | 20.9632 | 20.9937 | 20.9884 | 20.8845 | 20.5158 | 20.1070 | 19.7759 | (87) |
| Th 2 | 19.8595 | 19.8633 | 19.8671 | 19.8846 | 19.8879 | 19.9032 | 19.9032 | 19.9061 | 19.8973 | 19.8879 | 19.8812 | 19.8743 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9966 | 0.9938 | 0.9859 | 0.9482 | 0.8275 | 0.5926 | 0.3963 | 0.4559 | 0.7684 | 0.9633 | 0.9925 | 0.9972 | (89) |
| MIT 2 | 18.4639 | 18.6386 | 18.9358 | 19.3932 | 19.7337 | 19.8853 | 19.9017 | 19.9029 | 19.8250 | 19.4127 | 18.8934 | 18.4648 | (90) |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.5146 | (91) |
| MIT | 19.1430 | 19.2972 | 19.5606 | 19.9667 | 20.2858 | 20.4400 | 20.4637 | 20.4615 | 20.3702 | 19.9804 | 19.5180 | 19.1395 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.1430 | 19.2972 | 19.5606 | 19.9667 | 20.2858 | 20.4400 | 20.4637 | 20.4615 | 20.3702 | 19.9804 | 19.5180 | 19.1395 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9958 | 0.9926 | 0.9843 | 0.9497 | 0.8483 | 0.6444 | 0.4618 | 0.5246 | 0.8074 | 0.9648 | 0.9914 | 0.9964 | (94) |
| Useful gains | 539.7878 | 587.1383 | 621.0627 | 665.5856 | 639.6886 | 486.5364 | 331.6953 | 345.5224 | 483.0603 | 523.3065 | 519.2992 | 523.3842 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | | | | | | | | | | | | | |
| | 1341.3102 | 1296.1075 | 1171.4170 | 975.1938 | 754.0574 | 504.9112 | 334.0467 | 350.1211 | 545.4164 | 823.8422 | 1098.0050 | 1330.2473 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 596.3326 | 476.4273 | 409.4636 | 222.9179 | 85.0903 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 223.5986 | 416.6682 | 600.3062 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 3030.8047 | |
| Solar heating kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | | | | | | | | | | | | | |
| | 596.3326 | 476.4273 | 409.4636 | 222.9179 | 85.0903 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 223.5986 | 416.6682 | 600.3062 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 3030.8047 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 42.8019 | (99) |

## 9a. Energy requirements - Individual heating systems, including micro-CHP

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | 0.0000 | (201) |
| Fraction of space heat from main system(s) | | | | | | | | | | | | 1.0000 | (202) |
| Efficiency of main space heating system 1 (in %) | | | | | | | | | | | | 92.3000 | (206) |
| Efficiency of main space heating system 2 (in %) | | | | | | | | | | | | 0.0000 | (207) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 | (208) |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| Space heating requirement | | | | | | | | | | | | | |
| | 596.3326 | 476.4273 | 409.4636 | 222.9179 | 85.0903 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 223.5986 | 416.6682 | 600.3062 | (98) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating efficiency (main heating system 1) | | | | | | | | | | | | |
| | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.3000 | 92.3000 | 92.3000 (210) |
| Space heating fuel (main heating system) | | | | | | | | | | | | |
| | 646.0809 | 516.1726 | 443.6226 | 241.5145 | 92.1889 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 242.2520 | 451.4281 | 650.3859 (211) |
| Space heating efficiency (main heating system 2) | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (212) |
| Space heating fuel (main heating system 2) | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (213) |
| Space heating fuel (secondary) | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (215) |
| | | | | | | | | | | | | |
| Water heating | | | | | | | | | | | | |
| Water heating requirement | | | | | | | | | | | | |
| | 219.1561 | 193.7989 | 206.0824 | 181.9249 | 176.7884 | 159.7964 | 158.1822 | 164.2621 | 165.8165 | 184.2794 | 195.1440 | 216.8833 (64) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 (216) |
| (217)m | 86.1877 | 85.9956 | 85.5690 | 84.5166 | 82.5174 | 79.8000 | 79.8000 | 79.8000 | 79.8000 | 84.4946 | 85.7165 | 86.2192 (217) |
| Fuel for water heating, kWh/month | | | | | | | | | | | | |
| | 254.2777 | 225.3591 | 240.8377 | 215.2534 | 214.2437 | 200.2462 | 198.2233 | 205.8422 | 207.7902 | 218.0961 | 227.6620 | 251.5486 (219) |
| Space cooling fuel requirement | | | | | | | | | | | | |
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (221) |
| Pumps and Fa | 7.3041 | 6.5973 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 (231) |
| Lighting | 22.0151 | 17.6614 | 15.9021 | 11.6506 | 8.9992 | 7.3524 | 8.2094 | 10.6709 | 13.8604 | 18.1856 | 20.5406 | 22.6270 (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (233a)m | -15.7033 | -23.5545 | -35.9944 | -43.1076 | -48.8243 | -46.4356 | -45.8750 | -42.1430 | -35.9801 | -28.0737 | -17.7610 | -13.4167 (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | |
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (233b)m | -5.0327 | -10.8740 | -22.1603 | -34.1041 | -45.9102 | -46.4293 | -45.8790 | -38.4640 | -27.7006 | -15.8097 | -6.8010 | -3.9583 (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | |
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235d) |

| | |
|---|---|
| Annual totals kWh/year | |
| Space heating fuel - main system 1 | 3283.6454 (211) |
| Space heating fuel - main system 2 | 0.0000 (213) |
| Space heating fuel - secondary | 0.0000 (215) |
| Efficiency of water heater | 79.8000 |
| Water heating fuel used | 2659.3801 (219) |
| Space cooling fuel | 0.0000 (221) |
| | |
| Electricity for pumps and fans: | |
| Total electricity for the above, kWh/year | 86.0000 (231) |
| Electricity for lighting (calculated in Appendix L) | 177.6748 (232) |
| | |
| Energy saving/generation technologies (Appendices M ,N and Q) | |
| PV generation | -699.9923 (233) |
| Wind generation | 0.0000 (234) |
| Hydro-electric generation (Appendix N) | 0.0000 (235a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 (235) |
| Appendix Q - special features | |
| Energy saved or generated | -0.0000 (236) |
| Energy used | 0.0000 (237) |
| Total delivered energy for all uses | 5506.7080 (238) |

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 3283.6454 | 0.2100 | 689.5655 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2659.3801 | 0.2100 | 558.4698 | (264) |
| Space and water heating | | | 1248.0353 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 177.6748 | 0.1443 | 25.6440 | (268) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -396.8691 | 0.1333 | -52.9055 | |
| PV Unit electricity exported | -303.1232 | 0.1252 | -37.9483 | |
| Total | | | -90.8539 | (269) |
| Total CO2, kg/year | | | 1194.7547 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 16.8700 | (273) |

13a. Primary energy - Individual heating systems including micro-CHP

| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 3283.6454 | 1.1300 | 3710.5193 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2659.3801 | 1.1300 | 3005.0995 | (278) |
| Space and water heating | | | 6715.6188 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 177.6748 | 1.5338 | 272.5236 | (282) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -396.8691 | 1.4926 | -592.3700 | |
| PV Unit electricity exported | -303.1232 | 0.4595 | -139.2862 | |
| Total | | | -731.6562 | (283) |
| Total Primary energy kWh/year | | | 6386.5869 | (286) |
| Target Primary Energy Rate (TPER) | | | 90.1900 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Property Reference** | Unit 16 | **Issued on Date** | 17/05/2025 |
| **Assessment Reference** | 00001 | **Prop Type Ref** | Unit 16 |
| **Property** | | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 78 C | **DER** | 6.47 | **TER** | 16.36 |
| **Environmental** | 96 A | **% DER < TER** | | | 60.45 |
| **$CO_2$ Emissions (t/year)** | 0.3 | **DFEE** | 37.92 | **TFEE** | 40.71 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 6.85 |
| **% DPER < TPER** | 21.68 | **DPER** | 68.71 | **TPER** | 87.73 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Robert Arnold | **Assessor ID** | BA04-0001 |
| **Client** | | | |

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SAP 10 WORKSHEET FOR New Build (As Designed)  (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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## 1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 51.4400 | (1b) | x 3.0800 | (2b) = | 158.4352 | (1b) - (3b) (4) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 51.4400 | | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | 158.4352 | (5) |

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## 2. Ventilation rate

---

| | m3 per hour | |
|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 (6a) |
| Number of open flues | 0 * 20 = | 0.0000 (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 (6f) |
| Number of intermittent extract fans | 0 * 10 = | 0.0000 (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 (7c) |

| | Air changes per hour | |
|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 0.0000 / (5) = | 0.0000 (8) |
| Pressure test | | Yes |
| Pressure Test Method | | Blower Door |
| Measured/design AP50 | | 3.0000 (17) |
| Infiltration rate | | 0.1500 (18) |
| Number of sides sheltered | | 0 (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.1500 (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.1912 | 0.1875 | 0.1837 | 0.1650 | 0.1612 | 0.1425 | 0.1425 | 0.1388 | 0.1500 | 0.1612 | 0.1687 | 0.1762 | (22b) |

Balanced mechanical ventilation with heat recovery

| | | |
|---|---|---|
| If mechanical ventilation | | 0.5000 (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | | 0.5000 (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | | 81.0000 (23c) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective ac | 0.2862 | 0.2825 | 0.2787 | 0.2600 | 0.2562 | 0.2375 | 0.2375 | 0.2337 | 0.2450 | 0.2562 | 0.2637 | 0.2712 | (25) |

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## 3. Heat losses and heat loss parameter

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| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| Windows | | | 6.2900 | 1.0536 | 6.6274 | | | (27) |
| Door | | | 1.8900 | 1.4000 | 2.6460 | | | (26) |
| Glass Door | | | 2.4000 | 1.3258 | 3.1818 | | | (27) |
| Heatloss Floor | | | 51.4400 | 0.1000 | 5.1440 | 0.0000 | 0.0000 | (28b) |
| External Walls | 30.0800 | 8.6900 | 21.3900 | 0.1500 | 3.2085 | 150.0000 | 3208.5000 | (29a) |
| Wall to Communal Corridor | 24.4800 | 1.8900 | 22.5900 | 0.1400 | 3.1626 | 150.0000 | 3388.5000 | (29a) |
| Total net area of external elements Aum(A, m2) | | | 106.0000 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 23.9703 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 14 | | | 20.6600 | 0.0000 | 0.0000 | 110.0000 | 2272.6000 | (32) |
| Party Wall to Unit 18 | | | 20.6700 | 0.0000 | 0.0000 | 110.0000 | 2273.7000 | (32) |
| Party Ceiling | | | 51.4400 | | | 100.0000 | 5144.0000 | (32b) |
| Internal Walls | | | 73.6200 | | | 9.0000 | 662.5800 | (32c) |

| | | |
|---|---|---|
| Heat capacity Cm = Sum(A x k) | (28)...(30) + (32) + (32a)...(32e) = | 16949.8800 (34) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 329.5078 (35)

List of Thermal Bridges

| | K1 Element | Length | Psi-value | Total |
|---|---|---|---|---|
| E1 | Steel lintel with perforated steel base plate | 4.7700 | 0.0500 | 0.2385 |
| E4 | Jamb | 13.1200 | 0.0500 | 0.6560 |
| E7 | Party floor between dwellings (in blocks of flats) | 4.2570 | 0.0350 | 0.1490 |
| E7 | Party floor between dwellings (in blocks of flats) | 7.9490 | 0.0350 | 0.2782 |
| E16 | Corner (normal) | 6.1600 | 0.0900 | 0.5544 |
| E17 | Corner (inverted - internal area greater than external area) | 3.0800 | -0.0900 | -0.2772 |
| E20 | Exposed floor (normal) | 4.2570 | 0.3200 | 1.3622 |
| E23 | Balcony within or between dwellings, balcony support penetrates wall insulation | 5.5150 | 0.0200 | 0.1103 |
| E25 | Staggered party wall between dwellings | 6.1600 | 0.0600 | 0.3696 |
| P7 | Party Wall - Exposed floor (normal) | 13.4225 | 0.1600 | 2.1476 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 5.5887 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 29.5590 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 14.9662 | 14.7701 | 14.5741 | 13.5937 | 13.3977 | 12.4174 | 12.4174 | 12.2213 | 12.8095 | 13.3977 | 13.7898 | 14.1819 | (38) |
| Heat transfer coeff | 44.5251 | 44.3291 | 44.1330 | 43.1527 | 42.9566 | 41.9763 | 41.9763 | 41.7803 | 42.3684 | 42.9566 | 43.3488 | 43.7409 | (39) |

Average = Sum(39)m / 12 = 43.1037

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 0.8656 | 0.8618 | 0.8580 | 0.8389 | 0.8351 | 0.8160 | 0.8160 | 0.8122 | 0.8236 | 0.8351 | 0.8427 | 0.8503 | (40) |
| HLP (average) | | | | | | | | | | | | 0.8379 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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4. Water heating energy requirements (kWh/year)

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Assumed occupancy 1.7325 (42)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hot water usage for mixer showers | 51.9228 | 51.1279 | 49.9564 | 48.1542 | 46.5395 | 44.2805 | 42.4938 | 44.5825 | 45.6331 | 47.8705 | 50.2006 | 51.8760 | (42a) |
| Hot water usage for baths | 22.5171 | 22.1772 | 21.6936 | 20.9695 | 20.3168 | 19.4184 | 18.7368 | 19.5703 | 20.0077 | 20.8979 | 21.8234 | 22.4992 | (42b) |
| Hot water usage for other uses | 32.3730 | 31.1958 | 30.0186 | 28.8414 | 27.6642 | 26.4870 | 26.4870 | 27.6642 | 28.8414 | 30.0186 | 31.1958 | 32.3730 | (42c) |

Average daily hot water use (litres/day) 98.1775 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 106.8130 | 104.5009 | 101.6686 | 97.9651 | 94.5205 | 90.1859 | 87.7176 | 91.8171 | 94.4823 | 98.7871 | 103.2199 | 106.7483 | (44) |
| Energy conte | 157.2471 | 138.2759 | 145.2824 | 127.9669 | 121.7993 | 104.2970 | 96.9306 | 108.0704 | 109.5947 | 127.2971 | 139.5051 | 156.7677 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1533.0342 | |
| Distribution loss (46)m = 0.15 x (45)m | 23.5871 | 20.7414 | 21.7924 | 19.1950 | 18.2699 | 15.6446 | 14.5396 | 16.2106 | 16.4392 | 19.0946 | 20.9258 | 23.5152 | (46) |

Water storage loss:

Store volume 110.0000 (47)

b) If manufacturer declared loss factor is not known :

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.0152 (51)

Volume factor from Table 2a 1.0294 (52)

Temperature factor from Table 2b 0.6000 (53)

Enter (49) or (54) in (55) 1.0327 (55)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total storage loss | 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (56) |
| If cylinder contains dedicated solar storage | 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (57) |
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | 212.5239 | 188.2033 | 200.5592 | 181.4606 | 177.0761 | 157.7907 | 152.2074 | 163.3472 | 163.0884 | 182.5739 | 192.9988 | 212.0445 | (62) |
| WWHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | 212.5239 | 188.2033 | 200.5592 | 181.4606 | 177.0761 | 157.7907 | 152.2074 | 163.3472 | 163.0884 | 182.5739 | 192.9988 | 212.0445 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2183.8740 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2184 | (64) |
| Electric shower(s) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | 96.5061 | 85.9187 | 92.5278 | 85.3439 | 84.7197 | 77.4737 | 76.4509 | 80.1548 | 79.2352 | 86.5477 | 89.1804 | 96.3467 | (65) |

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5. Internal gains (see Table 5 and 5a)

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Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 86.6275 | 86.6275 | 86.6275 | 86.6275 | 86.6275 | 86.6275 | 86.6275 | 86.6275 | 86.6275 | 86.6275 | 86.6275 | 86.6275 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 78.6268 | 87.0511 | 78.6268 | 81.2477 | 78.6268 | 81.2477 | 78.6268 | 78.6268 | 81.2477 | 78.6268 | 81.2477 | 78.6268 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 150.9730 | 152.5396 | 148.5917 | 140.1872 | 129.5781 | 119.6069 | 112.9456 | 111.3790 | 115.3268 | 123.7313 | 134.3405 | 144.3116 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 31.6627 | 31.6627 | 31.6627 | 31.6627 | 31.6627 | 31.6627 | 31.6627 | 31.6627 | 31.6627 | 31.6627 | 31.6627 | 31.6627 | (69) |
| Pumps, fans | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | -69.3020 | -69.3020 | -69.3020 | -69.3020 | -69.3020 | -69.3020 | -69.3020 | -69.3020 | -69.3020 | -69.3020 | -69.3020 | -69.3020 | (71) |
| Water heating gains (Table 5) | 129.7125 | 127.8552 | 124.3654 | 118.5332 | 113.8706 | 107.6024 | 102.7565 | 107.7350 | 110.0489 | 116.3276 | 123.8617 | 129.4982 | (72) |
| Total internal gains | 408.3005 | 416.4341 | 400.5721 | 388.9564 | 371.0636 | 357.4452 | 343.3171 | 346.7290 | 355.6116 | 367.6740 | 388.4381 | 401.4249 | (73) |

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6. Solar gains

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| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W |
|---|---|---|---|---|---|---|

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southeast | | | 6.2900 | | 36.7938 | | 0.4500 | | 0.7000 | | 0.7700 | | 50.5207 (77) |
| Southeast | | | 2.4000 | | 36.7938 | | 0.4500 | | 0.7000 | | 0.7700 | | 19.2766 (77) |
| Solar gains | 69.7973 | 118.8906 | 162.6713 | 201.5577 | 225.7614 | 224.1288 | 216.0841 | 198.0270 | 176.1386 | 131.3995 | 83.6011 | 59.7319 | (83) |
| Total gains | 478.0978 | 535.3247 | 563.2435 | 590.5140 | 596.8250 | 581.5740 | 559.4012 | 544.7560 | 531.7502 | 499.0734 | 472.0391 | 461.1568 | (84) |

## 7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 105.7447 | 106.2124 | 106.6843 | 109.1079 | 109.6059 | 112.1656 | 112.1656 | 112.6920 | 111.1275 | 109.6059 | 108.6144 | 107.6407 | |
| alpha | 8.0496 | 8.0808 | 8.1123 | 8.2739 | 8.3071 | 8.4777 | 8.4777 | 8.5128 | 8.4085 | 8.3071 | 8.2410 | 8.1760 | |
| util living area | 0.9896 | 0.9736 | 0.9381 | 0.8299 | 0.6613 | 0.4616 | 0.3301 | 0.3528 | 0.5481 | 0.8370 | 0.9676 | 0.9916 | (86) |
| MIT | 20.5302 | 20.6654 | 20.8060 | 20.9440 | 20.9916 | 20.9996 | 21.0000 | 21.0000 | 20.9985 | 20.9494 | 20.7459 | 20.5167 | (87) |
| Th 2 | 20.1969 | 20.2001 | 20.2034 | 20.2198 | 20.2230 | 20.2395 | 20.2395 | 20.2428 | 20.2329 | 20.2230 | 20.2165 | 20.2099 | (88) |
| util rest of house | 0.9858 | 0.9648 | 0.9192 | 0.7913 | 0.6093 | 0.4069 | 0.2731 | 0.2947 | 0.4880 | 0.7923 | 0.9554 | 0.9885 | (89) |
| MIT 2 | 19.6697 | 19.8393 | 20.0091 | 20.1723 | 20.2175 | 20.2393 | 20.2395 | 20.2428 | 20.2322 | 20.1828 | 19.9534 | 19.6638 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.6371 | (91) |
| MIT | 20.2179 | 20.3656 | 20.5168 | 20.6639 | 20.7106 | 20.7237 | 20.7240 | 20.7251 | 20.7204 | 20.6712 | 20.4582 | 20.2072 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 20.2179 | 20.3656 | 20.5168 | 20.6639 | 20.7106 | 20.7237 | 20.7240 | 20.7251 | 20.7204 | 20.6712 | 20.4582 | 20.2072 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9859 | 0.9668 | 0.9272 | 0.8139 | 0.6422 | 0.4417 | 0.3094 | 0.3317 | 0.5263 | 0.8190 | 0.9596 | 0.9885 | (94) |
| Useful gains | 471.3650 | 517.5522 | 522.2275 | 480.6037 | 383.2716 | 256.9080 | 173.1027 | 180.6954 | 279.8808 | 408.7241 | 452.9573 | 455.8623 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | 708.7457 | 685.5739 | 618.6026 | 507.6445 | 387.0666 | 257.0495 | 173.1084 | 180.7055 | 280.4941 | 432.6229 | 579.0631 | 700.1679 | (97) |
| Space heating kWh | 176.6112 | 112.9106 | 71.7031 | 19.4693 | 2.8235 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 17.7807 | 90.7961 | 181.7634 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 673.8578 | |
| Solar heating kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | 176.6112 | 112.9106 | 71.7031 | 19.4693 | 2.8235 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 17.7807 | 90.7961 | 181.7634 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 673.8578 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 13.0999 | (99) |

## 8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ext. temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | |
| Heat loss rate W | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 394.5774 | 310.6248 | 317.5300 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (100) |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.9933 | 0.9984 | 0.9978 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (101) |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 391.9277 | 310.1376 | 316.8277 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (102) |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 635.8614 | 612.1530 | 595.6295 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 175.6323 | 224.6995 | 207.4285 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (104) |
| Cooled fraction | | | | | | | | | | fC = cooled area / (4) = | | 0.9914 | (105) |
| Intermittency factor (Table 10b) | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | (106) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 43.5325 | 55.6944 | 51.4136 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) |
| Space cooling requirement | | | | | | | | | | | | 150.6404 | (107) |

## 9b. Energy requirements

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | 0.0000 | (301) |
| Fraction of space heat from community system | | | | | | | | | | | | 1.0000 | (302) |
| Fraction of heat from community Heat pump-Space and Water | | | | | | | | | | | | 1.0000 | (303a) |
| Factor for control and charging method (Table 4c(3)) for space heating | | | | | | | | | | | | 1.0000 | (305) |
| Factor for charging method (Table 4c(3)) for water heating | | | | | | | | | | | | 1.0000 | (305a) |
| Distribution loss factor (Table 12c) for community heating system | | | | | | | | | | | | 2.0000 | (306) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 | (208) |
| Space heating: | | | | | | | | | | | | | |
| Space heating requirement | 176.6112 | 112.9106 | 71.7031 | 19.4693 | 2.8235 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 17.7807 | 90.7961 | 181.7634 | (98) |
| Space heat from Heat pump = (98) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 307a | 353.2224 | 225.8211 | 143.4061 | 38.9387 | 5.6469 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 35.5614 | 181.5923 | 363.5267 | |
| Space heating requirement | 353.2224 | 225.8211 | 143.4061 | 38.9387 | 5.6469 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 35.5614 | 181.5923 | 363.5267 | (307) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | | | | | | | | | | | 0.0000 | (308) |
| Space heating fuel for secondary/supplementary system | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (309) |
| Water heating | | | | | | | | | | | | | |
| Annual water heating requirement | 212.5239 | 188.2033 | 200.5592 | 181.4606 | 177.0761 | 157.7907 | 152.2074 | 163.3472 | 163.0884 | 182.5739 | 192.9988 | 212.0445 | (64) |
| Water heat from Heat pump = (64) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 310a | 425.0479 | 376.4066 | 401.1184 | 362.9211 | 354.1522 | 315.5814 | 304.4147 | 326.6944 | 326.1768 | 365.1479 | 385.9976 | 424.0890 | |
| Water heating fuel | 425.0479 | 376.4066 | 401.1184 | 362.9211 | 354.1522 | 315.5814 | 304.4147 | 326.6944 | 326.1768 | 365.1479 | 385.9976 | 424.0890 | (310) |
| Cooling System Energy Efficiency Ratio | | | | | | | | | | | | 2.6000 | (314) |
| Space coolin | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 16.7433 | 21.4209 | 19.7744 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (315) |
| Pumps and Fa | 14.4793 | 13.0781 | 14.4793 | 14.0123 | 14.4793 | 14.0123 | 14.4793 | 14.4793 | 14.0123 | 14.4793 | 14.0123 | 14.4793 | (331) |
| Lighting | 15.2018 | 12.1954 | 10.9806 | 8.0449 | 6.2141 | 5.0770 | 5.6687 | 7.3684 | 9.5708 | 12.5574 | 14.1836 | 15.6243 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333a)m | -4.7019 | -7.5801 | -12.5332 | -16.1580 | -19.2433 | -18.6569 | -18.3963 | -16.3903 | -13.2100 | -9.4378 | -5.4732 | -3.9502 | (333a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (334a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335a) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (333b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335b) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - community heating | 1347.7157 | (307) |
| Space heating fuel - secondary | 0.0000 | (309) |
| Water heating fuel - community heating | 4367.7479 | (310) |
| Efficiency of water heater | 0.0000 | (311) |
| Electricity used for heat distribution | 13.4772 | (313) |
| Space cooling fuel | 57.9386 | (321) |
| | | |
| Electricity for pumps and fans: | | |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8820) | | |
| mechanical ventilation fans (SFP = 0.8820) | 170.4826 | (330a) |
| Total electricity for the above, kWh/year | 170.4826 | (331) |
| Electricity for lighting (calculated in Appendix L) | 122.6869 | (332) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -145.7313 | (333) |
| Wind generation | 0.0000 | (334) |
| Hydro-electric generation (Appendix N) | 0.0000 | (335a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (335) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (336) |
| Energy used | 0.0000 | (337) |
| Total delivered energy for all uses | 5920.8404 | (338) |

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12b. Carbon dioxide emissions - Community heating scheme

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (367) |
| Space and Water heating from Heat pump | 2041.2370 | 0.1584 | 76.2404 | (367) |
| Electrical energy for heat distribution (space & water) | 13.4772 | 0.0000 | 8.2811 | (372) |
| Overall CO2 factor for heat network | | | 0.0532 | (386) |
| Total CO2 associated with community systems | | | 304.0359 | (373) |
| Space and water heating | | | 304.0359 | (376) |
| Space cooling | 57.9386 | 0.1139 | 6.6017 | (377) |
| Pumps, fans and electric keep-hot | 170.4826 | 0.1387 | 23.6480 | (378) |
| Energy for lighting | 122.6869 | 0.1443 | 17.7075 | (379) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -145.7313 | 0.1320 | -19.2296 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -19.2296 | (380) |
| Total CO2, kg/year | | | 332.7635 | (383) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 6.4700 | (384) |

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13b. Primary energy - Community heating scheme

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| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (467a) |
| Space and Water heating from Heat pump | 2041.2370 | 1.5863 | 763.5469 | (467) |
| Electrical energy for heat distribution (space & water) | 13.4772 | 0.0000 | 87.7835 | (472) |
| Overall CO2 factor for heat network | | | 0.5639 | (486) |
| Total CO2 associated with community systems | | | 3222.9097 | (473) |
| Space and water heating | | | 3222.9097 | (476) |
| Space cooling | 57.9386 | 1.4200 | 82.2718 | (477) |
| Pumps, fans and electric keep-hot | 170.4826 | 1.5128 | 257.9061 | (478) |
| Energy for lighting | 122.6869 | 1.5338 | 188.1812 | (479) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -145.7313 | 1.4875 | -216.7782 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -216.7782 | (480) |
| Total Primary energy kWh/year | | | 3534.4906 | (483) |
| Dwelling Primary energy Rate (DPER) | | | 68.7100 | (484) |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

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| | | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | |
| Ground floor | | 51.4400 | (1b) | x 3.0800 | (2b) = | 158.4352 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 51.4400 | | | | | | (4) |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | | 158.4352 | (5) |

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2. Ventilation rate

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m3 per hour

| | | |
|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 (6a) |
| Number of open flues | 0 * 20 = | 0.0000 (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 (6f) |
| Number of intermittent extract fans | 2 * 10 = | 20.0000 (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 (7c) |

| | | Air changes per hour | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 20.0000 / (5) = | 0.1262 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3762 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.3762 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.4797 | 0.4703 | 0.4609 | 0.4139 | 0.4045 | 0.3574 | 0.3574 | 0.3480 | 0.3762 | 0.4045 | 0.4233 | 0.4421 | (22b) |
| Effective ac | 0.6151 | 0.6106 | 0.6062 | 0.5856 | 0.5818 | 0.5639 | 0.5639 | 0.5606 | 0.5708 | 0.5818 | 0.5896 | 0.5977 | (25) |

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## 3. Heat losses and heat loss parameter

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| Element | Gross | Openings | NetArea | U-value | A x U | K-value | A x K | |
|---|---|---|---|---|---|---|---|---|
| | m2 | m2 | m2 | W/m2K | W/K | kJ/m2K | kJ/K | |
| Main dwelling | | | | | | | | |
| TER Opaque door | | | 1.8900 | 1.0000 | 1.8900 | | | (26) |
| TER Opening Type | | | 8.6900 | 1.1450 | 9.9504 | | | (27) |
| Heatloss Floor | | | 51.4400 | 0.1300 | 6.6872 | | | (28b) |
| External Walls | 30.0800 | 8.6900 | 21.3900 | 0.1800 | 3.8502 | | | (29a) |
| Wall to Communal Corridor | 24.4800 | 1.8900 | 22.5900 | 0.1800 | 4.0662 | | | (29a) |
| Total net area of external elements Aum(A, m2) | | | 106.0000 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 26.4440 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 14 | | | 20.6600 | 0.0000 | 0.0000 | | | (32) |
| Party Wall to Unit 18 | | | 20.6700 | 0.0000 | 0.0000 | | | (32) |

| | | |
|---|---|---|
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | 309.5078 | (35) |

List of Thermal Bridges

| K1 Element | Length | Psi-value | Total |
|---|---|---|---|
| E1 Steel lintel with perforated steel base plate | 4.7700 | 0.0500 | 0.2385 |
| E4 Jamb | 13.1200 | 0.0500 | 0.6560 |
| E7 Party floor between dwellings (in blocks of flats) | 4.2570 | 0.0700 | 0.2980 |
| E7 Party floor between dwellings (in blocks of flats) | 7.9490 | 0.0700 | 0.5564 |
| E16 Corner (normal) | 6.1600 | 0.0900 | 0.5544 |
| E17 Corner (inverted - internal area greater than external area) | 3.0800 | -0.0900 | -0.2772 |
| E20 Exposed floor (normal) | 4.2570 | 0.3200 | 1.3622 |
| E23 Balcony within or between dwellings, balcony support penetrates wall insulation | 5.5150 | 0.0200 | 0.1103 |
| E25 Staggered party wall between dwellings | 6.1600 | 0.0600 | 0.3696 |
| P7 Party Wall - Exposed floor (normal) | 13.4225 | 0.1600 | 2.1476 |

| | | | |
|---|---|---|---|
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | 6.0159 | (36) |
| Point Thermal bridges | (36a) = | 0.0000 | |
| Total fabric heat loss | (33) + (36) + (36a) = | 32.4598 | (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 32.1573 | 31.9237 | 31.6948 | 30.6193 | 30.4181 | 29.4815 | 29.4815 | 29.3080 | 29.8422 | 30.4181 | 30.8252 | 31.2507 | (38) |
| Heat transfer coeff | 64.6172 | 64.3836 | 64.1546 | 63.0792 | 62.8780 | 61.9413 | 61.9413 | 61.7678 | 62.3021 | 62.8780 | 63.2850 | 63.7106 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 63.0782 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.2562 | 1.2516 | 1.2472 | 1.2263 | 1.2224 | 1.2041 | 1.2041 | 1.2008 | 1.2112 | 1.2224 | 1.2303 | 1.2385 | (40) |
| HLP (average) | | | | | | | | | | | | 1.2262 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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## 4. Water heating energy requirements (kWh/year)

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| | | |
|---|---|---|
| Assumed occupancy | 1.7325 | (42) |

Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 53.2687 | 52.4681 | 51.3016 | 49.0697 | 47.4226 | 45.5857 | 44.5417 | 45.6994 | 46.9684 | 48.9406 | 51.2205 | 53.0646 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.0305 | 22.6885 | 22.2068 | 21.3187 | 20.6537 | 19.9164 | 19.5181 | 19.9964 | 20.5171 | 21.3061 | 22.2125 | 22.9526 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.3730 | 31.1958 | 30.0186 | 28.8414 | 27.6642 | 26.4870 | 26.4870 | 27.6642 | 28.8414 | 30.0186 | 31.1958 | 32.3730 | (42c) |

| | |
|---|---|
| Average daily hot water use (litres/day) | 99.8949 (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 108.6722 | 106.3524 | 103.5271 | 99.2298 | 95.7405 | 91.9891 | 90.5468 | 93.3600 | 96.3270 | 100.2654 | 104.6288 | 108.3902 | (44) |
| Energy conte | 172.1102 | 151.4444 | 159.1172 | 135.8407 | 128.8852 | 113.1114 | 109.5085 | 115.5991 | 118.7808 | 136.0592 | 149.0630 | 169.7129 | (45) |
| Energy content (annual) | | | | | | | | | | | Total = Sum(45)m = | 1659.2326 | |

Distribution loss (46)m = 0.15 x (45)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 25.8165 | 22.7167 | 23.8676 | 20.3761 | 19.3328 | 16.9667 | 16.4263 | 17.3399 | 17.8171 | 20.4089 | 22.3594 | 25.4569 | (46) |

| | |
|---|---|
| Water storage loss: | |
| Store volume | 150.0000 (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | 1.3938 (48) |
| Temperature factor from Table 2b | 0.5400 (49) |
| Enter (49) or (54) in (55) | 0.7527 (55) |

Total storage loss

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (56) |

If cylinder contains dedicated solar storage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (57) |
| Primary loss 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |

Total heat required for water heating calculated for each month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 218.7051 | 193.5302 | 205.7121 | 180.9325 | 175.4801 | 158.2032 | 156.1034 | 162.1940 | 163.8726 | 182.6541 | 194.1548 | 216.3078 | (62) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WWHRS | -24.3522 | -21.5373 | -22.5526 | -18.6745 | -17.4039 | -14.8927 | -13.9595 | -14.8445 | -15.4085 | -18.1649 | -20.5787 | -23.9012 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | | | | | | | | | | | | | |
| | 194.3529 | 171.9929 | 183.1595 | 162.2581 | 158.0761 | 143.3106 | 142.1439 | 147.3495 | 148.4641 | 164.4892 | 173.5761 | 192.4066 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 1981.5795 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 1982 | (64) |
| Electric shower(s) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | | | | | |
| | | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | | | | | | | | | | | | | |
| | 94.5026 | 84.0239 | 90.1824 | 81.2405 | 80.1302 | 73.6830 | 73.6875 | 75.7126 | 75.5681 | 82.5156 | 85.6369 | 93.7055 | (65) |

## 5. Internal gains (see Table 5 and 5a)

| Metabolic gains (Table 5), Watts | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 86.6275 | 86.6275 | 86.6275 | 86.6275 | 86.6275 | 86.6275 | 86.6275 | 86.6275 | 86.6275 | 86.6275 | 86.6275 | 86.6275 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 78.6268 | 87.0511 | 78.6268 | 81.2477 | 78.6268 | 81.2477 | 78.6268 | 78.6268 | 81.2477 | 78.6268 | 81.2477 | 78.6268 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 150.9730 | 152.5396 | 148.5917 | 140.1872 | 129.5781 | 119.6069 | 112.9456 | 111.3790 | 115.3268 | 123.7313 | 134.3405 | 144.3116 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 31.6627 | 31.6627 | 31.6627 | 31.6627 | 31.6627 | 31.6627 | 31.6627 | 31.6627 | 31.6627 | 31.6627 | 31.6627 | 31.6627 | (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.0000 | 3.0000 | 3.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | | | | | | | | | | | | | |
| | -69.3020 | -69.3020 | -69.3020 | -69.3020 | -69.3020 | -69.3020 | -69.3020 | -69.3020 | -69.3020 | -69.3020 | -69.3020 | -69.3020 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 127.0196 | 125.0355 | 121.2129 | 112.8340 | 107.7019 | 102.3375 | 99.0423 | 101.7643 | 104.9557 | 110.9081 | 118.9402 | 125.9482 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 408.6076 | 416.6144 | 400.4197 | 386.2572 | 367.8950 | 352.1803 | 339.6029 | 340.7583 | 350.5184 | 365.2544 | 386.5166 | 400.8749 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Southeast | 8.6900 | 36.7938 | 0.6300 | 0.7000 | 0.7700 | 97.7162 | (77) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 97.7162 | 166.4469 | 227.7399 | 282.1807 | 316.0659 | 313.7803 | 302.5177 | 277.2378 | 246.5941 | 183.9592 | 117.0415 | 83.6247 | (83) |
| Total gains | 506.3238 | 583.0613 | 628.1595 | 668.4379 | 683.9609 | 665.9606 | 642.1206 | 617.9961 | 597.1125 | 549.2137 | 503.5581 | 484.4996 | (84) |

## 7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, ni1,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 68.4419 | 68.6902 | 68.9354 | 70.1107 | 70.3350 | 71.3986 | 71.3986 | 71.5991 | 70.9851 | 70.3350 | 69.8826 | 69.4158 | |
| alpha | 5.5628 | 5.5793 | 5.5957 | 5.6740 | 5.6890 | 5.7599 | 5.7599 | 5.7733 | 5.7323 | 5.6890 | 5.6588 | 5.6277 | |
| util living area | | | | | | | | | | | | | |
| | 0.9921 | 0.9819 | 0.9610 | 0.9004 | 0.7767 | 0.5828 | 0.4227 | 0.4570 | 0.6855 | 0.9139 | 0.9813 | 0.9936 | (86) |
| MIT | 20.0046 | 20.1986 | 20.4356 | 20.7202 | 20.9071 | 20.9855 | 20.9980 | 20.9970 | 20.9643 | 20.7363 | 20.3321 | 19.9809 | (87) |
| Th 2 | 19.8753 | 19.8789 | 19.8824 | 19.8990 | 19.9022 | 19.9167 | 19.9167 | 19.9194 | 19.9111 | 19.9022 | 19.8959 | 19.8893 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9890 | 0.9752 | 0.9465 | 0.8655 | 0.7102 | 0.4901 | 0.3196 | 0.3512 | 0.5923 | 0.8759 | 0.9732 | 0.9912 | (89) |
| MIT 2 | 18.7555 | 19.0019 | 19.2970 | 19.6427 | 19.8354 | 19.9102 | 19.9162 | 19.9186 | 19.8924 | 19.6710 | 19.1850 | 18.7361 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.6371 | (91) |
| MIT | 19.5512 | 19.7642 | 20.0224 | 20.3291 | 20.5181 | 20.5952 | 20.6054 | 20.6056 | 20.5752 | 20.3497 | 19.9158 | 19.5291 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.5512 | 19.7642 | 20.0224 | 20.3291 | 20.5181 | 20.5952 | 20.6054 | 20.6056 | 20.5752 | 20.3497 | 19.9158 | 19.5291 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9879 | 0.9744 | 0.9486 | 0.8803 | 0.7490 | 0.5489 | 0.3854 | 0.4187 | 0.6507 | 0.8930 | 0.9733 | 0.9902 | (94) |
| Useful gains | 500.1876 | 568.1364 | 595.8559 | 588.4508 | 512.3046 | 365.5580 | 247.4623 | 258.7565 | 388.5355 | 490.4590 | 490.1292 | 479.7292 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | | | | | | | | | | | | | |
| | 985.4899 | 957.0136 | 867.5214 | 720.9372 | 554.4659 | 371.3518 | 248.0998 | 259.7702 | 403.4211 | 613.0383 | 811.0457 | 976.6275 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 361.0649 | 261.3255 | 202.1191 | 95.3902 | 31.3680 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 91.1990 | 231.0599 | 369.6924 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 1643.2190 | |
| Solar heating kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | | | | | | | | | | | | | |
| | 361.0649 | 261.3255 | 202.1191 | 95.3902 | 31.3680 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 91.1990 | 231.0599 | 369.6924 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 1643.2190 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 31.9444 | (99) |

## 9a. Energy requirements - Individual heating systems, including micro-CHP

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | 0.0000 | (201) |
| Fraction of space heat from main system(s) | | | | | | | | | | | | 1.0000 | (202) |
| Efficiency of main space heating system 1 (in %) | | | | | | | | | | | | 92.3000 | (206) |
| Efficiency of main space heating system 2 (in %) | | | | | | | | | | | | 0.0000 | (207) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 | (208) |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| Space heating requirement | | | | | | | | | | | | | |
| | 361.0649 | 261.3255 | 202.1191 | 95.3902 | 31.3680 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 91.1990 | 231.0599 | 369.6924 | (98) |

Space heating efficiency (main heating system 1)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 92.3000 | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.3000 | 92.3000 | 92.3000 | (210) |

Space heating fuel (main heating system)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 391.1863 | 283.1262 | 218.9806 | 103.3480 | 33.9849 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 98.8071 | 250.3357 | 400.5334 | (211) |

Space heating efficiency (main heating system 2)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (212) |

Space heating fuel (main heating system 2)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (213) |

Space heating fuel (secondary)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (215) |

Water heating

Water heating requirement

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 194.3529 | 171.9929 | 183.1595 | 162.2581 | 158.0761 | 143.3106 | 142.1439 | 147.3495 | 148.4641 | 164.4892 | 173.5761 | 192.4066 | (64) |

Efficiency of water heater

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | 79.8000 | (216) |
| (217)m | 85.4286 | 84.9952 | 84.2812 | 82.9111 | 81.1620 | 79.8000 | 79.8000 | 79.8000 | 79.8000 | 82.7930 | 84.7021 | 85.4993 | (217) |

Fuel for water heating, kWh/month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 227.5034 | 202.3561 | 217.3196 | 195.7012 | 194.7661 | 179.5872 | 178.1252 | 184.6485 | 186.0453 | 198.6753 | 204.9254 | 225.0389 | (219) |

Space cooling fuel requirement

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (221) |
| Pumps and Fa | 7.3041 | 6.5973 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | (231) |
| Lighting | 16.3371 | 13.1062 | 11.8007 | 8.6457 | 6.6782 | 5.4561 | 6.0921 | 7.9187 | 10.2856 | 13.4953 | 15.2429 | 16.7911 | (232) |

Electricity generated by PVs (Appendix M) (negative quantity)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (233a)m | -11.5092 | -17.3202 | -26.5591 | -31.9310 | -36.2890 | -34.5748 | -34.1718 | -31.3384 | -26.6683 | -20.7068 | -13.0411 | -9.8281 | (233a) |

Electricity generated by wind turbines (Appendix M) (negative quantity)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234a) |

Electricity generated by hydro-electric generators (Appendix M) (negative quantity)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235a) |

Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235c) |

Electricity generated by PVs (Appendix M) (negative quantity)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (233b)m | -3.5544 | -7.6904 | -15.6874 | -24.1595 | -32.5310 | -32.8870 | -32.4830 | -27.2186 | -19.5925 | -11.1724 | -4.8019 | -2.7940 | (233b) |

Electricity generated by wind turbines (Appendix M) (negative quantity)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234b) |

Electricity generated by hydro-electric generators (Appendix M) (negative quantity)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235b) |

Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235d) |

Annual totals kWh/year

| | | |
|---|---|---|
| Space heating fuel - main system 1 | 1780.3023 | (211) |
| Space heating fuel - main system 2 | 0.0000 | (213) |
| Space heating fuel - secondary | 0.0000 | (215) |
| Efficiency of water heater | 79.8000 | |
| Water heating fuel used | 2394.6920 | (219) |
| Space cooling fuel | 0.0000 | (221) |

Electricity for pumps and fans:

| | | |
|---|---|---|
| Total electricity for the above, kWh/year | 86.0000 | (231) |
| Electricity for lighting (calculated in Appendix L) | 131.8497 | (232) |

Energy saving/generation technologies (Appendices M ,N and Q)

| | | |
|---|---|---|
| PV generation | -508.5102 | (233) |
| Wind generation | 0.0000 | (234) |
| Hydro-electric generation (Appendix N) | 0.0000 | (235a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (235) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (236) |
| Energy used | 0.0000 | (237) |
| Total delivered energy for all uses | 3884.3338 | (238) |

---

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

---

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 1780.3023 | 0.2100 | 373.8635 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2394.6920 | 0.2100 | 502.8853 | (264) |
| Space and water heating | | | 876.7488 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 131.8497 | 0.1443 | 19.0300 | (268) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -293.9379 | 0.1332 | -39.1599 | |
| PV Unit electricity exported | -214.5723 | 0.1252 | -26.8608 | |
| Total | | | -66.0206 | (269) |
| Total CO2, kg/year | | | 841.6874 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 16.3600 | (273) |

---

13a. Primary energy - Individual heating systems including micro-CHP

---

| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 1780.3023 | 1.1300 | 2011.7416 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2394.6920 | 1.1300 | 2706.0020 | (278) |
| Space and water heating | | | 4717.7435 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 131.8497 | 1.5338 | 202.2354 | (282) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -293.9379 | 1.4923 | -438.6431 | |
| PV Unit electricity exported | -214.5723 | 0.4595 | -98.5903 | |
| Total | | | -537.2334 | (283) |
| Total Primary energy kWh/year | | | 4512.8463 | (286) |
| Target Primary Energy Rate (TPER) | | | 87.7300 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Property Reference** | Unit 17 | **Issued on Date** | 17/05/2025 |
| **Assessment Reference** | 00001 | **Prop Type Ref** | Unit 17 |
| **Property** | | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 73 C | **DER** | 7.81 | **TER** | 19.73 |
| **Environmental** | 94 A | **% DER < TER** | | | 60.42 |
| **$CO_2$ Emissions (t/year)** | 0.47 | **DFEE** | 56.14 | **TFEE** | 62.98 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 10.87 |
| **% DPER < TPER** | 22.44 | **DPER** | 81.81 | **TPER** | 105.47 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Robert Arnold | **Assessor ID** | BA04-0001 |
| **Client** | | | |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 69.5900 | (1b) | x 3.0800 | (2b) = | 214.3372 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 69.5900 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = | 214.3372 | (5) |

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2. Ventilation rate

---

| | | m3 per hour | |
|---|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 | (6a) |
| Number of open flues | 0 * 20 = | 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | 0 * 10 = | 0.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |

| | Air changes per hour | | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 0.0000 / (5) = | 0.0000 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 3.0000 | (17) |
| Infiltration rate | | 0.1500 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.1500 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.1912 | 0.1875 | 0.1837 | 0.1650 | 0.1612 | 0.1425 | 0.1425 | 0.1388 | 0.1500 | 0.1612 | 0.1687 | 0.1762 | (22b) |

Balanced mechanical ventilation with heat recovery

| | | |
|---|---|---|
| If mechanical ventilation | | 0.5000 (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | | 0.5000 (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | | 81.0000 (23c) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective ac | 0.2862 | 0.2825 | 0.2787 | 0.2600 | 0.2562 | 0.2375 | 0.2375 | 0.2337 | 0.2450 | 0.2562 | 0.2637 | 0.2712 | (25) |

---

3. Heat losses and heat loss parameter

---

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| Windows | | | 11.8200 | 1.0536 | 12.4540 | | | (27) |
| Door | | | 1.8900 | 1.4000 | 2.6460 | | | (26) |
| Glass Door | | | 2.4000 | 1.3258 | 3.1818 | | | (27) |
| Heatloss Floor | | | 69.5900 | 0.1000 | 6.9590 | 0.0000 | 0.0000 | (28b) |
| External Walls | 125.2900 | 14.2200 | 111.0700 | 0.1500 | 16.6605 | 150.0000 | 16660.5000 | (29a) |
| Wall to Communal Corridor | 30.8700 | 1.8900 | 28.9800 | 0.1400 | 4.0572 | 150.0000 | 4347.0000 | (29a) |
| Total net area of external elements Aum(A, m2) | | | 225.7500 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 45.9585 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 15 | | | 22.0600 | 0.0000 | 0.0000 | 110.0000 | 2426.6000 | (32) |
| Party Ceiling | | | 69.5900 | | | 100.0000 | 6959.0000 | (32b) |
| Internal Wall 1 | | | 158.3600 | | | 9.0000 | 1425.2400 | (32c) |

| | | |
|---|---|---|
| Heat capacity Cm = Sum(A x k) | (28)...(30) + (32) + (32a)...(32e) = | 31818.3400 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | | 457.2258 (35) |

List of Thermal Bridges

| | K1 Element | Length | Psi-value | Total |
|---|---|---|---|---|
| E1 | Steel lintel with perforated steel base plate | 7.3600 | 0.0500 | 0.3680 |
| E3 | Sill | 1.0225 | 0.0500 | 0.0511 |
| E4 | Jamb | 18.0200 | 0.0600 | 1.0812 |
| E7 | Party floor between dwellings (in blocks of flats) | 15.0700 | 0.0350 | 0.5275 |
| E16 | Corner (normal) | 9.2400 | 0.0900 | 0.8316 |
| E18 | Party wall between dwellings | 3.0800 | 0.0300 | 0.0924 |
| E7 | Party floor between dwellings (in blocks of flats) | 10.0250 | 0.0350 | 0.3509 |
| E17 | Corner (inverted - internal area greater than external area) | 6.1600 | -0.0900 | -0.5544 |
| E20 | Exposed floor (normal) | 15.0700 | 0.3200 | 4.8224 |
| E23 | Balcony within or between dwellings, balcony support penetrates wall insulation | 5.2870 | 0.0200 | 0.1057 |
| P7 | Party Wall - Exposed floor (normal) | 7.1650 | 0.0800 | 0.5732 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 8.2496 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 54.2081 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 20.2468 | 19.9816 | 19.7163 | 18.3901 | 18.1249 | 16.7987 | 16.7987 | 16.5334 | 17.3292 | 18.1249 | 18.6554 | 19.1859 | (38) |
| Heat transfer coeff | 74.4550 | 74.1897 | 73.9245 | 72.5983 | 72.3330 | 71.0068 | 71.0068 | 70.7416 | 71.5373 | 72.3330 | 72.8635 | 73.3940 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 72.5320 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.0699 | 1.0661 | 1.0623 | 1.0432 | 1.0394 | 1.0204 | 1.0204 | 1.0165 | 1.0280 | 1.0394 | 1.0470 | 1.0547 | (40) |
| HLP (average) | | | | | | | | | | | | 1.0423 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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4. Water heating energy requirements (kWh/year)

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Assumed occupancy 2.2361 (42)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hot water usage for mixer showers | 60.1530 | 59.2321 | 57.8749 | 55.7870 | 53.9164 | 51.2993 | 49.2294 | 51.6492 | 52.8663 | 55.4584 | 58.1578 | 60.0988 | (42a) |
| Hot water usage for baths | 26.0671 | 25.6736 | 25.1138 | 24.2755 | 23.5200 | 22.4799 | 21.6909 | 22.6558 | 23.1621 | 24.1927 | 25.2641 | 26.0465 | (42b) |
| Hot water usage for other uses | 37.5302 | 36.1655 | 34.8007 | 33.4360 | 32.0713 | 30.7065 | 30.7065 | 32.0713 | 33.4360 | 34.8007 | 36.1655 | 37.5302 | (42c) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 113.7452 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 123.7504 | 121.0712 | 117.7895 | 113.4985 | 109.5076 | 104.4858 | 101.6268 | 106.3763 | 109.4645 | 114.4518 | 119.5874 | 123.6755 | (44) |
| Energy conte | 182.1819 | 160.2017 | 168.3187 | 148.2575 | 141.1117 | 120.8343 | 112.3006 | 125.2068 | 126.9733 | 147.4828 | 161.6264 | 181.6265 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1776.1222 | |
| Distribution loss (46)m = 0.15 x (45)m | 27.3273 | 24.0303 | 25.2478 | 22.2386 | 21.1667 | 18.1251 | 16.8451 | 18.7810 | 19.0460 | 22.1224 | 24.2440 | 27.2440 | (46) |
| Water storage loss: | | | | | | | | | | | | | |
| Store volume | | | | | | | | | | | | 110.0000 | (47) |
| b) If manufacturer declared loss factor is not known : | | | | | | | | | | | | | |
| Hot water storage loss factor from Table 2 (kWh/litre/day) | | | | | | | | | | | | 0.0152 | (51) |
| Volume factor from Table 2a | | | | | | | | | | | | 1.0294 | (52) |
| Temperature factor from Table 2b | | | | | | | | | | | | 0.6000 | (53) |
| Enter (49) or (54) in (55) | | | | | | | | | | | | 1.0327 | (55) |
| Total storage loss | 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (56) |
| If cylinder contains dedicated solar storage | 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (57) |
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | 237.4587 | 210.1291 | 223.5955 | 201.7511 | 196.3885 | 174.3280 | 167.5774 | 180.4836 | 180.4670 | 202.7596 | 215.1201 | 236.9033 | (62) |
| WWHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | 237.4587 | 210.1291 | 223.5955 | 201.7511 | 196.3885 | 174.3280 | 167.5774 | 180.4836 | 180.4670 | 202.7596 | 215.1201 | 236.9033 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2426.9620 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2427 | (64) |
| Electric shower(s) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | 104.7969 | 93.2090 | 100.1874 | 92.0906 | 91.1411 | 82.9724 | 81.5614 | 85.8527 | 85.0136 | 93.2595 | 96.5357 | 104.6122 | (65) |

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5. Internal gains (see Table 5 and 5a)

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Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 111.8065 | 111.8065 | 111.8065 | 111.8065 | 111.8065 | 111.8065 | 111.8065 | 111.8065 | 111.8065 | 111.8065 | 111.8065 | 111.8065 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 99.5197 | 110.1825 | 99.5197 | 102.8370 | 99.5197 | 102.8370 | 99.5197 | 99.5197 | 102.8370 | 99.5197 | 102.8370 | 99.5197 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 196.3383 | 198.3756 | 193.2415 | 182.3116 | 168.5145 | 155.5472 | 146.8842 | 144.8468 | 149.9810 | 160.9109 | 174.7080 | 187.6753 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 34.1806 | 34.1806 | 34.1806 | 34.1806 | 34.1806 | 34.1806 | 34.1806 | 34.1806 | 34.1806 | 34.1806 | 34.1806 | 34.1806 | (69) |
| Pumps, fans | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | -89.4452 | -89.4452 | -89.4452 | -89.4452 | -89.4452 | -89.4452 | -89.4452 | -89.4452 | -89.4452 | -89.4452 | -89.4452 | -89.4452 | (71) |
| Water heating gains (Table 5) | 140.8561 | 138.7039 | 134.6605 | 127.9035 | 122.5014 | 115.2394 | 109.6255 | 115.3934 | 118.0744 | 125.3487 | 134.0774 | 140.6079 | (72) |
| Total internal gains | 493.2560 | 503.8040 | 483.9637 | 469.5941 | 447.0776 | 430.1655 | 412.5714 | 416.3019 | 427.4343 | 442.3213 | 468.1643 | 484.3448 | (73) |

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6. Solar gains

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| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W |
|---|---|---|---|---|---|---|

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northeast | | | 3.9900 | | 11.2829 | | 0.4500 | | 0.7000 | | 0.7700 | | 9.8274 (75) |
| Northwest | | | 7.8300 | | 11.2829 | | 0.4500 | | 0.7000 | | 0.7700 | | 19.2854 (81) |
| Northwest | | | 2.4000 | | 11.2829 | | 0.4500 | | 0.7000 | | 0.7700 | | 5.9112 (81) |
| Solar gains | 35.0240 | 71.2924 | 128.4462 | 210.9455 | 283.5521 | 302.2966 | 282.7923 | 225.4453 | 156.5137 | 87.1249 | 44.0693 | 28.6024 | (83) |
| Total gains | 528.2800 | 575.0963 | 612.4098 | 680.5396 | 730.6297 | 732.4621 | 695.3636 | 641.7471 | 583.9480 | 529.4462 | 512.2336 | 512.9471 | (84) |

## 7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 118.7084 | 119.1328 | 119.5602 | 121.7443 | 122.1908 | 124.4730 | 124.4730 | 124.9397 | 123.5499 | 122.1908 | 121.3012 | 120.4244 | |
| alpha | 8.9139 | 8.9422 | 8.9707 | 9.1163 | 9.1461 | 9.2982 | 9.2982 | 9.3293 | 9.2367 | 9.1461 | 9.0867 | 9.0283 | |
| util living area | 0.9997 | 0.9992 | 0.9972 | 0.9762 | 0.8603 | 0.6176 | 0.4492 | 0.5066 | 0.8116 | 0.9877 | 0.9990 | 0.9998 | (86) |
| MIT | 20.3285 | 20.4178 | 20.5666 | 20.7984 | 20.9584 | 20.9981 | 20.9999 | 20.9997 | 20.9814 | 20.7840 | 20.5283 | 20.3227 | (87) |
| Th 2 | 20.0255 | 20.0286 | 20.0318 | 20.0475 | 20.0506 | 20.0664 | 20.0664 | 20.0696 | 20.0601 | 20.0506 | 20.0443 | 20.0380 | (88) |
| util rest of house | 0.9995 | 0.9988 | 0.9952 | 0.9603 | 0.7973 | 0.5292 | 0.3540 | 0.4045 | 0.7189 | 0.9765 | 0.9982 | 0.9997 | (89) |
| MIT 2 | 19.2511 | 19.3681 | 19.5605 | 19.8593 | 20.0247 | 20.0658 | 20.0664 | 20.0695 | 20.0521 | 19.8492 | 19.5227 | 19.2540 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.5226 | (91) |
| MIT | 19.8141 | 19.9167 | 20.0863 | 20.3501 | 20.5127 | 20.5530 | 20.5543 | 20.5557 | 20.5378 | 20.3377 | 20.0483 | 19.8126 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.8141 | 19.9167 | 20.0863 | 20.3501 | 20.5127 | 20.5530 | 20.5543 | 20.5557 | 20.5378 | 20.3377 | 20.0483 | 19.8126 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9995 | 0.9987 | 0.9954 | 0.9663 | 0.8298 | 0.5756 | 0.4037 | 0.4579 | 0.7683 | 0.9807 | 0.9982 | 0.9996 | (94) |
| Useful gains | 528.0114 | 574.3430 | 609.5641 | 657.5888 | 606.3023 | 421.6245 | 280.7440 | 293.8700 | 448.6338 | 519.2212 | 511.3214 | 512.7472 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | 1155.1049 | 1114.0881 | 1004.3604 | 831.2574 | 637.4465 | 422.7056 | 280.7804 | 293.9794 | 460.5437 | 704.3605 | 943.4580 | 1145.8674 | (97) |
| Space heating kWh | 466.5576 | 362.7087 | 293.7285 | 125.0414 | 23.1713 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 137.7436 | 311.1383 | 471.0415 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 2191.1308 | |
| Solar heating kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | 466.5576 | 362.7087 | 293.7285 | 125.0414 | 23.1713 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 137.7436 | 311.1383 | 471.0415 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 2191.1308 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 31.4863 | (99) |

## 8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ext. temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | |
| Heat loss rate W | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 667.4640 | 525.4504 | 537.6359 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (100) |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.9648 | 0.9902 | 0.9793 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (101) |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 643.9989 | 520.2786 | 526.4962 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (102) |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 804.4615 | 763.7933 | 702.1977 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 115.5331 | 181.1750 | 130.7219 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (104) |
| Cooled fraction | | | | | | | | | fC = cooled area / (4) = | | | 0.9915 | (105) |
| Intermittency factor (Table 10b) | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | (106) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 28.6384 | 44.9097 | 32.4034 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) |
| Space cooling requirement | | | | | | | | | | | | 105.9515 | (107) |

## 9b. Energy requirements

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | 0.0000 | (301) |
| Fraction of space heat from community system | | | | | | | | | | | | 1.0000 | (302) |
| Fraction of heat from community Heat pump-Space and Water | | | | | | | | | | | | 1.0000 | (303a) |
| Factor for control and charging method (Table 4c(3)) for space heating | | | | | | | | | | | | 1.0000 | (305) |
| Factor for charging method (Table 4c(3)) for water heating | | | | | | | | | | | | 1.0000 | (305a) |
| Distribution loss factor (Table 12c) for community heating system | | | | | | | | | | | | 2.0000 | (306) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 | (208) |
| Space heating: | | | | | | | | | | | | | |
| Space heating requirement | 466.5576 | 362.7087 | 293.7285 | 125.0414 | 23.1713 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 137.7436 | 311.1383 | 471.0415 | (98) |
| Space heat from Heat pump = (98) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 307a | 933.1151 | 725.4174 | 587.4570 | 250.0827 | 46.3425 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 275.4873 | 622.2766 | 942.0830 | |
| Space heating requirement | 933.1151 | 725.4174 | 587.4570 | 250.0827 | 46.3425 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 275.4873 | 622.2766 | 942.0830 | (307) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | | | | | | | | | | | 0.0000 | (308) |
| Space heating fuel for secondary/supplementary system | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (309) |
| Water heating | | | | | | | | | | | | | |
| Annual water heating requirement | 237.4587 | 210.1291 | 223.5955 | 201.7511 | 196.3885 | 174.3280 | 167.5774 | 180.4836 | 180.4670 | 202.7596 | 215.1201 | 236.9033 | (64) |
| Water heat from Heat pump = (64) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 310a | 474.9175 | 420.2583 | 447.1911 | 403.5023 | 392.7769 | 348.6560 | 335.1548 | 360.9673 | 360.9340 | 405.5191 | 430.2401 | 473.8066 | |
| Water heating fuel | 474.9175 | 420.2583 | 447.1911 | 403.5023 | 392.7769 | 348.6560 | 335.1548 | 360.9673 | 360.9340 | 405.5191 | 430.2401 | 473.8066 | (310) |
| Cooling System Energy Efficiency Ratio | | | | | | | | | | | | 2.6000 | (314) |
| Space coolin | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 11.0148 | 17.2730 | 12.4628 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (315) |
| Pumps and Fa | 19.5882 | 17.6926 | 19.5882 | 18.9563 | 19.5882 | 18.9563 | 19.5882 | 19.5882 | 18.9563 | 19.5882 | 18.9563 | 19.5882 | (331) |
| Lighting | 21.1859 | 16.9961 | 15.3031 | 11.2117 | 8.6603 | 7.0755 | 7.9002 | 10.2690 | 13.3384 | 17.5006 | 19.7669 | 21.7747 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333a)m | -4.7948 | -7.7883 | -12.9772 | -16.8642 | -20.2053 | -19.6304 | -19.3523 | -17.1820 | -13.7655 | -9.7430 | -5.5995 | -4.0224 | (333a) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335a) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (333b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335b) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - community heating | 4382.2616 | (307) |
| Space heating fuel - secondary | 0.0000 | (309) |
| Water heating fuel - community heating | 4853.9239 | (310) |
| Efficiency of water heater | 0.0000 | (311) |
| Electricity used for heat distribution | 43.8226 | (313) |
| Space cooling fuel | 40.7506 | (321) |
| | | |
| Electricity for pumps and fans: | | |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8820) | | |
| mechanical ventilation fans (SFP = 0.8820) | 230.6354 | (330a) |
| Total electricity for the above, kWh/year | 230.6354 | (331) |
| Electricity for lighting (calculated in Appendix L) | 170.9824 | (332) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -151.9250 | (333) |
| Wind generation | 0.0000 | (334) |
| Hydro-electric generation (Appendix N) | 0.0000 | (335a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (335) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (336) |
| Energy used | 0.0000 | (337) |
| Total delivered energy for all uses | 9526.6289 | (338) |

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12b. Carbon dioxide emissions - Community heating scheme

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (367) |
| Space and Water heating from Heat pump | 3298.6377 | 0.1563 | 244.6122 | (367) |
| Electrical energy for heat distribution (space & water) | 43.8226 | 0.0000 | 13.6839 | (372) |
| Overall CO2 factor for heat network | | | 0.0544 | (386) |
| Total CO2 associated with community systems | | | 502.3928 | (373) |
| Space and water heating | | | 502.3928 | (376) |
| Space cooling | 40.7506 | 0.1137 | 4.6349 | (377) |
| Pumps, fans and electric keep-hot | 230.6354 | 0.1387 | 31.9920 | (378) |
| Energy for lighting | 170.9824 | 0.1443 | 24.6780 | (379) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -151.9250 | 0.1318 | -20.0256 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -20.0256 | (380) |
| Total CO2, kg/year | | | 543.6721 | (383) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 7.8100 | (384) |

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13b. Primary energy - Community heating scheme

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| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (467a) |
| Space and Water heating from Heat pump | 3298.6377 | 1.5786 | 2470.7327 | (467) |
| Electrical energy for heat distribution (space & water) | 43.8226 | 0.0000 | 142.9918 | (472) |
| Overall CO2 factor for heat network | | | 0.5684 | (486) |
| Total CO2 associated with community systems | | | 5249.8405 | (473) |
| Space and water heating | | | 5249.8405 | (476) |
| Space cooling | 40.7506 | 1.4193 | 57.8372 | (477) |
| Pumps, fans and electric keep-hot | 230.6354 | 1.5128 | 348.9052 | (478) |
| Energy for lighting | 170.9824 | 1.5338 | 262.2586 | (479) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -151.9250 | 1.4870 | -225.9120 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -225.9120 | (480) |
| Total Primary energy kWh/year | | | 5692.9296 | (483) |
| Dwelling Primary energy Rate (DPER) | | | 81.8100 | (484) |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 69.5900 | (1b) x | 3.0800 | (2b) = | 214.3372 | (1b) - (3b) (4) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 69.5900 | | | | | |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | | 214.3372 | (5) |

---

2. Ventilation rate

---

m3 per hour

| | | | |
|---|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 | (6a) |
| Number of open flues | 0 * 20 = | 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | 2 * 10 = | 20.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |

| | | Air changes per hour | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 20.0000 / (5) = | 0.0933 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3433 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.3433 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.4377 | 0.4291 | 0.4206 | 0.3776 | 0.3691 | 0.3261 | 0.3261 | 0.3176 | 0.3433 | 0.3691 | 0.3862 | 0.4034 | (22b) |
| Effective ac | 0.5958 | 0.5921 | 0.5884 | 0.5713 | 0.5681 | 0.5532 | 0.5532 | 0.5504 | 0.5589 | 0.5681 | 0.5746 | 0.5814 | (25) |

---

## 3. Heat losses and heat loss parameter

---

| Element | Gross | Openings | NetArea | U-value | A x U | K-value | A x K | |
|---|---|---|---|---|---|---|---|---|
| | m2 | m2 | m2 | W/m2K | W/K | kJ/m2K | kJ/K | |
| Main dwelling | | | | | | | | |
| TER Opaque door | | | 1.8900 | 1.0000 | 1.8900 | | | (26) |
| TER Opening Type | | | 14.2200 | 1.1450 | 16.2824 | | | (27) |
| Heatloss Floor | | | 69.5900 | 0.1300 | 9.0467 | | | (28b) |
| External Walls | 125.2900 | 14.2200 | 111.0700 | 0.1800 | 19.9926 | | | (29a) |
| Wall to Communal Corridor | 30.8700 | 1.8900 | 28.9800 | 0.1800 | 5.2164 | | | (29a) |
| Total net area of external elements Aum(A, m2) | | | 225.7500 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 52.4281 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 15 | | | 22.0600 | 0.0000 | 0.0000 | | | (32) |

| | |
|---|---|
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | 437.2258 (35) |

List of Thermal Bridges

| K1 Element | Length | Psi-value | Total |
|---|---|---|---|
| E1 Steel lintel with perforated steel base plate | 7.3600 | 0.0500 | 0.3680 |
| E3 Sill | 1.0225 | 0.0500 | 0.0511 |
| E4 Jamb | 18.0200 | 0.0500 | 0.9010 |
| E7 Party floor between dwellings (in blocks of flats) | 15.0700 | 0.0700 | 1.0549 |
| E16 Corner (normal) | 9.2400 | 0.0900 | 0.8316 |
| E18 Party wall between dwellings | 3.0800 | 0.0600 | 0.1848 |
| E7 Party floor between dwellings (in blocks of flats) | 10.0250 | 0.0700 | 0.7018 |
| E17 Corner (inverted - internal area greater than external area) | 6.1600 | -0.0900 | -0.5544 |
| E20 Exposed floor (normal) | 15.0700 | 0.3200 | 4.8224 |
| E23 Balcony within or between dwellings, balcony support penetrates wall insulation | 5.2870 | 0.0200 | 0.1057 |
| P7 Party Wall - Exposed floor (normal) | 7.1650 | 0.1600 | 1.1464 |

| | | |
|---|---|---|
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | 9.6133 (36) |
| Point Thermal bridges | (36a) = | 0.0000 |
| Total fabric heat loss | (33) + (36) + (36a) = | 62.0415 (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 42.1417 | 41.8786 | 41.6207 | 40.4093 | 40.1826 | 39.1275 | 39.1275 | 38.9321 | 39.5339 | 40.1826 | 40.6411 | 41.1205 | (38) |
| Heat transfer coeff | 104.1832 | 103.9200 | 103.6621 | 102.4507 | 102.2241 | 101.1690 | 101.1690 | 100.9736 | 101.5754 | 102.2241 | 102.6826 | 103.1619 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 102.4496 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.4971 | 1.4933 | 1.4896 | 1.4722 | 1.4689 | 1.4538 | 1.4538 | 1.4510 | 1.4596 | 1.4689 | 1.4755 | 1.4824 | (40) |
| HLP (average) | | | | | | | | | | | | 1.4722 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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## 4. Water heating energy requirements (kWh/year)

---

| | | |
|---|---|---|
| Assumed occupancy | 2.2361 | (42) |

Hot water usage for mixer showers

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 61.7122 | 60.7848 | 59.4333 | 56.8476 | 54.9395 | 52.8115 | 51.6019 | 52.9431 | 54.4133 | 56.6981 | 59.3394 | 61.4757 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 26.6615 | 26.2655 | 25.7079 | 24.6798 | 23.9100 | 23.0564 | 22.5953 | 23.1490 | 23.7519 | 24.6653 | 25.7145 | 26.5714 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 37.5302 | 36.1655 | 34.8007 | 33.4360 | 32.0713 | 30.7065 | 30.7065 | 32.0713 | 33.4360 | 34.8007 | 36.1655 | 37.5302 | (42c) |

| | |
|---|---|
| Average daily hot water use (litres/day) | 115.7343 (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 125.9039 | 123.2158 | 119.9420 | 114.9635 | 110.9207 | 106.5744 | 104.9037 | 108.1634 | 111.6012 | 116.1641 | 121.2194 | 125.5773 | (44) |
| Energy conte | 199.4010 | 175.4576 | 184.3464 | 157.3792 | 149.3206 | 131.0456 | 126.8720 | 133.9288 | 137.6154 | 157.6336 | 172.6992 | 196.6237 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1922.3232 | |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | | |
| | 29.9101 | 26.3186 | 27.6520 | 23.6069 | 22.3981 | 19.6568 | 19.0308 | 20.0893 | 20.6423 | 23.6450 | 25.9049 | 29.4936 | (46) |

| | |
|---|---|
| Water storage loss: | |
| Store volume | 150.0000 (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | 1.3938 (48) |
| Temperature factor from Table 2b | 0.5400 (49) |
| Enter (49) or (54) in (55) | 0.7527 (55) |

Total storage loss

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (56) |

If cylinder contains dedicated solar storage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (57) |
| Primary loss 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |

Total heat required for water heating calculated for each month

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 245.9959 | 217.5433 | 230.9413 | 202.4711 | 195.9155 | 176.1375 | 173.4669 | 180.5237 | 182.7072 | 204.2285 | 217.7911 | 243.2186 | (62) |
| WWHRS | -28.2122 | -24.9511 | -26.1274 | -21.6345 | -20.1626 | -17.2533 | -16.1722 | -17.1975 | -17.8509 | -21.0442 | -23.8406 | -27.6898 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | | | | | | | | | | | | | |
| | 217.7836 | 192.5922 | 204.8139 | 180.8366 | 175.7529 | 158.8842 | 157.2947 | 163.3262 | 164.8563 | 183.1843 | 193.9505 | 215.5288 | (64) |
| | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | | 2208.8043 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2209 | (64) |
| Electric shower(s) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | | | | | | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | | | | | | | | | | | | | |
| | 103.5767 | 92.0082 | 98.5711 | 88.4021 | 86.9250 | 79.6461 | 79.4609 | 81.8073 | 81.8306 | 89.6891 | 93.4960 | 102.6533 | (65) |

## 5. Internal gains (see Table 5 and 5a)

| Metabolic gains (Table 5), Watts | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 111.8065 | 111.8065 | 111.8065 | 111.8065 | 111.8065 | 111.8065 | 111.8065 | 111.8065 | 111.8065 | 111.8065 | 111.8065 | 111.8065 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 99.5197 | 110.1825 | 99.5197 | 102.8370 | 99.5197 | 102.8370 | 99.5197 | 99.5197 | 102.8370 | 99.5197 | 102.8370 | 99.5197 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 196.3383 | 198.3756 | 193.2415 | 182.3116 | 168.5145 | 155.5472 | 146.8842 | 144.8468 | 149.9810 | 160.9109 | 174.7080 | 187.6753 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 34.1806 | 34.1806 | 34.1806 | 34.1806 | 34.1806 | 34.1806 | 34.1806 | 34.1806 | 34.1806 | 34.1806 | 34.1806 | 34.1806 | (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.0000 | 3.0000 | 3.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | | | | | | | | | | | | | |
| | -89.4452 | -89.4452 | -89.4452 | -89.4452 | -89.4452 | -89.4452 | -89.4452 | -89.4452 | -89.4452 | -89.4452 | -89.4452 | -89.4452 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 139.2161 | 136.9170 | 132.4880 | 122.7807 | 116.8347 | 110.6196 | 106.8022 | 109.9560 | 113.6536 | 120.5499 | 129.8555 | 137.9749 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 494.6159 | 505.0171 | 484.7912 | 467.4712 | 444.4108 | 425.5458 | 409.7481 | 410.8644 | 423.0135 | 440.5224 | 466.9424 | 484.7118 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Northeast | 3.9900 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 13.7584 | (75) |
| Northwest | 10.2300 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 35.2752 | (81) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 49.0336 | 99.8093 | 179.8246 | 295.3237 | 396.9730 | 423.2152 | 395.9092 | 315.6234 | 219.1191 | 121.9749 | 61.6970 | 40.0433 | (83) |
| Total gains | 543.6495 | 604.8264 | 664.6158 | 762.7949 | 841.3838 | 848.7610 | 805.6572 | 726.4878 | 642.1326 | 562.4973 | 528.6394 | 524.7551 | (84) |

## 7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, ni1,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 81.1246 | 81.3300 | 81.5324 | 82.4964 | 82.6793 | 83.5416 | 83.5416 | 83.7032 | 83.2073 | 82.6793 | 82.3101 | 81.9277 | |
| alpha | 6.4083 | 6.4220 | 6.4355 | 6.4998 | 6.5120 | 6.5694 | 6.5694 | 6.5802 | 6.5472 | 6.5120 | 6.4873 | 6.4618 | |
| util living area | | | | | | | | | | | | | |
| | 0.9996 | 0.9991 | 0.9971 | 0.9832 | 0.9136 | 0.7278 | 0.5474 | 0.6268 | 0.9023 | 0.9925 | 0.9990 | 0.9997 | (86) |
| MIT | 19.8866 | 20.0049 | 20.2172 | 20.5430 | 20.8301 | 20.9722 | 20.9962 | 20.9915 | 20.8865 | 20.5287 | 20.1612 | 19.8735 | (87) |
| Th 2 | 19.6897 | 19.6925 | 19.6953 | 19.7084 | 19.7109 | 19.7223 | 19.7223 | 19.7245 | 19.7179 | 19.7109 | 19.7059 | 19.7007 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9994 | 0.9985 | 0.9950 | 0.9706 | 0.8549 | 0.6010 | 0.3916 | 0.4605 | 0.8112 | 0.9848 | 0.9982 | 0.9995 | (89) |
| MIT 2 | 18.4238 | 18.5775 | 18.8509 | 19.2690 | 19.5915 | 19.7126 | 19.7218 | 19.7231 | 19.6583 | 19.2588 | 18.7882 | 18.4154 | (90) |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.5226 | (91) |
| MIT | 19.1883 | 19.3235 | 19.5650 | 19.9349 | 20.2388 | 20.3709 | 20.3879 | 20.3860 | 20.3002 | 19.9225 | 19.5058 | 19.1775 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.1883 | 19.3235 | 19.5650 | 19.9349 | 20.2388 | 20.3709 | 20.3879 | 20.3860 | 20.3002 | 19.9225 | 19.5058 | 19.1775 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9992 | 0.9982 | 0.9948 | 0.9734 | 0.8823 | 0.6683 | 0.4738 | 0.5489 | 0.8589 | 0.9865 | 0.9981 | 0.9994 | (94) |
| Useful gains | 543.2227 | 603.7633 | 661.1315 | 742.5018 | 742.3162 | 567.2599 | 381.6835 | 398.7532 | 551.5455 | 554.9117 | 527.6090 | 524.4320 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | | | | | | | | | | | | | |
| | 1551.1110 | 1498.8917 | 1354.3444 | 1130.5288 | 872.8735 | 583.8362 | 383.2132 | 402.4798 | 629.7839 | 952.9831 | 1273.8558 | 1545.1032 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 749.8689 | 601.5263 | 515.7504 | 279.3795 | 97.1347 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 296.1651 | 537.2977 | 759.3794 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 3836.5019 | |
| Solar heating kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | | | | | | | | | | | | | |
| | 749.8689 | 601.5263 | 515.7504 | 279.3795 | 97.1347 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 296.1651 | 537.2977 | 759.3794 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 3836.5019 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 55.1301 | (99) |

## 9a. Energy requirements - Individual heating systems, including micro-CHP

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | 0.0000 | (201) |
| Fraction of space heat from main system(s) | | | | | | | | | | | | 1.0000 | (202) |
| Efficiency of main space heating system 1 (in %) | | | | | | | | | | | | 92.3000 | (206) |
| Efficiency of main space heating system 2 (in %) | | | | | | | | | | | | 0.0000 | (207) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 | (208) |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |

Space heating requirement
749.8689 601.5263 515.7504 279.3795 97.1347 0.0000 0.0000 0.0000 0.0000 296.1651 537.2977 759.3794 (98)
Space heating efficiency (main heating system 1)
92.3000 92.3000 92.3000 92.3000 92.3000 0.0000 0.0000 0.0000 0.0000 92.3000 92.3000 92.3000 (210)
Space heating fuel (main heating system)
812.4256 651.7078 558.7762 302.6863 105.2380 0.0000 0.0000 0.0000 0.0000 320.8723 582.1210 822.7295 (211)
Space heating efficiency (main heating system 2)
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (212)
Space heating fuel (main heating system 2)
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (213)
Space heating fuel (secondary)
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (215)

Water heating
Water heating requirement
217.7836 192.5922 204.8139 180.8366 175.7529 158.8842 157.2947 163.3262 164.8563 183.1843 193.9505 215.5288 (64)
Efficiency of water heater 79.8000 (216)
(217)m 86.6018 86.4358 86.0417 85.0317 82.7866 79.8000 79.8000 79.8000 79.8000 85.1309 86.2208 86.6398 (217)
Fuel for water heating, kWh/month
251.4771 222.8154 238.0402 212.6696 212.2963 199.1030 197.1111 204.6695 206.5869 215.1796 224.9462 248.7643 (219)
Space cooling fuel requirement
(221)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (221)
Pumps and Fa 7.3041 6.5973 7.3041 7.0685 7.3041 7.0685 7.3041 7.3041 7.0685 7.3041 7.0685 7.3041 (231)
Lighting 20.6782 16.5888 14.9364 10.9431 8.4527 6.9060 7.7109 10.0229 13.0187 17.0813 19.2932 21.2529 (232)
Electricity generated by PVs (Appendix M) (negative quantity)
(233a)m -15.4331 -23.1514 -35.3846 -42.3879 -48.0217 -45.6783 -45.1242 -41.4429 -35.3717 -27.5928 -17.4551 -13.1855 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)
(234a)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)
(235a)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)
(235c)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)
(233b)m -4.9456 -10.6839 -21.7681 -33.4934 -45.0806 -45.5867 -45.0490 -37.7753 -27.2118 -15.5346 -6.6837 -3.8902 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)
(234b)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)
(235b)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)
(235d)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (235d)
Annual totals kWh/year
Space heating fuel - main system 1 4156.5567 (211)
Space heating fuel - main system 2 0.0000 (213)
Space heating fuel - secondary 0.0000 (215)
Efficiency of water heater 79.8000
Water heating fuel used 2633.6591 (219)
Space cooling fuel 0.0000 (221)

Electricity for pumps and fans:
Total electricity for the above, kWh/year 86.0000 (231)
Electricity for lighting (calculated in Appendix L) 166.8851 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV generation -687.9320 (233)
Wind generation 0.0000 (234)
Hydro-electric generation (Appendix N) 0.0000 (235a)
Electricity generated - Micro CHP (Appendix N) 0.0000 (235)
Appendix Q - special features
Energy saved or generated -0.0000 (236)
Energy used 0.0000 (237)
Total delivered energy for all uses 6355.1689 (238)

---
12a. Carbon dioxide emissions - Individual heating systems including micro-CHP
---

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 4156.5567 | 0.2100 | 872.8769 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2633.6591 | 0.2100 | 553.0684 | (264) |
| Space and water heating | | | 1425.9453 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 166.8851 | 0.1443 | 24.0867 | (268) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -390.2292 | 0.1333 | -52.0187 | |
| PV Unit electricity exported | -297.7028 | 0.1252 | -37.2714 | |
| Total | | | -89.2901 | (269) |
| Total CO2, kg/year | | | 1372.6712 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 19.7300 | (273) |

---
13a. Primary energy - Individual heating systems including micro-CHP
---

| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 4156.5567 | 1.1300 | 4696.9091 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2633.6591 | 1.1300 | 2976.0348 | (278) |
| Space and water heating | | | 7672.9439 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 166.8851 | 1.5338 | 255.9740 | (282) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -390.2292 | 1.4926 | -582.4529 | |
| PV Unit electricity exported | -297.7028 | 0.4595 | -136.8015 | |
| Total | | | -719.2544 | (283) |
| Total Primary energy kWh/year | | | 7339.7643 | (286) |
| Target Primary Energy Rate (TPER) | | | 105.4700 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Property Reference** | Unit 18 | **Issued on Date** | 17/05/2025 |
| **Assessment Reference** | 00001 | **Prop Type Ref** | Unit 18 |
| **Property** | | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 75 C | **DER** | 7.74 | **TER** | 18.70 |
| **Environmental** | 95 A | **% DER < TER** | | | 58.61 |
| **$CO_2$ Emissions (t/year)** | 0.35 | **DFEE** | 49.59 | **TFEE** | 51.44 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 3.59 |
| **% DPER < TPER** | 18.54 | **DPER** | 81.66 | **TPER** | 100.25 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Robert Arnold | **Assessor ID** | BA04-0001 |
| **Client** | | | |

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SAP 10 WORKSHEET FOR New Build (As Designed)  (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 51.0300 | (1b) | x 3.0800 | (2b) = | 157.1724 | (1b) - (3b) (4) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 51.0300 | | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | 157.1724 | (5) |

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2. Ventilation rate

---

| | m3 per hour | |
|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 (6a) |
| Number of open flues | 0 * 20 = | 0.0000 (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 (6f) |
| Number of intermittent extract fans | 0 * 10 = | 0.0000 (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 (7c) |

| | Air changes per hour | |
|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 0.0000 / (5) = | 0.0000 (8) |
| Pressure test | | Yes |
| Pressure Test Method | | Blower Door |
| Measured/design AP50 | | 3.0000 (17) |
| Infiltration rate | | 0.1500 (18) |
| Number of sides sheltered | | 0 (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.1500 (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.1912 | 0.1875 | 0.1837 | 0.1650 | 0.1612 | 0.1425 | 0.1425 | 0.1388 | 0.1500 | 0.1612 | 0.1687 | 0.1762 | (22b) |
| Balanced mechanical ventilation with heat recovery | | | | | | | | | | | | | |
| If mechanical ventilation | | | | | | | | | | | | 0.5000 | (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | | | | | | | | | | | | 0.5000 | (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | | | | | | | | | | | | 81.0000 | (23c) |
| Effective ac | 0.2862 | 0.2825 | 0.2787 | 0.2600 | 0.2562 | 0.2375 | 0.2375 | 0.2337 | 0.2450 | 0.2562 | 0.2637 | 0.2712 | (25) |

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3. Heat losses and heat loss parameter

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| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| Windows | | | 12.5700 | 1.0536 | 13.2443 | | | (27) |
| Door | | | 1.8900 | 1.4000 | 2.6460 | | | (26) |
| Glass Door | | | 2.4000 | 1.3258 | 3.1818 | | | (27) |
| Heatloss Floor 1 | | | 51.0300 | 0.1000 | 5.1030 | 0.0000 | 0.0000 | (28b) |
| External Walls | 49.4400 | 14.9700 | 34.4700 | 0.1500 | 5.1705 | 150.0000 | 5170.5000 | (29a) |
| Wall to Communal Corridor | 21.7900 | 1.8900 | 19.9000 | 0.1400 | 2.7860 | 150.0000 | 2985.0000 | (29a) |
| Total net area of external elements Aum(A, m2) | | | 122.2600 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 32.1316 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 16 | | | 20.6700 | 0.0000 | 0.0000 | 110.0000 | 2273.7000 | (32) |
| Party Ceiling | | | 51.0300 | | | 100.0000 | 5103.0000 | (32b) |
| Internal Walls | | | 108.0500 | | | 9.0000 | 972.4500 | (32c) |
| Heat capacity Cm = Sum(A x k) | | | | | (28)...(30) + (32) + (32a)...(32e) = | | 16504.6500 | (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | | | | | | | 323.4303 | (35) |

List of Thermal Bridges

| | K1 Element | Length | Psi-value | Total |
|---|---|---|---|---|
| E1 | Steel lintel with perforated steel base plate | 7.4700 | 0.0500 | 0.3735 |
| E3 | Sill | 3.6200 | 0.0500 | 0.1810 |
| E4 | Jamb | 15.9800 | 0.0500 | 0.7990 |
| E7 | Party floor between dwellings (in blocks of flats) | 10.9800 | 0.0350 | 0.3843 |
| E16 | Corner (normal) | 6.1600 | 0.0900 | 0.5544 |
| E17 | Corner (inverted - internal area greater than external area) | 3.0800 | -0.0900 | -0.2772 |
| E7 | Party floor between dwellings (in blocks of flats) | 7.0750 | 0.0350 | 0.2476 |
| E23 | Balcony within or between dwellings, balcony support penetrates wall insulation | 5.0750 | 0.0200 | 0.1015 |
| E20 | Exposed floor (normal) | 16.0550 | 0.3500 | 5.6192 |
| E25 | Staggered party wall between dwellings | 3.0800 | 0.0600 | 0.1848 |
| P7 | Party Wall - Exposed floor (normal) | 6.7125 | 0.1600 | 1.0740 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 9.2422 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 41.3737 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 14.8469 | 14.6524 | 14.4579 | 13.4854 | 13.2909 | 12.3184 | 12.3184 | 12.1239 | 12.7074 | 13.2909 | 13.6799 | 14.0689 | (38) |
| Heat transfer coeff | 56.2206 | 56.0261 | 55.8316 | 54.8591 | 54.6646 | 53.6921 | 53.6921 | 53.4976 | 54.0811 | 54.6646 | 55.0536 | 55.4426 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 54.8105 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.1017 | 1.0979 | 1.0941 | 1.0750 | 1.0712 | 1.0522 | 1.0522 | 1.0484 | 1.0598 | 1.0712 | 1.0788 | 1.0865 | (40) |
| HLP (average) | | | | | | | | | | | | 1.0741 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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4. Water heating energy requirements (kWh/year)

---

Assumed occupancy 1.7205 (42)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hot water usage for mixer showers | 51.7252 | 50.9333 | 49.7662 | 47.9709 | 46.3623 | 44.1119 | 42.3320 | 44.4128 | 45.4594 | 47.6883 | 50.0095 | 51.6785 | (42a) |
| Hot water usage for baths | 22.4318 | 22.0932 | 21.6115 | 20.8901 | 20.2399 | 19.3449 | 18.6659 | 19.4962 | 19.9320 | 20.8188 | 21.7408 | 22.4140 | (42b) |
| Hot water usage for other uses | 32.2492 | 31.0765 | 29.9038 | 28.7311 | 27.5584 | 26.3857 | 26.3857 | 27.5584 | 28.7311 | 29.9038 | 31.0765 | 32.2492 | (42c) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 97.8037 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 106.4062 | 104.1030 | 101.2815 | 97.5920 | 94.1606 | 89.8425 | 87.3836 | 91.4674 | 94.1225 | 98.4109 | 102.8268 | 106.3418 | (44) |
| Energy conte | 156.6483 | 137.7493 | 144.7292 | 127.4796 | 121.3355 | 103.8999 | 96.5614 | 107.6588 | 109.1773 | 126.8124 | 138.9739 | 156.1707 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1527.1962 | |
| Distribution loss (46)m = 0.15 x (45)m | 23.4972 | 20.6624 | 21.7094 | 19.1219 | 18.2003 | 15.5850 | 14.4842 | 16.1488 | 16.3766 | 19.0219 | 20.8461 | 23.4256 | (46) |
| Water storage loss: | | | | | | | | | | | | | |
| Store volume | | | | | | | | | | | | 110.0000 | (47) |
| b) If manufacturer declared loss factor is not known : | | | | | | | | | | | | | |
| Hot water storage loss factor from Table 2 (kWh/litre/day) | | | | | | | | | | | | 0.0152 | (51) |
| Volume factor from Table 2a | | | | | | | | | | | | 1.0294 | (52) |
| Temperature factor from Table 2b | | | | | | | | | | | | 0.6000 | (53) |
| Enter (49) or (54) in (55) | | | | | | | | | | | | 1.0327 | (55) |
| Total storage loss | 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (56) |
| If cylinder contains dedicated solar storage | 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (57) |
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | 211.9251 | 187.6767 | 200.0060 | 180.9733 | 176.6123 | 157.3936 | 151.8382 | 162.9356 | 162.6710 | 182.0892 | 192.4675 | 211.4475 | (62) |
| WWHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | 211.9251 | 187.6767 | 200.0060 | 180.9733 | 176.6123 | 157.3936 | 151.8382 | 162.9356 | 162.6710 | 182.0892 | 192.4675 | 211.4475 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2178.0360 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2178 | (64) |
| Electric shower(s) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | 96.3070 | 85.7436 | 92.3439 | 85.1819 | 84.5655 | 77.3417 | 76.3281 | 80.0180 | 79.0964 | 86.3866 | 89.0038 | 96.1482 | (65) |

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5. Internal gains (see Table 5 and 5a)

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Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 86.0228 | 86.0228 | 86.0228 | 86.0228 | 86.0228 | 86.0228 | 86.0228 | 86.0228 | 86.0228 | 86.0228 | 86.0228 | 86.0228 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 75.6117 | 83.7130 | 75.6117 | 78.1321 | 75.6117 | 78.1321 | 75.6117 | 75.6117 | 78.1321 | 75.6117 | 78.1321 | 75.6117 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 149.9087 | 151.4643 | 147.5442 | 139.1990 | 128.6646 | 118.7638 | 112.1494 | 110.5938 | 114.5138 | 122.8591 | 133.3935 | 143.2943 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 31.6023 | 31.6023 | 31.6023 | 31.6023 | 31.6023 | 31.6023 | 31.6023 | 31.6023 | 31.6023 | 31.6023 | 31.6023 | 31.6023 | (69) |
| Pumps, fans | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | -68.8182 | -68.8182 | -68.8182 | -68.8182 | -68.8182 | -68.8182 | -68.8182 | -68.8182 | -68.8182 | -68.8182 | -68.8182 | -68.8182 | (71) |
| Water heating gains (Table 5) | 129.4449 | 127.5946 | 124.1181 | 118.3082 | 113.6633 | 107.4190 | 102.5916 | 107.5511 | 109.8561 | 116.1110 | 123.6163 | 129.2314 | (72) |
| Total internal gains | 403.7721 | 411.5787 | 396.0809 | 384.4461 | 366.7464 | 353.1217 | 339.1595 | 342.5634 | 351.3089 | 363.3886 | 383.9487 | 396.9443 | (73) |

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6. Solar gains

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| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W |
|---|---|---|---|---|---|---|

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northeast | | | | 6.2800 | 11.2829 | 0.4500 | 0.7000 | 0.7700 | | | | 15.4677 | (75) |
| Southeast | | | | 6.2900 | 36.7938 | 0.4500 | 0.7000 | 0.7700 | | | | 50.5207 | (77) |
| Southeast | | | | 2.4000 | 36.7938 | 0.4500 | 0.7000 | 0.7700 | | | | 19.2766 | (77) |
| Solar gains | 85.2650 | 150.3756 | 219.3972 | 294.7178 | 350.9869 | 357.6325 | 340.9740 | 297.5907 | 245.2600 | 169.8766 | 103.0634 | 72.3636 | (83) |
| Total gains | 489.0371 | 561.9543 | 615.4781 | 679.1640 | 717.7334 | 710.7541 | 680.1335 | 640.1542 | 596.5689 | 533.2652 | 487.0122 | 469.3079 | (84) |

7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, ni1,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 81.5470 | 81.8301 | 82.1152 | 83.5709 | 83.8682 | 85.3873 | 85.3873 | 85.6977 | 84.7731 | 83.8682 | 83.2756 | 82.6913 | |
| alpha | 6.4365 | 6.4553 | 6.4743 | 6.5714 | 6.5912 | 6.6925 | 6.6925 | 6.7132 | 6.6515 | 6.5912 | 6.5517 | 6.5128 | |
| util living area | 0.9927 | 0.9817 | 0.9533 | 0.8578 | 0.6854 | 0.4815 | 0.3472 | 0.3840 | 0.6149 | 0.8943 | 0.9805 | 0.9943 | (86) |
| MIT | 20.2215 | 20.3981 | 20.6170 | 20.8600 | 20.9716 | 20.9976 | 20.9998 | 20.9996 | 20.9890 | 20.8420 | 20.5043 | 20.2000 | (87) |
| Th 2 | 19.9994 | 20.0025 | 20.0057 | 20.0213 | 20.0244 | 20.0401 | 20.0401 | 20.0432 | 20.0338 | 20.0244 | 20.0181 | 20.0119 | (88) |
| util rest of house | 0.9899 | 0.9749 | 0.9368 | 0.8171 | 0.6221 | 0.4103 | 0.2715 | 0.3044 | 0.5339 | 0.8528 | 0.9720 | 0.9920 | (89) |
| MIT 2 | 19.1213 | 19.3449 | 19.6142 | 19.8993 | 20.0055 | 20.0391 | 20.0400 | 20.0431 | 20.0284 | 19.8907 | 19.4924 | 19.1040 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.6524 | (91) |
| MIT | 19.8390 | 20.0320 | 20.2684 | 20.5260 | 20.6357 | 20.6644 | 20.6661 | 20.6671 | 20.6551 | 20.5113 | 20.1525 | 19.8190 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.8390 | 20.0320 | 20.2684 | 20.5260 | 20.6357 | 20.6644 | 20.6661 | 20.6671 | 20.6551 | 20.5113 | 20.1525 | 19.8190 | (93) |

8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9893 | 0.9751 | 0.9417 | 0.8391 | 0.6624 | 0.4568 | 0.3209 | 0.3564 | 0.5865 | 0.8751 | 0.9734 | 0.9914 | (94) |
| Useful gains | 483.8251 | 547.9767 | 579.5761 | 569.9032 | 475.4166 | 324.6582 | 218.2455 | 228.1336 | 349.9092 | 466.6377 | 474.0538 | 465.2892 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | 873.6145 | 847.7856 | 768.7115 | 637.7925 | 488.4691 | 325.6105 | 218.3194 | 228.2784 | 354.5073 | 541.7979 | 718.5884 | 865.9605 | (97) |
| Space heating kWh | 290.0033 | 201.4716 | 140.7168 | 48.8803 | 9.7111 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 55.9192 | 176.0649 | 298.0994 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 1220.8667 | |
| Solar heating kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | 290.0033 | 201.4716 | 140.7168 | 48.8803 | 9.7111 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 55.9192 | 176.0649 | 298.0994 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 1220.8667 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 23.9245 | (99) |

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ext. temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | |
| Heat loss rate W | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 504.7060 | 397.3218 | 406.5820 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (100) |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.9814 | 0.9936 | 0.9897 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (101) |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 495.3143 | 394.7630 | 402.4081 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (102) |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 789.9064 | 756.2001 | 709.9975 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 212.1063 | 268.9092 | 228.8465 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (104) |
| Cooled fraction | | | | | | | | | | fC = cooled area / (4) = | | 0.9994 | (105) |
| Intermittency factor (Table 10b) | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | (106) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 52.9954 | 67.1878 | 57.1780 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) |
| Space cooling requirement | | | | | | | | | | | | 177.3612 | (107) |

9b. Energy requirements

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | 0.0000 | (301) |
| Fraction of space heat from community system | | | | | | | | | | | | 1.0000 | (302) |
| Fraction of heat from community Heat pump-Space and Water | | | | | | | | | | | | 1.0000 | (303a) |
| Factor for control and charging method (Table 4c(3)) for space heating | | | | | | | | | | | | 1.0000 | (305) |
| Factor for charging method (Table 4c(3)) for water heating | | | | | | | | | | | | 1.0000 | (305a) |
| Distribution loss factor (Table 12c) for community heating system | | | | | | | | | | | | 2.0000 | (306) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 | (208) |
| Space heating: | | | | | | | | | | | | | |
| Space heating requirement | | | | | | | | | | | | | |
| | 290.0033 | 201.4716 | 140.7168 | 48.8803 | 9.7111 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 55.9192 | 176.0649 | 298.0994 | (98) |
| Space heat from Heat pump = (98) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 307a | 580.0066 | 402.9432 | 281.4335 | 97.7606 | 19.4221 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 111.8385 | 352.1299 | 596.1989 | |
| Space heating requirement | | | | | | | | | | | | | |
| | 580.0066 | 402.9432 | 281.4335 | 97.7606 | 19.4221 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 111.8385 | 352.1299 | 596.1989 | (307) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | | | | | | | | | | | 0.0000 | (308) |
| Space heating fuel for secondary/supplementary system | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (309) |
| Water heating | | | | | | | | | | | | | |
| Annual water heating requirement | | | | | | | | | | | | | |
| | 211.9251 | 187.6767 | 200.0060 | 180.9733 | 176.6123 | 157.3936 | 151.8382 | 162.9356 | 162.6710 | 182.0892 | 192.4675 | 211.4475 | (64) |
| Water heat from Heat pump = (64) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 310a | 423.8502 | 375.3534 | 400.0119 | 361.9466 | 353.2246 | 314.7871 | 303.6765 | 325.8713 | 325.3420 | 364.1783 | 384.9351 | 422.8950 | |
| Water heating fuel | | | | | | | | | | | | | |
| | 423.8502 | 375.3534 | 400.0119 | 361.9466 | 353.2246 | 314.7871 | 303.6765 | 325.8713 | 325.3420 | 364.1783 | 384.9351 | 422.8950 | (310) |
| Cooling System Energy Efficiency Ratio | | | | | | | | | | | | 2.6000 | (314) |
| Space coolin | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 20.3828 | 25.8415 | 21.9915 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (315) |
| Pumps and Fa | 14.3639 | 12.9739 | 14.3639 | 13.9006 | 14.3639 | 13.9006 | 14.3639 | 14.3639 | 13.9006 | 14.3639 | 13.9006 | 14.3639 | (331) |
| Lighting | 14.6188 | 11.7278 | 10.5595 | 7.7364 | 5.9758 | 4.8823 | 5.4513 | 7.0858 | 9.2038 | 12.0759 | 13.6397 | 15.0251 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333a)m | -4.6984 | -7.5727 | -12.5179 | -16.1346 | -19.2125 | -18.6263 | -18.3657 | -16.3640 | -13.1906 | -9.4266 | -5.4685 | -3.9475 | (333a) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (334a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (335a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335a) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (333b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (333b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (334b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (335b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335b) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - community heating | 2441.7333 | (307) |
| Space heating fuel - secondary | 0.0000 | (309) |
| Water heating fuel - community heating | 4356.0720 | (310) |
| Efficiency of water heater | 0.0000 | (311) |
| Electricity used for heat distribution | 24.4173 | (313) |
| Space cooling fuel | 68.2158 | (321) |
| | | |
| Electricity for pumps and fans: | | |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8820) | | |
| mechanical ventilation fans (SFP = 0.8820) | 169.1238 | (330a) |
| Total electricity for the above, kWh/year | 169.1238 | (331) |
| Electricity for lighting (calculated in Appendix L) | 117.9823 | (332) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -145.5252 | (333) |
| Wind generation | 0.0000 | (334) |
| Hydro-electric generation (Appendix N) | 0.0000 | (335a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (335) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (336) |
| Energy used | 0.0000 | (337) |
| Total delivered energy for all uses | 7007.6020 | (338) |

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12b. Carbon dioxide emissions - Community heating scheme

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (367) |
| Space and Water heating from Heat pump | 2427.7876 | 0.1573 | 137.2060 | (367) |
| Electrical energy for heat distribution (space & water) | 24.4173 | 0.0000 | 9.9716 | (372) |
| Overall CO2 factor for heat network | | | 0.0539 | (386) |
| Total CO2 associated with community systems | | | 366.1016 | (373) |
| Space and water heating | | | 366.1016 | (376) |
| Space cooling | 68.2158 | 0.1140 | 7.7774 | (377) |
| Pumps, fans and electric keep-hot | 169.1238 | 0.1387 | 23.4596 | (378) |
| Energy for lighting | 117.9823 | 0.1443 | 17.0285 | (379) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -145.5252 | 0.1320 | -19.2030 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -19.2030 | (380) |
| Total CO2, kg/year | | | 395.1641 | (383) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 7.7400 | (384) |

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13b. Primary energy - Community heating scheme

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| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (467a) |
| Space and Water heating from Heat pump | 2427.7876 | 1.5825 | 1379.9742 | (467) |
| Electrical energy for heat distribution (space & water) | 24.4173 | 0.0000 | 104.8656 | (472) |
| Overall CO2 factor for heat network | | | 0.5664 | (486) |
| Total CO2 associated with community systems | | | 3850.0660 | (473) |
| Space and water heating | | | 3850.0660 | (476) |
| Space cooling | 68.2158 | 1.4202 | 96.8822 | (477) |
| Pumps, fans and electric keep-hot | 169.1238 | 1.5128 | 255.8505 | (478) |
| Energy for lighting | 117.9823 | 1.5338 | 180.9651 | (479) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -145.5252 | 1.4875 | -216.4740 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -216.4740 | (480) |
| Total Primary energy kWh/year | | | 4167.2898 | (483) |
| Dwelling Primary energy Rate (DPER) | | | 81.6600 | (484) |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 51.0300 | (1b) x | 3.0800 | (2b) = | 157.1724 | (1b) - (3b) (4) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 51.0300 | | | | | |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | | 157.1724 | (5) |

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2. Ventilation rate

---

m3 per hour

| | | |
|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 (6a) |
| Number of open flues | 0 * 20 = | 0.0000 (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 (6f) |
| Number of intermittent extract fans | 2 * 10 = | 20.0000 (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 (7c) |

| | | Air changes per hour | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 20.0000 / (5) = | 0.1272 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3772 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.3772 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.4810 | 0.4716 | 0.4621 | 0.4150 | 0.4055 | 0.3584 | 0.3584 | 0.3490 | 0.3772 | 0.4055 | 0.4244 | 0.4433 | (22b) |
| Effective ac | 0.6157 | 0.6112 | 0.6068 | 0.5861 | 0.5822 | 0.5642 | 0.5642 | 0.5609 | 0.5712 | 0.5822 | 0.5901 | 0.5982 | (25) |

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## 3. Heat losses and heat loss parameter

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| Element | Gross | Openings | NetArea | U-value | A x U | K-value | A x K | |
|---|---|---|---|---|---|---|---|---|
| | m2 | m2 | m2 | W/m2K | W/K | kJ/m2K | kJ/K | |
| Main dwelling | | | | | | | | |
| TER Opaque door | | | 1.8900 | 1.0000 | 1.8900 | | | (26) |
| TER Opening Type | | | 10.8700 | 1.1450 | 12.4466 | | | (27) |
| Heatloss Floor 1 | | | 51.0300 | 0.1300 | 6.6339 | | | (28b) |
| External Walls | 49.4400 | 10.8700 | 38.5700 | 0.1800 | 6.9426 | | | (29a) |
| Wall to Communal Corridor | 21.7900 | 1.8900 | 19.9000 | 0.1800 | 3.5820 | | | (29a) |
| Total net area of external elements Aum(A, m2) | | | 122.2600 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 31.4951 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 16 | | | 20.6700 | 0.0000 | 0.0000 | | | (32) |

| | | |
|---|---|---|
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | 303.4303 | (35) |

List of Thermal Bridges

| K1 Element | Length | Psi-value | Total |
|---|---|---|---|
| E1 Steel lintel with perforated steel base plate | 7.4700 | 0.0500 | 0.3735 |
| E3 Sill | 3.6200 | 0.0500 | 0.1810 |
| E4 Jamb | 15.9800 | 0.0500 | 0.7990 |
| E7 Party floor between dwellings (in blocks of flats) | 10.9800 | 0.0700 | 0.7686 |
| E16 Corner (normal) | 6.1600 | 0.0900 | 0.5544 |
| E17 Corner (inverted - internal area greater than external area) | 3.0800 | -0.0900 | -0.2772 |
| E7 Party floor between dwellings (in blocks of flats) | 7.0750 | 0.0700 | 0.4953 |
| E23 Balcony within or between dwellings, balcony support penetrates wall insulation | 5.0750 | 0.0200 | 0.1015 |
| E20 Exposed floor (normal) | 16.0550 | 0.3200 | 5.1376 |
| E25 Staggered party wall between dwellings | 3.0800 | 0.0600 | 0.1848 |
| P7 Party Wall - Exposed floor (normal) | 6.7125 | 0.1600 | 1.0740 |

| | | |
|---|---|---|
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | 9.3924 | (36) |
| Point Thermal bridges | (36a) = 0.0000 | |
| Total fabric heat loss | (33) + (36) + (36a) = 40.8875 | (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 31.9332 | 31.7003 | 31.4719 | 30.3993 | 30.1986 | 29.2644 | 29.2644 | 29.0914 | 29.6242 | 30.1986 | 30.6046 | 31.0290 | (38) |
| Heat transfer coeff | 72.8208 | 72.5878 | 72.3594 | 71.2868 | 71.0861 | 70.1519 | 70.1519 | 69.9789 | 70.5117 | 71.0861 | 71.4921 | 71.9165 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 71.2858 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.4270 | 1.4225 | 1.4180 | 1.3970 | 1.3930 | 1.3747 | 1.3747 | 1.3713 | 1.3818 | 1.3930 | 1.4010 | 1.4093 | (40) |
| HLP (average) | | | | | | | | | | | | 1.3969 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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## 4. Water heating energy requirements (kWh/year)

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| | | |
|---|---|---|
| Assumed occupancy | 1.7205 | (42) |

Hot water usage for mixer showers

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 53.0659 | 52.2684 | 51.1063 | 48.8829 | 47.2421 | 45.4122 | 44.3721 | 45.5254 | 46.7896 | 48.7543 | 51.0255 | 52.8626 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 22.9433 | 22.6026 | 22.1227 | 21.2380 | 20.5755 | 19.8409 | 19.4442 | 19.9206 | 20.4394 | 21.2255 | 22.1284 | 22.8657 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.2492 | 31.0765 | 29.9038 | 28.7311 | 27.5584 | 26.3857 | 26.3857 | 27.5584 | 28.7311 | 29.9038 | 31.0765 | 32.2492 | (42c) |

| | |
|---|---|
| Average daily hot water use (litres/day) | 99.5145 (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 108.2584 | 105.9474 | 103.1328 | 98.8520 | 95.3760 | 91.6389 | 90.2020 | 93.0044 | 95.9602 | 99.8836 | 104.2304 | 107.9775 | (44) |
| Energy conte | 171.4548 | 150.8678 | 158.5113 | 135.3234 | 128.3944 | 112.6807 | 109.0915 | 115.1589 | 118.3285 | 135.5411 | 148.4953 | 169.0666 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1652.9143 | |

Distribution loss (46)m = 0.15 x (45)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 25.7182 | 22.6302 | 23.7767 | 20.2985 | 19.2592 | 16.9021 | 16.3637 | 17.2738 | 17.7493 | 20.3312 | 22.2743 | 25.3600 | (46) |

| | |
|---|---|
| Water storage loss: | |
| Store volume | 150.0000 (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | 1.3938 (48) |
| Temperature factor from Table 2b | 0.5400 (49) |
| Enter (49) or (54) in (55) | 0.7527 (55) |

Total storage loss

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (56) |

If cylinder contains dedicated solar storage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (57) |
| Primary loss 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |

Total heat required for water heating calculated for each month

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 218.0497 | 192.9535 | 205.1062 | 180.4153 | 174.9893 | 157.7725 | 155.6864 | 161.7538 | 163.4203 | 182.1360 | 193.5872 | 215.6615 | (62) |
| WWHRS | -24.2595 | -21.4553 | -22.4668 | -18.6034 | -17.3377 | -14.8360 | -13.9064 | -14.7880 | -15.3499 | -18.0958 | -20.5003 | -23.8103 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | | | | | | | | | | | | | |
| | 193.7902 | 171.4982 | 182.6395 | 161.8119 | 157.6516 | 142.9365 | 141.7800 | 146.9658 | 148.0704 | 164.0402 | 173.0868 | 191.8513 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 1976.1225 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 1976 | (64) |
| Electric shower(s) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | | | | | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | | | | | | | | | | | | | |
| | 94.2846 | 83.8321 | 89.9809 | 81.0685 | 79.9671 | 73.5398 | 73.5488 | 75.5663 | 75.4177 | 82.3433 | 85.4482 | 93.4906 | (65) |

## 5. Internal gains (see Table 5 and 5a)

| Metabolic gains (Table 5), Watts | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 86.0228 | 86.0228 | 86.0228 | 86.0228 | 86.0228 | 86.0228 | 86.0228 | 86.0228 | 86.0228 | 86.0228 | 86.0228 | 86.0228 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 75.7493 | 83.8653 | 75.7493 | 78.2743 | 75.7493 | 78.2743 | 75.7493 | 75.7493 | 78.2743 | 75.7493 | 78.2743 | 75.7493 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 149.9087 | 151.4643 | 147.5442 | 139.1990 | 128.6646 | 118.7638 | 112.1494 | 110.5938 | 114.5138 | 122.8591 | 133.3935 | 143.2943 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 31.6023 | 31.6023 | 31.6023 | 31.6023 | 31.6023 | 31.6023 | 31.6023 | 31.6023 | 31.6023 | 31.6023 | 31.6023 | 31.6023 | (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.0000 | 3.0000 | 3.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | | | | | | | | | | | | | |
| | -68.8182 | -68.8182 | -68.8182 | -68.8182 | -68.8182 | -68.8182 | -68.8182 | -68.8182 | -68.8182 | -68.8182 | -68.8182 | -68.8182 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 126.7267 | 124.7502 | 120.9421 | 112.5952 | 107.4826 | 102.1386 | 98.8560 | 101.5676 | 104.7468 | 110.6765 | 118.6780 | 125.6594 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 404.1915 | 411.8866 | 396.0425 | 381.8753 | 363.7034 | 347.9835 | 335.5615 | 336.7175 | 346.3418 | 361.0918 | 382.1526 | 396.5099 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Northeast | 4.5600 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 15.7239 | (75) |
| Southeast | 6.3100 | 36.7938 | 0.6300 | 0.7000 | 0.7700 | 70.9539 | (77) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 86.6777 | 152.8671 | 223.0322 | 299.6006 | 356.8018 | 363.5574 | 346.6230 | 302.5210 | 249.3234 | 172.6912 | 104.7711 | 73.5626 | (83) |
| Total gains | 490.8693 | 564.7537 | 619.0747 | 681.4759 | 720.5051 | 711.5409 | 682.1845 | 639.2386 | 595.6652 | 533.7829 | 486.9237 | 470.0725 | (84) |

## 7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, ni1,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 59.0645 | 59.2541 | 59.4411 | 60.3355 | 60.5059 | 61.3116 | 61.3116 | 61.4632 | 60.9987 | 60.5059 | 60.1623 | 59.8072 | |
| alpha | 4.9376 | 4.9503 | 4.9627 | 5.0224 | 5.0337 | 5.0874 | 5.0874 | 5.0975 | 5.0666 | 5.0337 | 5.0108 | 4.9871 | |
| util living area | | | | | | | | | | | | | |
| | 0.9932 | 0.9857 | 0.9688 | 0.9152 | 0.7964 | 0.6072 | 0.4481 | 0.4959 | 0.7409 | 0.9373 | 0.9855 | 0.9945 | (86) |
| MIT | 19.7449 | 19.9450 | 20.2246 | 20.5866 | 20.8489 | 20.9706 | 20.9948 | 20.9915 | 20.9216 | 20.5862 | 20.1113 | 19.7206 | (87) |
| Th 2 | 19.7427 | 19.7462 | 19.7496 | 19.7657 | 19.7687 | 19.7828 | 19.7828 | 19.7854 | 19.7773 | 19.7687 | 19.7626 | 19.7562 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9905 | 0.9801 | 0.9564 | 0.8825 | 0.7272 | 0.5026 | 0.3265 | 0.3691 | 0.6397 | 0.9054 | 0.9788 | 0.9923 | (89) |
| MIT 2 | 18.3316 | 18.5868 | 18.9379 | 19.3811 | 19.6584 | 19.7695 | 19.7816 | 19.7833 | 19.7345 | 19.3944 | 18.8113 | 18.3104 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.6524 | (91) |
| MIT | 19.2536 | 19.4728 | 19.7773 | 20.1675 | 20.4350 | 20.5531 | 20.5730 | 20.5714 | 20.5089 | 20.1719 | 19.6594 | 19.2304 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.2536 | 19.4728 | 19.7773 | 20.1675 | 20.4350 | 20.5531 | 20.5730 | 20.5714 | 20.5089 | 20.1719 | 19.6594 | 19.2304 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9892 | 0.9786 | 0.9567 | 0.8944 | 0.7667 | 0.5701 | 0.4060 | 0.4521 | 0.7031 | 0.9174 | 0.9781 | 0.9911 | (94) |
| Useful gains | 485.5486 | 552.6850 | 592.2617 | 609.4788 | 552.4166 | 405.6845 | 276.9729 | 288.9705 | 418.7951 | 489.6884 | 476.2710 | 465.8675 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | | | | | | | | | | | | | |
| | 1088.9319 | 1057.8107 | 960.7399 | 803.2260 | 620.9382 | 417.6176 | 278.7157 | 291.9132 | 451.9022 | 680.4255 | 897.8957 | 1080.9309 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 448.9172 | 339.4444 | 274.1478 | 139.4980 | 50.9801 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 141.9084 | 303.5698 | 457.6072 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 2156.0730 | |
| Solar heating kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | | | | | | | | | | | | | |
| | 448.9172 | 339.4444 | 274.1478 | 139.4980 | 50.9801 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 141.9084 | 303.5698 | 457.6072 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 2156.0730 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 42.2511 | (99) |

## 9a. Energy requirements - Individual heating systems, including micro-CHP

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | 0.0000 | (201) |
| Fraction of space heat from main system(s) | | | | | | | | | | | | 1.0000 | (202) |
| Efficiency of main space heating system 1 (in %) | | | | | | | | | | | | 92.3000 | (206) |
| Efficiency of main space heating system 2 (in %) | | | | | | | | | | | | 0.0000 | (207) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 | (208) |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |

Space heating requirement
448.9172 339.4444 274.1478 139.4980 50.9801 0.0000 0.0000 0.0000 0.0000 141.9084 303.5698 457.6072 (98)
Space heating efficiency (main heating system 1)
92.3000 92.3000 92.3000 92.3000 92.3000 0.0000 0.0000 0.0000 0.0000 92.3000 92.3000 92.3000 (210)
Space heating fuel (main heating system)
486.3675 367.7621 297.0182 151.1355 55.2331 0.0000 0.0000 0.0000 0.0000 153.7469 328.8947 495.7825 (211)
Space heating efficiency (main heating system 2)
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (212)
Space heating fuel (main heating system 2)
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (213)
Space heating fuel (secondary)
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (215)

Water heating
Water heating requirement
193.7902 171.4982 182.6395 161.8119 157.6516 142.9365 141.7800 146.9658 148.0704 164.0402 173.0868 191.8513 (64)
Efficiency of water heater 79.8000 (216)
(217)m 85.8796 85.5611 84.9684 83.7288 81.8265 79.8000 79.8000 79.8000 79.8000 83.7364 85.3064 85.9369 (217)
Fuel for water heating, kWh/month
225.6534 200.4395 214.9498 193.2572 192.6658 179.1185 177.6692 184.1677 185.5519 195.9006 202.9003 223.2466 (219)
Space cooling fuel requirement
(221)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (221)
Pumps and Fa 7.3041 6.5973 7.3041 7.0685 7.3041 7.0685 7.3041 7.3041 7.0685 7.3041 7.0685 7.3041 (231)
Lighting 15.7392 12.6266 11.3688 8.3293 6.4338 5.2565 5.8691 7.6289 9.9092 13.0014 14.6850 16.1767 (232)
Electricity generated by PVs (Appendix M) (negative quantity)
(233a)m -11.4163 -17.1805 -26.3465 -31.6786 -36.0064 -34.3077 -33.9067 -31.0914 -26.4543 -20.5390 -12.9355 -9.7487 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)
(234a)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)
(235a)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)
(235c)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)
(233b)m -3.5273 -7.6307 -15.5633 -23.9648 -32.2651 -32.6164 -32.2168 -26.9989 -19.4378 -11.0861 -4.7654 -2.7729 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)
(234b)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)
(235b)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)
(235d)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (235d)
Annual totals kWh/year
Space heating fuel - main system 1 2335.9404 (211)
Space heating fuel - main system 2 0.0000 (213)
Space heating fuel - secondary 0.0000 (215)
Efficiency of water heater 79.8000
Water heating fuel used 2375.5205 (219)
Space cooling fuel 0.0000 (221)

Electricity for pumps and fans:
Total electricity for the above, kWh/year 86.0000 (231)
Electricity for lighting (calculated in Appendix L) 127.0245 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV generation -504.4571 (233)
Wind generation 0.0000 (234)
Hydro-electric generation (Appendix N) 0.0000 (235a)
Electricity generated - Micro CHP (Appendix N) 0.0000 (235)
Appendix Q - special features
Energy saved or generated -0.0000 (236)
Energy used 0.0000 (237)
Total delivered energy for all uses 4420.0283 (238)

---
12a. Carbon dioxide emissions - Individual heating systems including micro-CHP
---

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 2335.9404 | 0.2100 | 490.5475 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2375.5205 | 0.2100 | 498.8593 | (264) |
| Space and water heating | | | 989.4068 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 127.0245 | 0.1443 | 18.3336 | (268) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -291.6116 | 0.1332 | -38.8495 | |
| PV Unit electricity exported | -212.8455 | 0.1252 | -26.6454 | |
| Total | | | -65.4949 | (269) |
| Total CO2, kg/year | | | 954.1747 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 18.7000 | (273) |

---
13a. Primary energy - Individual heating systems including micro-CHP
---

| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 2335.9404 | 1.1300 | 2639.6127 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2375.5205 | 1.1300 | 2684.3382 | (278) |
| Space and water heating | | | 5323.9509 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 127.0245 | 1.5338 | 194.8344 | (282) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -291.6116 | 1.4923 | -435.1699 | |
| PV Unit electricity exported | -212.8455 | 0.4595 | -97.8000 | |
| Total | | | -532.9698 | (283) |
| Total Primary energy kWh/year | | | 5115.9163 | (286) |
| Target Primary Energy Rate (TPER) | | | 100.2500 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Property Reference** | Unit 19 | **Issued on Date** | 17/05/2025 |
| **Assessment Reference** | 00001 | **Prop Type Ref** | Unit 19 |
| **Property** | | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 78 C | **DER** | 6.08 | **TER** | 14.36 |
| **Environmental** | 96 A | **% DER < TER** | | | 57.66 |
| **$CO_2$ Emissions (t/year)** | 0.3 | **DFEE** | 34.42 | **TFEE** | 33.95 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | -1.38 |
| **% DPER < TPER** | 15.60 | **DPER** | 64.81 | **TPER** | 76.79 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Robert Arnold | **Assessor ID** | BA04-0001 |
| **Client** | | | |

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SAP 10 WORKSHEET FOR New Build (As Designed)  (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 55.2800 | (1b) | x 3.0000 | (2b) = | 165.8400 | (1b) - (3b) (4) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 55.2800 | | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | 165.8400 | (5) |

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2. Ventilation rate

---

| | | m3 per hour | |
|---|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 | (6a) |
| Number of open flues | 0 * 20 = | 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | 0 * 10 = | 0.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |

| | Air changes per hour | | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 0.0000 / (5) = | 0.0000 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 3.0000 | (17) |
| Infiltration rate | | 0.1500 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.1500 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.1912 | 0.1875 | 0.1837 | 0.1650 | 0.1612 | 0.1425 | 0.1425 | 0.1388 | 0.1500 | 0.1612 | 0.1687 | 0.1762 | (22b) |

Balanced mechanical ventilation with heat recovery

| | | |
|---|---|---|
| If mechanical ventilation | | 0.5000 (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | | 0.5000 (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | | 81.0000 (23c) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective ac | 0.2862 | 0.2825 | 0.2787 | 0.2600 | 0.2562 | 0.2375 | 0.2375 | 0.2337 | 0.2450 | 0.2562 | 0.2637 | 0.2712 | (25) |

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3. Heat losses and heat loss parameter

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| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| Window | | | 11.7100 | 1.0536 | 12.3381 | | | (27) |
| Front Door | | | 1.8900 | 1.4000 | 2.6460 | | | (26) |
| Glass Door | | | 4.9700 | 1.3258 | 6.5890 | | | (27) |
| External Walls | 51.5600 | 16.6800 | 34.8800 | 0.1500 | 5.2320 | 150.0000 | 5232.0000 | (29a) |
| Wall to Communal Corridor | 6.3000 | 1.8900 | 4.4100 | 0.1300 | 0.5733 | 150.0000 | 661.5000 | (29a) |
| Total net area of external elements Aum(A, m2) | | | 57.8600 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 27.3784 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 20 | | | 15.1500 | 0.0000 | 0.0000 | 70.0000 | 1060.5000 | (32) |
| Party Wall to Unit 23 | | | 19.6100 | 0.0000 | 0.0000 | 70.0000 | 1372.7000 | (32) |
| Party Floor | | | 55.2800 | | | 80.0000 | 4422.4000 | (32d) |
| Party Ceiling | | | 55.2800 | | | 100.0000 | 5528.0000 | (32b) |
| Internal Walls | | | 93.3900 | | | 9.0000 | 840.5100 | (32c) |

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 19117.6100 (34)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 345.8323 (35)

List of Thermal Bridges

| | K1 Element | Length | Psi-value | Total |
|---|---|---|---|---|
| E1 | Steel lintel with perforated steel base plate | 8.3000 | 0.0500 | 0.4150 |
| E4 | Jamb | 31.2000 | 0.0500 | 1.5600 |
| E7 | Party floor between dwellings (in blocks of flats) | 20.1940 | 0.0350 | 0.7068 |
| E16 | Corner (normal) | 6.0000 | 0.0900 | 0.5400 |
| E18 | Party wall between dwellings | 3.0000 | 0.0300 | 0.0900 |
| E25 | Staggered party wall between dwellings | 3.0000 | 0.0300 | 0.0900 |
| E7 | Party floor between dwellings (in blocks of flats) | 4.2000 | 0.0350 | 0.1470 |
| E17 | Corner (inverted - internal area greater than external area) | 3.0000 | -0.0900 | -0.2700 |
| E23 | Balcony within or between dwellings, balcony support penetrates wall insulation | 17.1870 | 0.0200 | 0.3437 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 3.6225 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 31.0010 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 15.6657 | 15.4604 | 15.2552 | 14.2291 | 14.0238 | 12.9977 | 12.9977 | 12.7925 | 13.4082 | 14.0238 | 14.4343 | 14.8448 | (38) |
| Heat transfer coeff | 46.6666 | 46.4614 | 46.2562 | 45.2300 | 45.0248 | 43.9987 | 43.9987 | 43.7935 | 44.4091 | 45.0248 | 45.4353 | 45.8457 | (39) |

Average = Sum(39)m / 12 = 45.1787

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 0.8442 | 0.8405 | 0.8368 | 0.8182 | 0.8145 | 0.7959 | 0.7959 | 0.7922 | 0.8033 | 0.8145 | 0.8219 | 0.8293 | (40) |
| HLP (average) | | | | | | | | | | | | 0.8173 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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## 4. Water heating energy requirements (kWh/year)

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Assumed occupancy 1.8456 (42)

Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 53.7698 | 52.9466 | 51.7334 | 49.8671 | 48.1949 | 45.8556 | 44.0053 | 46.1684 | 47.2563 | 49.5733 | 51.9863 | 53.7213 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.3138 | 22.9618 | 22.4612 | 21.7114 | 21.0357 | 20.1055 | 19.3997 | 20.2627 | 20.7156 | 21.6373 | 22.5956 | 23.2953 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 33.5304 | 32.3111 | 31.0918 | 29.8725 | 28.6532 | 27.4339 | 27.4339 | 28.6532 | 29.8725 | 31.0918 | 32.3111 | 33.5304 | (42c) |

Average daily hot water use (litres/day) 101.6711 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 110.6139 | 108.2195 | 105.2864 | 101.4510 | 97.8838 | 93.3950 | 90.8390 | 95.0843 | 97.8445 | 102.3024 | 106.8930 | 110.5469 | (44) |
| Energy conte | 162.8428 | 143.1963 | 150.4520 | 132.5203 | 126.1332 | 108.0082 | 100.3798 | 111.9160 | 113.4947 | 131.8270 | 144.4694 | 162.3463 | (45) |

Energy content (annual) Total = Sum(45)m = 1587.5860

Distribution loss (46)m = 0.15 x (45)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 24.4264 | 21.4794 | 22.5678 | 19.8781 | 18.9200 | 16.2012 | 15.0570 | 16.7874 | 17.0242 | 19.7741 | 21.6704 | 24.3519 | (46) |

Water storage loss:

Store volume 110.0000 (47)

b) If manufacturer declared loss factor is not known :

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.0152 (51)

Volume factor from Table 2a 1.0294 (52)

Temperature factor from Table 2b 0.6000 (53)

Enter (49) or (54) in (55) 1.0327 (55)

Total storage loss

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (56) |

If cylinder contains dedicated solar storage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (57) |
| Primary loss 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |

Total heat required for water heating calculated for each month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 218.1196 | 193.1237 | 205.7288 | 186.0140 | 181.4100 | 161.5019 | 155.6566 | 167.1928 | 166.9884 | 187.1038 | 197.9631 | 217.6231 | (62) |
| WWHRS 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63a) |
| PV diverter -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |

Output from w/h

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 218.1196 | 193.1237 | 205.7288 | 186.0140 | 181.4100 | 161.5019 | 155.6566 | 167.1928 | 166.9884 | 187.1038 | 197.9631 | 217.6231 | (64) |

Total per year (kWh/year) = Sum(64)m = 2238.4258 (64)

12Total per year (kWh/year) 2238 (64)

Electric shower(s)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)

Heat gains from water heating, kWh/month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 98.3667 | 87.5547 | 94.2467 | 86.8580 | 86.1607 | 78.7077 | 77.5977 | 81.4335 | 80.5319 | 88.0539 | 90.8310 | 98.2016 | (65) |

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## 5. Internal gains (see Table 5 and 5a)

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Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 92.2779 | 92.2779 | 92.2779 | 92.2779 | 92.2779 | 92.2779 | 92.2779 | 92.2779 | 92.2779 | 92.2779 | 92.2779 | 92.2779 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 81.1591 | 89.8547 | 81.1591 | 83.8644 | 81.1591 | 83.8644 | 81.1591 | 81.1591 | 83.8644 | 81.1591 | 83.8644 | 81.1591 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 160.9069 | 162.5766 | 158.3690 | 149.4115 | 138.1042 | 127.4770 | 120.3774 | 118.7077 | 122.9153 | 131.8728 | 143.1801 | 153.8073 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 32.2278 | 32.2278 | 32.2278 | 32.2278 | 32.2278 | 32.2278 | 32.2278 | 32.2278 | 32.2278 | 32.2278 | 32.2278 | 32.2278 | (69) |
| Pumps, fans | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | -73.8224 | -73.8224 | -73.8224 | -73.8224 | -73.8224 | -73.8224 | -73.8224 | -73.8224 | -73.8224 | -73.8224 | -73.8224 | -73.8224 | (71) |
| Water heating gains (Table 5) | 132.2133 | 130.2897 | 126.6757 | 120.6361 | 115.8074 | 109.3162 | 104.2980 | 109.4536 | 111.8499 | 118.3521 | 126.1542 | 131.9914 | (72) |
| Total internal gains | 424.9627 | 433.4045 | 416.8872 | 404.5953 | 385.7541 | 371.3410 | 356.5178 | 360.0038 | 369.3129 | 382.0673 | 403.8820 | 417.6411 | (73) |

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## 6. Solar gains

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| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Southeast | 1.5500 | 36.7938 | 0.4500 | 0.7000 | 0.7700 | 12.4495 | (77) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southwest | | | | 3.5000 | | 36.7938 | | 0.4500 | | 0.7000 | | 0.7700 | 28.1117 (79) |
| Northwest | | | | 6.6600 | | 11.2829 | | 0.4500 | | 0.7000 | | 0.7700 | 16.4036 (81) |
| Southwest | | | | 4.9700 | | 36.7938 | | 0.4500 | | 0.7000 | | 0.7700 | 39.9186 (79) |
| Solar gains | 96.8834 | 170.4769 | 247.7264 | 331.2032 | 393.1169 | 400.0135 | 381.6026 | 333.9232 | 276.4004 | 192.3154 | 117.0362 | 82.2699 (83) | |
| Total gains | 521.8460 | 603.8813 | 664.6136 | 735.7985 | 778.8711 | 771.3545 | 738.1205 | 693.9270 | 645.7134 | 574.3827 | 520.9182 | 499.9110 (84) | |

## 7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 (85) | |
| Utilisation factor for gains for living area, ni1,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 113.7954 | 114.2980 | 114.8052 | 117.4097 | 117.9449 | 120.6956 | 120.6956 | 121.2612 | 119.5801 | 117.9449 | 116.8794 | 115.8330 | |
| alpha | 8.5864 | 8.6199 | 8.6537 | 8.8273 | 8.8630 | 9.0464 | 9.0464 | 9.0841 | 8.9720 | 8.8630 | 8.7920 | 8.7222 | |
| util living area | 0.9892 | 0.9651 | 0.9005 | 0.7290 | 0.5366 | 0.3650 | 0.2623 | 0.2903 | 0.4742 | 0.7868 | 0.9620 | 0.9918 (86) | |
| MIT | 20.5909 | 20.7430 | 20.8875 | 20.9830 | 20.9988 | 21.0000 | 21.0000 | 21.0000 | 20.9997 | 20.9745 | 20.7966 | 20.5725 (87) | |
| Th 2 | 20.2152 | 20.2184 | 20.2216 | 20.2376 | 20.2408 | 20.2569 | 20.2569 | 20.2601 | 20.2504 | 20.2408 | 20.2344 | 20.2280 (88) | |
| util rest of house | 0.9851 | 0.9537 | 0.8746 | 0.6880 | 0.4932 | 0.3227 | 0.2180 | 0.2436 | 0.4229 | 0.7393 | 0.9477 | 0.9886 (89) | |
| MIT 2 | 19.7591 | 19.9474 | 20.1149 | 20.2244 | 20.2400 | 20.2569 | 20.2569 | 20.2601 | 20.2503 | 20.2219 | 20.0281 | 19.7470 (90) | |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.6742 (91) | |
| MIT | 20.3199 | 20.4838 | 20.6358 | 20.7359 | 20.7516 | 20.7579 | 20.7579 | 20.7589 | 20.7555 | 20.7293 | 20.5462 | 20.3035 (92) | |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 20.3199 | 20.4838 | 20.6358 | 20.7359 | 20.7516 | 20.7579 | 20.7579 | 20.7589 | 20.7555 | 20.7293 | 20.5462 | 20.3035 (93) | |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9858 | 0.9579 | 0.8890 | 0.7150 | 0.5224 | 0.3512 | 0.2478 | 0.2751 | 0.4575 | 0.7704 | 0.9541 | 0.9890 (94) | |
| Useful gains | 514.4154 | 578.4784 | 590.8126 | 526.1305 | 406.9201 | 270.9243 | 182.9412 | 190.8918 | 295.4220 | 442.5123 | 496.9941 | 494.4038 (95) | |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 (96) | |
| Heat loss rate W | 747.5968 | 724.0445 | 653.8685 | 535.3363 | 407.5455 | 270.9379 | 182.9416 | 190.8929 | 295.5666 | 456.0695 | 610.9320 | 738.2780 (97) | |
| Space heating kWh | 173.4869 | 97.8204 | 46.9136 | 6.6282 | 0.4653 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 10.0865 | 82.0353 | 181.4424 (98a) | |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 598.8786 | |
| Solar heating kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (98b) | |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | 173.4869 | 97.8204 | 46.9136 | 6.6282 | 0.4653 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 10.0865 | 82.0353 | 181.4424 (98c) | |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 598.8786 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 10.8336 (99) | |

## 8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ext. temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | |
| Heat loss rate W | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 413.5876 | 325.5902 | 332.8302 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (100) | |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.9993 | 0.9999 | 0.9997 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (101) | |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 413.2969 | 325.5448 | 332.7380 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (102) | |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 858.1839 | 821.5513 | 770.5025 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (103) | |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 320.3186 | 369.0289 | 325.6969 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (104) | |
| Cooled fraction | | | | | | | | | | fC = cooled area / (4) = | | 0.9949 (105) | |
| Intermittency factor (Table 10b) | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 (106) | |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 79.6740 | 91.7899 | 81.0118 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (107) | |
| Space cooling requirement | | | | | | | | | | | | 252.4758 (107) | |

## 9b. Energy requirements

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | 0.0000 (301) | |
| Fraction of space heat from community system | | | | | | | | | | | | 1.0000 (302) | |
| Fraction of heat from community Heat pump-Space and Water | | | | | | | | | | | | 1.0000 (303a) | |
| Factor for control and charging method (Table 4c(3)) for space heating | | | | | | | | | | | | 1.0000 (305) | |
| Factor for charging method (Table 4c(3)) for water heating | | | | | | | | | | | | 1.0000 (305a) | |
| Distribution loss factor (Table 12c) for community heating system | | | | | | | | | | | | 2.0000 (306) | |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 (208) | |
| Space heating: | | | | | | | | | | | | | |
| Space heating requirement | | | | | | | | | | | | | |
| | 173.4869 | 97.8204 | 46.9136 | 6.6282 | 0.4653 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 10.0865 | 82.0353 | 181.4424 (98) | |
| Space heat from Heat pump = (98) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 307a | 346.9738 | 195.6408 | 93.8272 | 13.2564 | 0.9305 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 20.1730 | 164.0706 | 362.8849 | |
| Space heating requirement | | | | | | | | | | | | | |
| | 346.9738 | 195.6408 | 93.8272 | 13.2564 | 0.9305 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 20.1730 | 164.0706 | 362.8849 (307) | |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | | | | | | | | | | | 0.0000 (308) | |
| Space heating fuel for secondary/supplementary system | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (309) | |
| Water heating | | | | | | | | | | | | | |
| Annual water heating requirement | | | | | | | | | | | | | |
| | 218.1196 | 193.1237 | 205.7288 | 186.0140 | 181.4100 | 161.5019 | 155.6566 | 167.1928 | 166.9884 | 187.1038 | 197.9631 | 217.6231 (64) | |
| Water heat from Heat pump = (64) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 310a | 436.2392 | 386.2474 | 411.4577 | 372.0280 | 362.8200 | 323.0037 | 311.3132 | 334.3856 | 333.9767 | 374.2077 | 395.9261 | 435.2462 | |
| Water heating fuel | | | | | | | | | | | | | |
| | 436.2392 | 386.2474 | 411.4577 | 372.0280 | 362.8200 | 323.0037 | 311.3132 | 334.3856 | 333.9767 | 374.2077 | 395.9261 | 435.2462 (310) | |
| Cooling System Energy Efficiency Ratio | | | | | | | | | | | | 2.6000 (314) | |
| Space coolin | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 30.6439 | 35.3038 | 31.1584 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (315) | |
| Pumps and Fa | 15.1561 | 13.6894 | 15.1561 | 14.6672 | 15.1561 | 14.6672 | 15.1561 | 15.1561 | 14.6672 | 15.1561 | 14.6672 | 15.1561 (331) | |
| Lighting | 15.7888 | 12.6664 | 11.4047 | 8.3556 | 6.4541 | 5.2730 | 5.8876 | 7.6529 | 9.9404 | 13.0424 | 14.7313 | 16.2276 (332) | |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333a)m | -4.7234 | -7.6286 | -12.6368 | -16.3230 | -19.4680 | -18.8839 | -18.6180 | -16.5728 | -13.3375 | -9.5078 | -5.5023 | -3.9669 (333a) | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335a) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (333b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335b) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - community heating | 1197.7573 | (307) |
| Space heating fuel - secondary | 0.0000 | (309) |
| Water heating fuel - community heating | 4476.8516 | (310) |
| Efficiency of water heater | 0.0000 | (311) |
| Electricity used for heat distribution | 11.9776 | (313) |
| Space cooling fuel | 97.1061 | (321) |
| | | |
| Electricity for pumps and fans: | | |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8820) | | |
| mechanical ventilation fans (SFP = 0.8820) | 178.4505 | (330a) |
| Total electricity for the above, kWh/year | 178.4505 | (331) |
| Electricity for lighting (calculated in Appendix L) | 127.4249 | (332) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -147.1690 | (333) |
| Wind generation | 0.0000 | (334) |
| Hydro-electric generation (Appendix N) | 0.0000 | (335a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (335) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (336) |
| Energy used | 0.0000 | (337) |
| Total delivered energy for all uses | 5930.4213 | (338) |

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12b. Carbon dioxide emissions - Community heating scheme

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (367) |
| Space and Water heating from Heat pump | 2026.6460 | 0.1594 | 68.1792 | (367) |
| Electrical energy for heat distribution (space & water) | 11.9776 | 0.0000 | 8.2099 | (372) |
| Overall CO2 factor for heat network | | | 0.0531 | (386) |
| Total CO2 associated with community systems | | | 301.4200 | (373) |
| Space and water heating | | | 301.4200 | (376) |
| Space cooling | 97.1061 | 0.1142 | 11.0857 | (377) |
| Pumps, fans and electric keep-hot | 178.4505 | 0.1387 | 24.7533 | (378) |
| Energy for lighting | 127.4249 | 0.1443 | 18.3913 | (379) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -147.1690 | 0.1319 | -19.4144 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -19.4144 | (380) |
| Total CO2, kg/year | | | 336.2360 | (383) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 6.0800 | (384) |

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13b. Primary energy - Community heating scheme

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| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (467a) |
| Space and Water heating from Heat pump | 2026.6460 | 1.5899 | 680.1159 | (467) |
| Electrical energy for heat distribution (space & water) | 11.9776 | 0.0000 | 87.1097 | (472) |
| Overall CO2 factor for heat network | | | 0.5636 | (486) |
| Total CO2 associated with community systems | | | 3198.1700 | (473) |
| Space and water heating | | | 3198.1700 | (476) |
| Space cooling | 97.1061 | 1.4207 | 137.9630 | (477) |
| Pumps, fans and electric keep-hot | 178.4505 | 1.5128 | 269.9599 | (478) |
| Energy for lighting | 127.4249 | 1.5338 | 195.4485 | (479) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -147.1690 | 1.4874 | -218.8985 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -218.8985 | (480) |
| Total Primary energy kWh/year | | | 3582.6430 | (483) |
| Dwelling Primary energy Rate (DPER) | | | 64.8100 | (484) |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 55.2800 | (1b) | x 3.0000 | (2b) = | 165.8400 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 55.2800 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = | 165.8400 | (5) |

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2. Ventilation rate

---

m3 per hour

| | | | |
|---|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 | (6a) |
| Number of open flues | 0 * 20 = | 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | 2 * 10 = | 20.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |

| | | Air changes per hour | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 20.0000 / (5) = | 0.1206 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3706 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.3706 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.4725 | 0.4632 | 0.4540 | 0.4077 | 0.3984 | 0.3521 | 0.3521 | 0.3428 | 0.3706 | 0.3984 | 0.4169 | 0.4355 | (22b) |
| Effective ac | 0.6116 | 0.6073 | 0.6031 | 0.5831 | 0.5794 | 0.5620 | 0.5620 | 0.5588 | 0.5687 | 0.5794 | 0.5869 | 0.5948 | (25) |

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## 3. Heat losses and heat loss parameter

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| Element | Gross | Openings | NetArea | U-value | A x U | K-value | A x K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | m2 | m2 | m2 | W/m2K | W/K | kJ/m2K | kJ/K | |
| TER Opaque door | | | 1.8900 | 1.0000 | 1.8900 | | | (26) |
| TER Opening Type | | | 11.9500 | 1.1450 | 13.6832 | | | (27) |
| External Walls | 51.5600 | 11.9500 | 39.6100 | 0.1800 | 7.1298 | | | (29a) |
| Wall to Communal Corridor | 6.3000 | 1.8900 | 4.4100 | 0.1800 | 0.7938 | | | (29a) |
| Total net area of external elements Aum(A, m2) | | | 57.8600 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 23.4968 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 20 | | | 15.1500 | 0.0000 | 0.0000 | | | (32) |
| Party Wall to Unit 23 | | | 19.6100 | 0.0000 | 0.0000 | | | (32) |

| | | |
|---|---|---|
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | 325.8323 | (35) |

List of Thermal Bridges

| K1 Element | Length | Psi-value | Total |
|---|---|---|---|
| E1 Steel lintel with perforated steel base plate | 8.3000 | 0.0500 | 0.4150 |
| E4 Jamb | 31.2000 | 0.0500 | 1.5600 |
| E7 Party floor between dwellings (in blocks of flats) | 20.1940 | 0.0700 | 1.4136 |
| E16 Corner (normal) | 6.0000 | 0.0900 | 0.5400 |
| E18 Party wall between dwellings | 3.0000 | 0.0600 | 0.1800 |
| E25 Staggered party wall between dwellings | 3.0000 | 0.0600 | 0.1800 |
| E7 Party floor between dwellings (in blocks of flats) | 4.2000 | 0.0700 | 0.2940 |
| E17 Corner (inverted - internal area greater than external area) | 3.0000 | -0.0900 | -0.2700 |
| E23 Balcony within or between dwellings, balcony support penetrates wall insulation | 17.1870 | 0.0200 | 0.3437 |

| | | | |
|---|---|---|---|
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | 4.6563 | (36) |
| Point Thermal bridges | (36a) = | 0.0000 | |
| Total fabric heat loss | (33) + (36) + (36a) = | 28.1531 | (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 33.4730 | 33.2358 | 33.0032 | 31.9110 | 31.7067 | 30.7554 | 30.7554 | 30.5792 | 31.1218 | 31.7067 | 32.1201 | 32.5523 | (38) |
| Heat transfer coeff | 61.6261 | 61.3889 | 61.1564 | 60.0641 | 59.8598 | 58.9085 | 58.9085 | 58.7323 | 59.2749 | 59.8598 | 60.2732 | 60.7054 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 60.0632 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.1148 | 1.1105 | 1.1063 | 1.0865 | 1.0828 | 1.0656 | 1.0656 | 1.0625 | 1.0723 | 1.0828 | 1.0903 | 1.0981 | (40) |
| HLP (average) | | | | | | | | | | | | 1.0865 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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## 4. Water heating energy requirements (kWh/year)

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| | | |
|---|---|---|
| Assumed occupancy | 1.8456 | (42) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hot water usage for mixer showers | 55.1635 | 54.3345 | 53.1265 | 50.8152 | 49.1095 | 47.2073 | 46.1261 | 47.3250 | 48.6391 | 50.6815 | 53.0425 | 54.9521 | (42a) |
| Hot water usage for baths | 23.8453 | 23.4912 | 22.9925 | 22.0730 | 21.3845 | 20.6210 | 20.2086 | 20.7038 | 21.2430 | 22.0600 | 22.9984 | 23.7647 | (42b) |
| Hot water usage for other uses | 33.5304 | 32.3111 | 31.0918 | 29.8725 | 28.6532 | 27.4339 | 27.4339 | 28.6532 | 29.8725 | 31.0918 | 32.3111 | 33.5304 | (42c) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 103.4494 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 112.5392 | 110.1368 | 107.2108 | 102.7607 | 99.1471 | 95.2622 | 93.7687 | 96.6820 | 99.7547 | 103.8333 | 108.3520 | 112.2472 | (44) |
| Energy conte | 178.2346 | 156.8333 | 164.7790 | 140.6742 | 133.4711 | 117.1360 | 113.4051 | 119.7125 | 123.0075 | 140.9008 | 154.3672 | 175.7520 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1718.2732 | |
| Distribution loss (46)m = 0.15 x (45)m | 26.7352 | 23.5250 | 24.7168 | 21.1011 | 20.0207 | 17.5704 | 17.0108 | 17.9569 | 18.4511 | 21.1351 | 23.1551 | 26.3628 | (46) |

| | | |
|---|---|---|
| Water storage loss: | | |
| Store volume | 150.0000 | (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | 1.3938 | (48) |
| Temperature factor from Table 2b | 0.5400 | (49) |
| Enter (49) or (54) in (55) | 0.7527 | (55) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total storage loss | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (56) |
| If cylinder contains dedicated solar storage | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (57) |
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | 224.8295 | 198.9190 | 211.3739 | 185.7660 | 180.0660 | 162.2279 | 160.0000 | 166.3074 | 168.0993 | 187.4957 | 199.4591 | 222.3469 | (62) |
| WWHRS | -25.2184 | -22.3034 | -23.3548 | -19.3387 | -18.0230 | -15.4224 | -14.4560 | -15.3726 | -15.9566 | -18.8111 | -21.3107 | -24.7514 | (63a) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | | | | | | | | | | | | | |
| | 199.6110 | 176.6156 | 188.0190 | 166.4273 | 162.0430 | 146.8055 | 145.5439 | 150.9349 | 152.1427 | 168.6846 | 178.1484 | 197.5955 | (64) |
| | | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | 2032.5714 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2033 | (64) |
| Electric shower(s) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | | | | | | | | | | | | | |
| | 96.5389 | 85.8156 | 92.0649 | 82.8476 | 81.6551 | 75.0212 | 74.9831 | 77.0803 | 76.9735 | 84.1254 | 87.4006 | 95.7135 | (65) |

## 5. Internal gains (see Table 5 and 5a)

| Metabolic gains (Table 5), Watts | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 92.2779 | 92.2779 | 92.2779 | 92.2779 | 92.2779 | 92.2779 | 92.2779 | 92.2779 | 92.2779 | 92.2779 | 92.2779 | 92.2779 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 81.2433 | 89.9479 | 81.2433 | 83.9514 | 81.2433 | 83.9514 | 81.2433 | 81.2433 | 83.9514 | 81.2433 | 83.9514 | 81.2433 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 160.9069 | 162.5766 | 158.3690 | 149.4115 | 138.1042 | 127.4770 | 120.3774 | 118.7077 | 122.9153 | 131.8728 | 143.1801 | 153.8073 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 32.2278 | 32.2278 | 32.2278 | 32.2278 | 32.2278 | 32.2278 | 32.2278 | 32.2278 | 32.2278 | 32.2278 | 32.2278 | 32.2278 | (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.0000 | 3.0000 | 3.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | | | | | | | | | | | | | |
| | -73.8224 | -73.8224 | -73.8224 | -73.8224 | -73.8224 | -73.8224 | -73.8224 | -73.8224 | -73.8224 | -73.8224 | -73.8224 | -73.8224 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 129.7566 | 127.7018 | 123.7432 | 115.0662 | 109.7514 | 104.1961 | 100.7837 | 103.6026 | 106.9076 | 113.0718 | 121.3897 | 128.6471 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 425.5902 | 433.9098 | 417.0389 | 402.1125 | 382.7824 | 366.3079 | 353.0878 | 354.2369 | 364.4577 | 379.8713 | 402.2045 | 417.3811 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Southeast | 1.1100 | 36.7938 | 0.6300 | 0.7000 | 0.7700 | 12.4816 | (77) |
| Southwest | 6.0700 | 36.7938 | 0.6300 | 0.7000 | 0.7700 | 68.2552 | (79) |
| Northwest | 4.7700 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 16.4480 | (81) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 97.1847 | 171.0049 | 248.4880 | 332.2124 | 394.3072 | 401.2215 | 382.7563 | 334.9378 | 277.2472 | 192.9096 | 117.3998 | 82.5261 | (83) |
| Total gains | 522.7749 | 604.9147 | 665.5269 | 734.3249 | 777.0896 | 767.5294 | 735.8441 | 689.1748 | 641.7048 | 572.7808 | 519.6044 | 499.9072 | (84) |

## 7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 81.1885 | 81.5023 | 81.8122 | 83.2999 | 83.5843 | 84.9340 | 84.9340 | 85.1888 | 84.4090 | 83.5843 | 83.0110 | 82.4200 | |
| alpha | 6.4126 | 6.4335 | 6.4541 | 6.5533 | 6.5723 | 6.6623 | 6.6623 | 6.6793 | 6.6273 | 6.5723 | 6.5341 | 6.4947 | |
| util living area | | | | | | | | | | | | | |
| | 0.9936 | 0.9831 | 0.9556 | 0.8631 | 0.6917 | 0.4890 | 0.3520 | 0.3916 | 0.6253 | 0.9012 | 0.9828 | 0.9950 | (86) |
| MIT | 20.1986 | 20.3806 | 20.6052 | 20.8532 | 20.9697 | 20.9973 | 20.9997 | 20.9995 | 20.9877 | 20.8320 | 20.4838 | 20.1766 | (87) |
| Th 2 | 19.9888 | 19.9923 | 19.9957 | 20.0118 | 20.0149 | 20.0290 | 20.0290 | 20.0316 | 20.0235 | 20.0149 | 20.0087 | 20.0023 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9910 | 0.9767 | 0.9396 | 0.8228 | 0.6277 | 0.4160 | 0.2745 | 0.3094 | 0.5426 | 0.8608 | 0.9751 | 0.9930 | (89) |
| MIT 2 | 19.0834 | 19.3146 | 19.5916 | 19.8837 | 19.9948 | 20.0279 | 20.0289 | 20.0315 | 20.0176 | 19.8719 | 19.4592 | 19.0662 | (90) |
| Living area fraction | | | | | | | | | | | fLA = Living area / (4) = | 0.6742 | (91) |
| MIT | 19.8352 | 20.0333 | 20.2750 | 20.5373 | 20.6521 | 20.6815 | 20.6835 | 20.6841 | 20.6717 | 20.5192 | 20.1500 | 19.8148 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.8352 | 20.0333 | 20.2750 | 20.5373 | 20.6521 | 20.6815 | 20.6835 | 20.6841 | 20.6717 | 20.5192 | 20.1500 | 19.8148 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9905 | 0.9770 | 0.9446 | 0.8453 | 0.6698 | 0.4652 | 0.3268 | 0.3648 | 0.5981 | 0.8830 | 0.9764 | 0.9925 | (94) |
| Useful gains | 517.8178 | 590.9872 | 628.6351 | 620.7006 | 520.4884 | 357.0549 | 240.4563 | 251.4259 | 383.8075 | 505.7765 | 507.3189 | 496.1721 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | | | | | | | | | | | | | |
| | 957.3771 | 929.0183 | 842.4298 | 698.9859 | 535.8701 | 358.2510 | 240.5506 | 251.6168 | 389.5347 | 593.7611 | 786.5643 | 947.9038 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 327.0321 | 227.1569 | 159.0633 | 56.3654 | 11.4440 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 65.4605 | 201.0567 | 336.0884 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 1383.6673 | |
| Solar heating kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | | | | | | | | | | | | | |
| | 327.0321 | 227.1569 | 159.0633 | 56.3654 | 11.4440 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 65.4605 | 201.0567 | 336.0884 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 1383.6673 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 25.0302 | (99) |

## 9a. Energy requirements - Individual heating systems, including micro-CHP

| | | |
|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | 0.0000 | (201) |
| Fraction of space heat from main system(s) | 1.0000 | (202) |
| Efficiency of main space heating system 1 (in %) | 92.3000 | (206) |
| Efficiency of main space heating system 2 (in %) | 0.0000 | (207) |
| Efficiency of secondary/supplementary heating system, % | 0.0000 | (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement | | | | | | | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 327.0321 | 227.1569 | 159.0633 | 56.3654 | 11.4440 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 65.4605 | 201.0567 | 336.0884 (98) |
| Space heating efficiency (main heating system 1) | | | | | | | | | | | | |
| | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.3000 | 92.3000 | 92.3000 (210) |
| Space heating fuel (main heating system) | | | | | | | | | | | | |
| | 354.3143 | 246.1071 | 172.3329 | 61.0676 | 12.3987 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 70.9215 | 217.8296 | 364.1261 (211) |
| Space heating efficiency (main heating system 2) | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (212) |
| Space heating fuel (main heating system 2) | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (213) |
| Space heating fuel (secondary) | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (215) |
| Water heating | | | | | | | | | | | | |
| Water heating requirement | | | | | | | | | | | | |
| | 199.6110 | 176.6156 | 188.0190 | 166.4273 | 162.0430 | 146.8055 | 145.5439 | 150.9349 | 152.1427 | 168.6846 | 178.1484 | 197.5955 (64) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 (216) |
| (217)m | 85.1597 | 84.6252 | 83.6871 | 81.9000 | 80.3371 | 79.8000 | 79.8000 | 79.8000 | 79.8000 | 82.1271 | 84.3317 | 85.2406 (217) |
| Fuel for water heating, kWh/month | | | | | | | | | | | | |
| | 234.3962 | 208.7032 | 224.6691 | 203.2079 | 201.7038 | 183.9667 | 182.3859 | 189.1415 | 190.6550 | 205.3946 | 211.2471 | 231.8092 (219) |
| Space cooling fuel requirement | | | | | | | | | | | | |
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (221) |
| Pumps and Fa | 7.3041 | 6.5973 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 (231) |
| Lighting | 16.8807 | 13.5424 | 12.1934 | 8.9334 | 6.9004 | 5.6377 | 6.2948 | 8.1822 | 10.6279 | 13.9444 | 15.7501 | 17.3499 (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (233a)m | -12.3404 | -18.5566 | -28.4333 | -34.1561 | -38.7904 | -36.9442 | -36.5078 | -33.4895 | -28.5169 | -22.1668 | -13.9761 | -10.5391 (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | |
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (233b)m | -3.8477 | -8.3210 | -16.9670 | -26.1216 | -35.1670 | -35.5537 | -35.1228 | -29.4388 | -21.1973 | -12.0922 | -5.1989 | -3.0253 (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | |
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235d) |

| | |
|---|---|
| Annual totals kWh/year | |
| Space heating fuel - main system 1 | 1499.0979 (211) |
| Space heating fuel - main system 2 | 0.0000 (213) |
| Space heating fuel - secondary | 0.0000 (215) |
| Efficiency of water heater | 79.8000 |
| Water heating fuel used | 2467.2802 (219) |
| Space cooling fuel | 0.0000 (221) |
| Electricity for pumps and fans: | |
| Total electricity for the above, kWh/year | 86.0000 (231) |
| Electricity for lighting (calculated in Appendix L) | 136.2373 (232) |
| Energy saving/generation technologies (Appendices M ,N and Q) | |
| PV generation | -546.4705 (233) |
| Wind generation | 0.0000 (234) |
| Hydro-electric generation (Appendix N) | 0.0000 (235a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 (235) |
| Appendix Q - special features | |
| Energy saved or generated | -0.0000 (236) |
| Energy used | 0.0000 (237) |
| Total delivered energy for all uses | 3642.1449 (238) |

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 1499.0979 | 0.2100 | 314.8106 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2467.2802 | 0.2100 | 518.1289 | (264) |
| Space and water heating | | | 832.9394 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 136.2373 | 0.1443 | 19.6633 | (268) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -314.4173 | 0.1332 | -41.8940 | |
| PV Unit electricity exported | -232.0532 | 0.1252 | -29.0503 | |
| Total | | | -70.9443 | (269) |
| Total CO2, kg/year | | | 793.5876 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 14.3600 | (273) |

13a. Primary energy - Individual heating systems including micro-CHP

| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 1499.0979 | 1.1300 | 1693.9806 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2467.2802 | 1.1300 | 2788.0267 | (278) |
| Space and water heating | | | 4482.0073 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 136.2373 | 1.5338 | 208.9653 | (282) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -314.4173 | 1.4924 | -469.2262 | |
| PV Unit electricity exported | -232.0532 | 0.4595 | -106.6269 | |
| Total | | | -575.8532 | (283) |
| Total Primary energy kWh/year | | | 4245.2203 | (286) |
| Target Primary Energy Rate (TPER) | | | 76.7900 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Property Reference** | Unit 20 | **Issued on Date** | 17/05/2025 |
| **Assessment Reference** | 00001 | **Prop Type Ref** | Unit 20 |
| **Property** | | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 80 C | **DER** | 5.30 | **TER** | 13.33 |
| **Environmental** | 96 A | **% DER < TER** | | | 60.24 |
| **$CO_2$ Emissions (t/year)** | 0.28 | **DFEE** | 26.64 | **TFEE** | 29.09 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 8.41 |
| **% DPER < TPER** | 20.38 | **DPER** | 56.81 | **TPER** | 71.35 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Robert Arnold | **Assessor ID** | BA04-0001 |
| **Client** | | | |

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SAP 10 WORKSHEET FOR New Build (As Designed)  (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 56.2700 | (1b) | x 3.0000 | (2b) = | 168.8100 | (1b) - (3b) (4) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 56.2700 | | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | 168.8100 | (5) |

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2. Ventilation rate

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| | | m3 per hour | |
|---|---|---|---|
| Number of open chimneys | | 0 * 80 = | 0.0000 (6a) |
| Number of open flues | | 0 * 20 = | 0.0000 (6b) |
| Number of chimneys / flues attached to closed fire | | 0 * 10 = | 0.0000 (6c) |
| Number of flues attached to solid fuel boiler | | 0 * 20 = | 0.0000 (6d) |
| Number of flues attached to other heater | | 0 * 35 = | 0.0000 (6e) |
| Number of blocked chimneys | | 0 * 20 = | 0.0000 (6f) |
| Number of intermittent extract fans | | 0 * 10 = | 0.0000 (7a) |
| Number of passive vents | | 0 * 10 = | 0.0000 (7b) |
| Number of flueless gas fires | | 0 * 40 = | 0.0000 (7c) |

| | | Air changes per hour | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 0.0000 | / (5) = | 0.0000 (8) |
| Pressure test | | | Yes |
| Pressure Test Method | | | Blower Door |
| Measured/design AP50 | | | 3.0000 (17) |
| Infiltration rate | | | 0.1500 (18) |
| Number of sides sheltered | | | 0 (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] | = | 1.0000 (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) | = | 0.1500 (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.1912 | 0.1875 | 0.1837 | 0.1650 | 0.1612 | 0.1425 | 0.1425 | 0.1388 | 0.1500 | 0.1612 | 0.1687 | 0.1762 | (22b) |

Balanced mechanical ventilation with heat recovery

| | | |
|---|---|---|
| If mechanical ventilation | | 0.5000 (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | | 0.5000 (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | | 81.0000 (23c) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective ac | 0.2862 | 0.2825 | 0.2787 | 0.2600 | 0.2562 | 0.2375 | 0.2375 | 0.2337 | 0.2450 | 0.2562 | 0.2637 | 0.2712 | (25) |

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3. Heat losses and heat loss parameter

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| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| Windows | | | 6.1300 | 1.0536 | 6.4588 | | | (27) |
| Door | | | 1.8800 | 1.4000 | 2.6320 | | | (26) |
| Glass Door | | | 2.4000 | 1.3258 | 3.1818 | | | (27) |
| External Walls | 33.6900 | 10.4100 | 23.2800 | 0.1500 | 3.4920 | 150.0000 | 3492.0000 | (29a) |
| to Communal Corridor | 25.0100 | | 25.0100 | 0.1300 | 3.2513 | 150.0000 | 3751.5000 | (29a) |
| Total net area of external elements Aum(A, m2) | | | 58.7000 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 19.0159 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 20 | | | 15.1500 | 0.0000 | 0.0000 | 110.0000 | 1666.5000 | (32) |
| Party Wall to Unit 21 | | | 21.6800 | 0.0000 | 0.0000 | 110.0000 | 2384.8000 | (32) |
| Party Floor | | | 56.2700 | | | 80.0000 | 4501.6000 | (32d) |
| Party Ceiling | | | 56.2700 | | | 100.0000 | 5627.0000 | (32b) |
| Internal Walls | | | 85.4500 | | | 9.0000 | 769.0500 | (32c) |

| | | |
|---|---|---|
| Heat capacity Cm = Sum(A x k) | (28)...(30) + (32) + (32a)...(32e) = | 22192.4500 (34) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 394.3922 (35)

List of Thermal Bridges

| K1 Element | Length | Psi-value | Total |
|---|---|---|---|
| E1 Steel lintel with perforated steel base plate | 4.3200 | 0.0500 | 0.2160 |
| E3 Sill | 1.8100 | 0.0500 | 0.0905 |
| E4 Jamb | 12.0700 | 0.0500 | 0.6035 |
| E7 Party floor between dwellings (in blocks of flats) | 6.2700 | 0.0350 | 0.2195 |
| E18 Party wall between dwellings | 12.0000 | 0.0300 | 0.3600 |
| E7 Party floor between dwellings (in blocks of flats) | 8.3370 | 0.0350 | 0.2918 |
| E23 Balcony within or between dwellings, balcony support penetrates wall insulation | 6.8600 | 0.0200 | 0.1372 |
| E16 Corner (normal) | 9.0000 | 0.0900 | 0.8100 |
| E17 Corner (inverted - internal area greater than external area) | 3.0000 | -0.0900 | -0.2700 |
| E25 Staggered party wall between dwellings | 6.0000 | 0.0300 | 0.1800 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 2.6384 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 21.6544 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 15.9462 | 15.7373 | 15.5284 | 14.4839 | 14.2750 | 13.2305 | 13.2305 | 13.0216 | 13.6483 | 14.2750 | 14.6928 | 15.1106 | (38) |
| Heat transfer coeff | 37.6006 | 37.3917 | 37.1828 | 36.1383 | 35.9294 | 34.8849 | 34.8849 | 34.6760 | 35.3027 | 35.9294 | 36.3472 | 36.7650 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 36.0860 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 0.6682 | 0.6645 | 0.6608 | 0.6422 | 0.6385 | 0.6200 | 0.6200 | 0.6162 | 0.6274 | 0.6385 | 0.6459 | 0.6534 | (40) |
| HLP (average) | | | | | | | | | | | | 0.6413 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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4. Water heating energy requirements (kWh/year)

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Assumed occupancy 1.8745 (42)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hot water usage for mixer showers | 54.2422 | 53.4117 | 52.1879 | 50.3052 | 48.6183 | 46.2584 | 44.3919 | 46.5740 | 47.6715 | 50.0088 | 52.4430 | 54.1932 | (42a) |
| Hot water usage for baths | 23.5175 | 23.1625 | 22.6575 | 21.9011 | 21.2195 | 20.2812 | 19.5693 | 20.4398 | 20.8967 | 21.8264 | 22.7930 | 23.4989 | (42b) |
| Hot water usage for other uses | 33.8264 | 32.5963 | 31.3663 | 30.1362 | 28.9062 | 27.6761 | 27.6761 | 28.9062 | 30.1362 | 31.3663 | 32.5963 | 33.8264 | (42c) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 102.5646 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 111.5860 | 109.1705 | 106.2116 | 102.3425 | 98.7440 | 94.2157 | 91.6373 | 95.9200 | 98.7043 | 103.2015 | 107.8324 | 111.5185 | (44) |
| Energy conte | 164.2739 | 144.4547 | 151.7742 | 133.6849 | 127.2416 | 108.9573 | 101.2619 | 112.8995 | 114.4921 | 132.9856 | 145.7390 | 163.7731 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1601.5380 | |
| Distribution loss (46)m = 0.15 x (45)m | 24.6411 | 21.6682 | 22.7661 | 20.0527 | 19.0862 | 16.3436 | 15.1893 | 16.9349 | 17.1738 | 19.9478 | 21.8609 | 24.5660 | (46) |
| Water storage loss: | | | | | | | | | | | | | |
| Store volume | | | | | | | | | | | | 110.0000 | (47) |
| b) If manufacturer declared loss factor is not known : | | | | | | | | | | | | | |
| Hot water storage loss factor from Table 2 (kWh/litre/day) | | | | | | | | | | | | 0.0152 | (51) |
| Volume factor from Table 2a | | | | | | | | | | | | 1.0294 | (52) |
| Temperature factor from Table 2b | | | | | | | | | | | | 0.6000 | (53) |
| Enter (49) or (54) in (55) | | | | | | | | | | | | 1.0327 | (55) |
| Total storage loss | 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (56) |
| If cylinder contains dedicated solar storage | 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (57) |
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | 219.5507 | 194.3821 | 207.0510 | 187.1786 | 182.5184 | 162.4510 | 156.5387 | 168.1763 | 167.9858 | 188.2624 | 199.2327 | 219.0499 | (62) |
| WWHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | 219.5507 | 194.3821 | 207.0510 | 187.1786 | 182.5184 | 162.4510 | 156.5387 | 168.1763 | 167.9858 | 188.2624 | 199.2327 | 219.0499 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2252.3777 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2252 | (64) |
| Electric shower(s) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | 98.8425 | 87.9731 | 94.6864 | 87.2452 | 86.5293 | 79.0233 | 77.8910 | 81.7605 | 80.8636 | 88.4391 | 91.2532 | 98.6760 | (65) |

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5. Internal gains (see Table 5 and 5a)

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Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 93.7231 | 93.7231 | 93.7231 | 93.7231 | 93.7231 | 93.7231 | 93.7231 | 93.7231 | 93.7231 | 93.7231 | 93.7231 | 93.7231 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 86.9582 | 96.2752 | 86.9582 | 89.8568 | 86.9582 | 89.8568 | 86.9582 | 86.9582 | 89.8568 | 86.9582 | 89.8568 | 86.9582 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 163.4519 | 165.1480 | 160.8739 | 151.7747 | 140.2886 | 129.4933 | 122.2813 | 120.5852 | 124.8594 | 133.9586 | 145.4447 | 156.2400 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 32.3723 | 32.3723 | 32.3723 | 32.3723 | 32.3723 | 32.3723 | 32.3723 | 32.3723 | 32.3723 | 32.3723 | 32.3723 | 32.3723 | (69) |
| Pumps, fans | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | -74.9785 | -74.9785 | -74.9785 | -74.9785 | -74.9785 | -74.9785 | -74.9785 | -74.9785 | -74.9785 | -74.9785 | -74.9785 | -74.9785 | (71) |
| Water heating gains (Table 5) | 132.8529 | 130.9124 | 127.2666 | 121.1739 | 116.3028 | 109.7545 | 104.6923 | 109.8932 | 112.3105 | 118.8698 | 126.7405 | 132.6290 | (72) |
| Total internal gains | 434.3799 | 443.4526 | 426.2157 | 413.9223 | 394.6666 | 380.2216 | 365.0488 | 368.5536 | 378.1437 | 390.9036 | 413.1590 | 426.9442 | (73) |

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6. Solar gains

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| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W |
|---|---|---|---|---|---|---|

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southwest | | | 6.1300 | | 36.7938 | | 0.4500 | | 0.7000 | | 0.7700 | | 49.2356 (79) |
| Southwest | | | 2.4000 | | 36.7938 | | 0.4500 | | 0.7000 | | 0.7700 | | 19.2766 (79) |
| Solar gains | 68.5122 | 116.7016 | 159.6762 | 197.8466 | 221.6047 | 220.0021 | 212.1055 | 194.3809 | 172.8956 | 128.9801 | 82.0618 | 58.6322 | (83) |
| Total gains | 502.8921 | 560.1542 | 585.8919 | 611.7689 | 616.2712 | 600.2237 | 577.1543 | 562.9345 | 551.0393 | 519.8837 | 495.2208 | 485.5763 | (84) |

## 7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 163.9487 | 164.8647 | 165.7910 | 170.5828 | 171.5747 | 176.7119 | 176.7119 | 177.7765 | 174.6205 | 171.5747 | 169.6024 | 167.6750 | |
| alpha | 11.9299 | 11.9910 | 12.0527 | 12.3722 | 12.4383 | 12.7808 | 12.7808 | 12.8518 | 12.6414 | 12.4383 | 12.3068 | 12.1783 | |
| util living area | 0.9851 | 0.9518 | 0.8795 | 0.7115 | 0.5421 | 0.3720 | 0.2659 | 0.2834 | 0.4420 | 0.7154 | 0.9337 | 0.9881 | (86) |
| MIT | 20.8155 | 20.9041 | 20.9668 | 20.9972 | 20.9999 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 20.9976 | 20.9402 | 20.8078 | (87) |
| Th 2 | 20.3690 | 20.3723 | 20.3756 | 20.3921 | 20.3955 | 20.4121 | 20.4121 | 20.4154 | 20.4054 | 20.3955 | 20.3888 | 20.3822 | (88) |
| util rest of house | 0.9793 | 0.9370 | 0.8526 | 0.6770 | 0.5069 | 0.3378 | 0.2304 | 0.2473 | 0.4040 | 0.6753 | 0.9128 | 0.9834 | (89) |
| MIT 2 | 20.1695 | 20.2764 | 20.3462 | 20.3901 | 20.3954 | 20.4121 | 20.4121 | 20.4154 | 20.4054 | 20.3939 | 20.3333 | 20.1721 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.6437 | (91) |
| MIT | 20.5853 | 20.6805 | 20.7457 | 20.7809 | 20.7845 | 20.7905 | 20.7905 | 20.7917 | 20.7881 | 20.7824 | 20.7240 | 20.5812 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 20.5853 | 20.6805 | 20.7457 | 20.7809 | 20.7845 | 20.7905 | 20.7905 | 20.7917 | 20.7881 | 20.7824 | 20.7240 | 20.5812 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9815 | 0.9447 | 0.8689 | 0.6992 | 0.5295 | 0.3598 | 0.2533 | 0.2705 | 0.4285 | 0.7011 | 0.9248 | 0.9851 | (94) |
| Useful gains | 493.5825 | 529.1755 | 509.1020 | 427.7392 | 326.3438 | 215.9548 | 146.1854 | 152.2863 | 236.1060 | 364.4662 | 457.9925 | 478.3201 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | 612.3381 | 590.0583 | 529.6935 | 429.3559 | 326.4004 | 215.9551 | 146.1854 | 152.2863 | 236.1090 | 365.8489 | 495.1933 | 602.2561 | (97) |
| Space heating kWh | 88.3542 | 40.9132 | 15.3201 | 1.1641 | 0.0421 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 1.0288 | 26.7846 | 92.2084 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 265.8154 | |
| Solar heating kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | 88.3542 | 40.9132 | 15.3201 | 1.1641 | 0.0421 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 1.0288 | 26.7846 | 92.2084 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 265.8154 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 4.7239 | (99) |

## 8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ext. temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | |
| Heat loss rate W | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 327.9177 | 258.1480 | 263.5373 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (100) |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.9999 | 1.0000 | 1.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (101) |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 327.8929 | 258.1462 | 263.5343 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (102) |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 652.5076 | 627.9930 | 612.1237 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 233.7226 | 275.1660 | 259.3505 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (104) |
| Cooled fraction | | | | | | | | | | fC = cooled area / (4) = | | 0.9952 | (105) |
| Intermittency factor (Table 10b) | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | (106) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 58.1503 | 68.4614 | 64.5265 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) |
| Space cooling requirement | | | | | | | | | | | | 191.1382 | (107) |

## 9b. Energy requirements

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | 0.0000 | (301) |
| Fraction of space heat from community system | | | | | | | | | | | | 1.0000 | (302) |
| Fraction of heat from community Heat pump-Space and Water | | | | | | | | | | | | 1.0000 | (303a) |
| Factor for control and charging method (Table 4c(3)) for space heating | | | | | | | | | | | | 1.0000 | (305) |
| Factor for charging method (Table 4c(3)) for water heating | | | | | | | | | | | | 1.0000 | (305a) |
| Distribution loss factor (Table 12c) for community heating system | | | | | | | | | | | | 2.0000 | (306) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 | (208) |
| Space heating: | | | | | | | | | | | | | |
| Space heating requirement | | | | | | | | | | | | | |
| | 88.3542 | 40.9132 | 15.3201 | 1.1641 | 0.0421 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 1.0288 | 26.7846 | 92.2084 | (98) |
| Space heat from Heat pump = (98) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 307a | 176.7083 | 81.8265 | 30.6401 | 2.3281 | 0.0843 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 2.0576 | 53.5691 | 184.4168 | |
| Space heating requirement | | | | | | | | | | | | | |
| | 176.7083 | 81.8265 | 30.6401 | 2.3281 | 0.0843 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 2.0576 | 53.5691 | 184.4168 | (307) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | | | | | | | | | | | 0.0000 | (308) |
| Space heating fuel for secondary/supplementary system | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (309) |
| Water heating | | | | | | | | | | | | | |
| Annual water heating requirement | | | | | | | | | | | | | |
| | 219.5507 | 194.3821 | 207.0510 | 187.1786 | 182.5184 | 162.4510 | 156.5387 | 168.1763 | 167.9858 | 188.2624 | 199.2327 | 219.0499 | (64) |
| Water heat from Heat pump = (64) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 310a | 439.1015 | 388.7643 | 414.1020 | 374.3572 | 365.0369 | 324.9021 | 313.0775 | 336.3527 | 335.9716 | 376.5248 | 398.4654 | 438.0997 | |
| Water heating fuel | | | | | | | | | | | | | |
| | 439.1015 | 388.7643 | 414.1020 | 374.3572 | 365.0369 | 324.9021 | 313.0775 | 336.3527 | 335.9716 | 376.5248 | 398.4654 | 438.0997 | (310) |
| Cooling System Energy Efficiency Ratio | | | | | | | | | | | | 2.6000 | (314) |
| Space coolin | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 22.3655 | 26.3313 | 24.8179 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (315) |
| Pumps and Fa | 15.4275 | 13.9345 | 15.4275 | 14.9298 | 15.4275 | 14.9298 | 15.4275 | 15.4275 | 14.9298 | 15.4275 | 14.9298 | 15.4275 | (331) |
| Lighting | 17.0535 | 13.6809 | 12.3181 | 9.0248 | 6.9710 | 5.6954 | 6.3592 | 8.2659 | 10.7366 | 14.0870 | 15.9113 | 17.5274 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333a)m | -4.7306 | -7.6443 | -12.6692 | -16.3728 | -19.5340 | -18.9499 | -18.6837 | -16.6292 | -13.3788 | -9.5313 | -5.5122 | -3.9726 | (333a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (334a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335a) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (333b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335b) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - community heating | 531.6309 | (307) |
| Space heating fuel - secondary | 0.0000 | (309) |
| Water heating fuel - community heating | 4504.7555 | (310) |
| Efficiency of water heater | 0.0000 | (311) |
| Electricity used for heat distribution | 5.3163 | (313) |
| Space cooling fuel | 73.5147 | (321) |
| | | |
| Electricity for pumps and fans: | | |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8820) | | |
| mechanical ventilation fans (SFP = 0.8820) | 181.6463 | (330a) |
| Total electricity for the above, kWh/year | 181.6463 | (331) |
| Electricity for lighting (calculated in Appendix L) | 137.6312 | (332) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -147.6085 | (333) |
| Wind generation | 0.0000 | (334) |
| Hydro-electric generation (Appendix N) | 0.0000 | (335a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (335) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (336) |
| Energy used | 0.0000 | (337) |
| Total delivered energy for all uses | 5281.5700 | (338) |

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12b. Carbon dioxide emissions - Community heating scheme

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (367) |
| Space and Water heating from Heat pump | 1798.7094 | 0.1606 | 30.4844 | (367) |
| Electrical energy for heat distribution (space & water) | 5.3163 | 0.0000 | 7.1939 | (372) |
| Overall CO2 factor for heat network | | | 0.0524 | (386) |
| Total CO2 associated with community systems | | | 264.1202 | (373) |
| Space and water heating | | | 264.1202 | (376) |
| Space cooling | 73.5147 | 0.1141 | 8.3862 | (377) |
| Pumps, fans and electric keep-hot | 181.6463 | 0.1387 | 25.1966 | (378) |
| Energy for lighting | 137.6312 | 0.1443 | 19.8644 | (379) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -147.6085 | 0.1319 | -19.4710 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -19.4710 | (380) |
| Total CO2, kg/year | | | 298.0964 | (383) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 5.3000 | (384) |

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13b. Primary energy - Community heating scheme

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| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (467a) |
| Space and Water heating from Heat pump | 1798.7094 | 1.5942 | 302.6883 | (467) |
| Electrical energy for heat distribution (space & water) | 5.3163 | 0.0000 | 76.9668 | (472) |
| Overall CO2 factor for heat network | | | 0.5611 | (486) |
| Total CO2 associated with community systems | | | 2825.7826 | (473) |
| Space and water heating | | | 2825.7826 | (476) |
| Space cooling | 73.5147 | 1.4204 | 104.4235 | (477) |
| Pumps, fans and electric keep-hot | 181.6463 | 1.5128 | 274.7945 | (478) |
| Energy for lighting | 137.6312 | 1.5338 | 211.1033 | (479) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -147.6085 | 1.4874 | -219.5473 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -219.5473 | (480) |
| Total Primary energy kWh/year | | | 3196.5566 | (483) |
| Dwelling Primary energy Rate (DPER) | | | 56.8100 | (484) |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

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| | | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | |
| Ground floor | | 56.2700 | (1b) | x 3.0000 | (2b) = | 168.8100 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 56.2700 | | | | | | (4) |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | | 168.8100 | (5) |

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2. Ventilation rate

---

m3 per hour

| | | |
|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 (6a) |
| Number of open flues | 0 * 20 = | 0.0000 (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 (6f) |
| Number of intermittent extract fans | 2 * 10 = | 20.0000 (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 (7c) |

| | | Air changes per hour | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 20.0000 / (5) = | 0.1185 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3685 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.3685 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.4698 | 0.4606 | 0.4514 | 0.4053 | 0.3961 | 0.3501 | 0.3501 | 0.3408 | 0.3685 | 0.3961 | 0.4145 | 0.4330 | (22b) |
| Effective ac | 0.6104 | 0.6061 | 0.6019 | 0.5821 | 0.5785 | 0.5613 | 0.5613 | 0.5581 | 0.5679 | 0.5785 | 0.5859 | 0.5937 | (25) |

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## 3. Heat losses and heat loss parameter

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| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| TER Opaque door | | | 1.8800 | 1.0000 | 1.8800 | | | (26) |
| TER Opening Type | | | 8.5300 | 1.1450 | 9.7672 | | | (27) |
| External Walls | 33.6900 | 10.4100 | 23.2800 | 0.1800 | 4.1904 | | | (29a) |
| to Communal Corridor | 25.0100 | | 25.0100 | 0.1800 | 4.5018 | | | (29a) |
| Total net area of external elements Aum(A, m2) | | | 58.7000 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 20.3394 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 20 | | | 15.1500 | 0.0000 | 0.0000 | | | (32) |
| Party Wall to Unit 21 | | | 21.6800 | 0.0000 | 0.0000 | | | (32) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 374.3922 (35)

List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E1 Steel lintel with perforated steel base plate | 4.3200 | 0.0500 | 0.2160 |
| E3 Sill | 1.8100 | 0.0500 | 0.0905 |
| E4 Jamb | 12.0700 | 0.0500 | 0.6035 |
| E7 Party floor between dwellings (in blocks of flats) | 6.2700 | 0.0700 | 0.4389 |
| E18 Party wall between dwellings | 12.0000 | 0.0600 | 0.7200 |
| E7 Party floor between dwellings (in blocks of flats) | 8.3370 | 0.0700 | 0.5836 |
| E23 Balcony within or between dwellings, balcony support penetrates wall insulation | 6.8600 | 0.0200 | 0.1372 |
| E16 Corner (normal) | 9.0000 | 0.0900 | 0.8100 |
| E17 Corner (inverted - internal area greater than external area) | 3.0000 | -0.0900 | -0.2700 |
| E25 Staggered party wall between dwellings | 6.0000 | 0.0600 | 0.3600 |

| | | |
|---|---|---|
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | 3.6897 (36) |
| Point Thermal bridges | (36a) = | 0.0000 |
| Total fabric heat loss | (33) + (36) + (36a) = | 24.0291 (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 34.0015 | 33.7628 | 33.5288 | 32.4297 | 32.2240 | 31.2667 | 31.2667 | 31.0895 | 31.6355 | 32.2240 | 32.6400 | 33.0749 | (38) |
| Heat transfer coeff | 58.0305 | 57.7918 | 57.5578 | 56.4587 | 56.2531 | 55.2958 | 55.2958 | 55.1185 | 55.6645 | 56.2531 | 56.6691 | 57.1040 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 56.4577 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.0313 | 1.0270 | 1.0229 | 1.0034 | 0.9997 | 0.9827 | 0.9827 | 0.9795 | 0.9892 | 0.9997 | 1.0071 | 1.0148 | (40) |
| HLP (average) | | | | | | | | | | | | 1.0033 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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## 4. Water heating energy requirements (kWh/year)

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| | | |
|---|---|---|
| Assumed occupancy | | 1.8745 (42) |

Hot water usage for mixer showers

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 55.6481 | 54.8118 | 53.5932 | 51.2616 | 49.5409 | 47.6220 | 46.5313 | 47.7407 | 49.0664 | 51.1267 | 53.5084 | 55.4349 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 24.0537 | 23.6965 | 23.1934 | 22.2659 | 21.5714 | 20.8012 | 20.3852 | 20.8848 | 21.4287 | 22.2528 | 23.1994 | 23.9724 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 33.8264 | 32.5963 | 31.3663 | 30.1362 | 28.9062 | 27.6761 | 27.6761 | 28.9062 | 30.1362 | 31.3663 | 32.5963 | 33.8264 | (42c) |

| | | |
|---|---|---|
| Average daily hot water use (litres/day) | | 104.3585 (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 113.5282 | 111.1046 | 108.1529 | 103.6637 | 100.0184 | 96.0993 | 94.5927 | 97.5317 | 100.6313 | 104.7458 | 109.3042 | 113.2337 | (44) |
| Energy conte | 179.8009 | 158.2115 | 166.2270 | 141.9104 | 134.6440 | 118.1654 | 114.4016 | 120.7646 | 124.0885 | 142.1390 | 155.7238 | 177.2966 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1733.3732 | |
| Distribution loss (46)m = 0.15 x (45)m | 26.9701 | 23.7317 | 24.9340 | 21.2866 | 20.1966 | 17.7248 | 17.1602 | 18.1147 | 18.6133 | 21.3209 | 23.3586 | 26.5945 | (46) |

| | | |
|---|---|---|
| Water storage loss: | | |
| Store volume | | 150.0000 (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | | 1.3938 (48) |
| Temperature factor from Table 2b | | 0.5400 (49) |
| Enter (49) or (54) in (55) | | 0.7527 (55) |

Total storage loss

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (56) |

If cylinder contains dedicated solar storage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (57) |
| Primary loss 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |

Total heat required for water heating calculated for each month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 226.3958 | 200.2972 | 212.8219 | 187.0022 | 181.2389 | 163.2572 | 160.9965 | 167.3595 | 169.1804 | 188.7339 | 200.8157 | 223.8915 | (62) |
| WWHRS -25.4400 | -22.4993 | -23.5600 | -19.5086 | -18.1813 | -15.5579 | -14.5830 | -15.5076 | -16.0968 | -18.9763 | -21.4979 | -24.9689 | (63a) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | | | | | | | | | | | | | |
| | 200.9558 | 177.7979 | 189.2619 | 167.4936 | 163.0576 | 147.6993 | 146.4135 | 151.8519 | 153.0836 | 169.7576 | 179.3178 | 198.9226 | (64) |
| | | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | 2045.6129 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2046 | (64) |
| Electric shower(s) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | | | | | | | | | | | | | |
| | 97.0597 | 86.2739 | 92.5464 | 83.2587 | 82.0451 | 75.3635 | 75.3145 | 77.4301 | 77.3329 | 84.5371 | 87.8516 | 96.2270 | (65) |

## 5. Internal gains (see Table 5 and 5a)

| Metabolic gains (Table 5), Watts | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 93.7231 | 93.7231 | 93.7231 | 93.7231 | 93.7231 | 93.7231 | 93.7231 | 93.7231 | 93.7231 | 93.7231 | 93.7231 | 93.7231 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 86.9582 | 96.2752 | 86.9582 | 89.8568 | 86.9582 | 89.8568 | 86.9582 | 86.9582 | 89.8568 | 86.9582 | 89.8568 | 86.9582 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 163.4519 | 165.1480 | 160.8739 | 151.7747 | 140.2886 | 129.4933 | 122.2813 | 120.5852 | 124.8594 | 133.9586 | 145.4447 | 156.2400 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 32.3723 | 32.3723 | 32.3723 | 32.3723 | 32.3723 | 32.3723 | 32.3723 | 32.3723 | 32.3723 | 32.3723 | 32.3723 | 32.3723 | (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.0000 | 3.0000 | 3.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | | | | | | | | | | | | | |
| | -74.9785 | -74.9785 | -74.9785 | -74.9785 | -74.9785 | -74.9785 | -74.9785 | -74.9785 | -74.9785 | -74.9785 | -74.9785 | -74.9785 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 130.4566 | 128.3838 | 124.3903 | 115.6371 | 110.2756 | 104.6715 | 101.2291 | 104.0728 | 107.4068 | 113.6252 | 122.0162 | 129.3374 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 434.9837 | 443.9239 | 426.3394 | 411.3855 | 391.6394 | 375.1385 | 361.5856 | 362.7332 | 373.2400 | 388.6589 | 411.4346 | 426.6526 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Southwest | 8.5300 | 36.7938 | 0.6300 | 0.7000 | 0.7700 | 95.9171 | (79) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 95.9171 | 163.3823 | 223.5467 | 276.9852 | 310.2465 | 308.0030 | 296.9478 | 272.1333 | 242.0538 | 180.5722 | 114.8865 | 82.0850 | (83) |
| Total gains | 530.9008 | 607.3062 | 649.8861 | 688.3707 | 701.8859 | 683.1415 | 658.5334 | 634.8665 | 615.2938 | 569.2311 | 526.3212 | 508.7376 | (84) |

## 7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, ni1,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 100.8427 | 101.2593 | 101.6710 | 103.6502 | 104.0291 | 105.8300 | 105.8300 | 106.1704 | 105.1290 | 104.0291 | 103.2654 | 102.4790 | |
| alpha | 7.7228 | 7.7506 | 7.7781 | 7.9100 | 7.9353 | 8.0553 | 8.0553 | 8.0780 | 8.0086 | 7.9353 | 7.8844 | 7.8319 | |
| util living area | | | | | | | | | | | | | |
| | 0.9956 | 0.9870 | 0.9644 | 0.8844 | 0.7255 | 0.5168 | 0.3694 | 0.3992 | 0.6188 | 0.8999 | 0.9858 | 0.9967 | (86) |
| MIT | 20.3882 | 20.5400 | 20.7110 | 20.8963 | 20.9806 | 20.9988 | 20.9999 | 20.9999 | 20.9953 | 20.8985 | 20.6254 | 20.3705 | (87) |
| Th 2 | 20.0573 | 20.0609 | 20.0643 | 20.0805 | 20.0836 | 20.0978 | 20.0978 | 20.1004 | 20.0923 | 20.0836 | 20.0774 | 20.0710 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9936 | 0.9813 | 0.9497 | 0.8457 | 0.6622 | 0.4446 | 0.2937 | 0.3212 | 0.5403 | 0.8572 | 0.9786 | 0.9952 | (89) |
| MIT 2 | 19.3679 | 19.5612 | 19.7726 | 19.9928 | 20.0714 | 20.0973 | 20.0978 | 20.1004 | 20.0903 | 20.0021 | 19.6834 | 19.3566 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.6437 | (91) |
| MIT | 20.0246 | 20.1912 | 20.3766 | 20.5744 | 20.6566 | 20.6776 | 20.6785 | 20.6794 | 20.6728 | 20.5791 | 20.2898 | 20.0092 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 20.0246 | 20.1912 | 20.3766 | 20.5744 | 20.6566 | 20.6776 | 20.6785 | 20.6794 | 20.6728 | 20.5791 | 20.2898 | 20.0092 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9936 | 0.9822 | 0.9552 | 0.8676 | 0.7024 | 0.4911 | 0.3424 | 0.3715 | 0.5908 | 0.8818 | 0.9805 | 0.9951 | (94) |
| Useful gains | 527.4836 | 596.5248 | 620.7660 | 597.1995 | 493.0390 | 335.5016 | 225.4962 | 235.8229 | 363.5438 | 501.9465 | 516.0656 | 506.2350 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | | | | | | | | | | | | | |
| | 912.5099 | 883.7076 | 798.7096 | 659.1193 | 503.8374 | 336.0657 | 225.5226 | 235.8727 | 365.8733 | 561.3537 | 747.4518 | 902.7704 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 286.4596 | 192.9869 | 132.3900 | 44.5822 | 8.0341 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 44.1990 | 166.5981 | 295.0223 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 1170.2722 | |
| Solar heating kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | | | | | | | | | | | | | |
| | 286.4596 | 192.9869 | 132.3900 | 44.5822 | 8.0341 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 44.1990 | 166.5981 | 295.0223 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 1170.2722 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 20.7974 | (99) |

## 9a. Energy requirements - Individual heating systems, including micro-CHP

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | 0.0000 | (201) |
| Fraction of space heat from main system(s) | | | | | | | | | | | | 1.0000 | (202) |
| Efficiency of main space heating system 1 (in %) | | | | | | | | | | | | 92.3000 | (206) |
| Efficiency of main space heating system 2 (in %) | | | | | | | | | | | | 0.0000 | (207) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 | (208) |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| Space heating requirement | | | | | | | | | | | | | |
| | 286.4596 | 192.9869 | 132.3900 | 44.5822 | 8.0341 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 44.1990 | 166.5981 | 295.0223 | (98) |
| Space heating efficiency (main heating system 1) | | | | | | | | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.3000 | 92.3000 | 92.3000 (210) |
| Space heating fuel (main heating system) | | | | | | | | | | | | |
| | 310.3571 | 209.0865 | 143.4344 | 48.3014 | 8.7043 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 47.8862 | 180.4963 | 319.6342 (211) |
| Space heating efficiency (main heating system 2) | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (212) |
| Space heating fuel (main heating system 2) | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (213) |
| Space heating fuel (secondary) | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (215) |
| Water heating | | | | | | | | | | | | |
| Water heating requirement | | | | | | | | | | | | |
| | 200.9558 | 177.7979 | 189.2619 | 167.4936 | 163.0576 | 147.6993 | 146.4135 | 151.8519 | 153.0836 | 169.7576 | 179.3178 | 198.9226 (64) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 (216) |
| (217)m | 84.8544 | 84.2440 | 83.2738 | 81.5372 | 80.1816 | 79.8000 | 79.8000 | 79.8000 | 79.8000 | 81.5065 | 83.8951 | 84.9420 (217) |
| Fuel for water heating, kWh/month | | | | | | | | | | | | |
| | 236.8243 | 211.0511 | 227.2766 | 205.4198 | 203.3603 | 185.0868 | 183.4755 | 190.2906 | 191.8340 | 208.2749 | 213.7404 | 234.1865 (219) |
| Space cooling fuel requirement | | | | | | | | | | | | |
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (221) |
| Pumps and Fa | 7.3041 | 6.5973 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 (231) |
| Lighting | 18.0682 | 14.4950 | 13.0511 | 9.5618 | 7.3858 | 6.0343 | 6.7376 | 8.7578 | 11.3755 | 14.9253 | 16.8580 | 18.5704 (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (233a)m | -12.5627 | -18.8899 | -28.9400 | -34.7571 | -39.4635 | -37.5804 | -37.1385 | -34.0762 | -29.0248 | -22.5657 | -14.2283 | -10.7292 (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | |
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (233b)m | -3.9154 | -8.4691 | -17.2734 | -26.6000 | -35.8184 | -36.2159 | -35.7749 | -29.9791 | -21.5798 | -12.3068 | -5.2901 | -3.0782 (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | |
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235d) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - main system 1 | 1267.9005 | (211) |
| Space heating fuel - main system 2 | 0.0000 | (213) |
| Space heating fuel - secondary | 0.0000 | (215) |
| Efficiency of water heater | 79.8000 | |
| Water heating fuel used | 2490.8209 | (219) |
| Space cooling fuel | 0.0000 | (221) |
| Electricity for pumps and fans: | | |
| Total electricity for the above, kWh/year | 86.0000 | (231) |
| Electricity for lighting (calculated in Appendix L) | 145.8208 | (232) |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -556.2571 | (233) |
| Wind generation | 0.0000 | (234) |
| Hydro-electric generation (Appendix N) | 0.0000 | (235a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (235) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (236) |
| Energy used | 0.0000 | (237) |
| Total delivered energy for all uses | 3434.2850 | (238) |

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 1267.9005 | 0.2100 | 266.2591 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2490.8209 | 0.2100 | 523.0724 | (264) |
| Space and water heating | | | 789.3315 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 145.8208 | 0.1443 | 21.0464 | (268) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -319.9562 | 0.1332 | -42.6332 | |
| PV Unit electricity exported | -236.3009 | 0.1252 | -29.5805 | |
| Total | | | -72.2137 | (269) |
| Total CO2, kg/year | | | 750.0935 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 13.3300 | (273) |

13a. Primary energy - Individual heating systems including micro-CHP

| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 1267.9005 | 1.1300 | 1432.7276 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2490.8209 | 1.1300 | 2814.6276 | (278) |
| Space and water heating | | | 4247.3552 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 145.8208 | 1.5338 | 223.6648 | (282) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -319.9562 | 1.4924 | -477.4968 | |
| PV Unit electricity exported | -236.3009 | 0.4595 | -108.5729 | |
| Total | | | -586.0697 | (283) |
| Total Primary energy kWh/year | | | 4015.0511 | (286) |
| Target Primary Energy Rate (TPER) | | | 71.3500 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Property Reference** | Unit 21 | **Issued on Date** | 17/05/2025 |
| **Assessment Reference** | 00001 | **Prop Type Ref** | Unit 21 |
| **Property** | | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 77 C | **DER** | 6.12 | **TER** | 14.78 |
| **Environmental** | 95 A | **% DER < TER** | | | 58.59 |
| **$CO_2$ Emissions (t/year)** | 0.4 | **DFEE** | 40.35 | **TFEE** | 42.55 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 5.17 |
| **% DPER < TPER** | 18.03 | **DPER** | 64.59 | **TPER** | 78.79 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Robert Arnold | **Assessor ID** | BA04-0001 |
| **Client** | | | |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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## 1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 74.8700 | (1b) | x 3.0000 | (2b) = | 224.6100 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 74.8700 | | | | | (4) |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | 224.6100 | (5) |

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## 2. Ventilation rate

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| | | m3 per hour | |
|---|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 | (6a) |
| Number of open flues | 0 * 20 = | 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | 0 * 10 = | 0.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |

| | Air changes per hour | | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 0.0000 / (5) = | 0.0000 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 3.0000 | (17) |
| Infiltration rate | | 0.1500 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.1500 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.1912 | 0.1875 | 0.1837 | 0.1650 | 0.1612 | 0.1425 | 0.1425 | 0.1388 | 0.1500 | 0.1612 | 0.1687 | 0.1762 | (22b) |

Balanced mechanical ventilation with heat recovery

| | | |
|---|---|---|
| If mechanical ventilation | | 0.5000 (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | | 0.5000 (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | | 81.0000 (23c) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective ac | 0.2862 | 0.2825 | 0.2787 | 0.2600 | 0.2562 | 0.2375 | 0.2375 | 0.2337 | 0.2450 | 0.2562 | 0.2637 | 0.2712 | (25) |

---

## 3. Heat losses and heat loss parameter

---

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| Windows | | | 12.2900 | 1.0536 | 12.9492 | | | (27) |
| Front Door | | | 1.8900 | 1.4000 | 2.6460 | | | (26) |
| Glass Door | | | 4.6900 | 1.3258 | 6.2178 | | | (27) |
| External Walls | 60.4400 | 16.9800 | 43.4600 | 0.1500 | 6.5190 | 150.0000 | 6519.0000 | (29a) |
| to Communal Corridor | 5.0100 | 1.8900 | 3.1200 | 0.1300 | 0.4056 | 150.0000 | 468.0000 | (29a) |
| External Roof | 29.8600 | | 29.8600 | 0.1000 | 2.9860 | 9.0000 | 268.7400 | (30) |
| Total net area of external elements Aum(A, m2) | | | 95.3100 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 31.7236 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to unit 20 | | | 21.6800 | 0.0000 | 0.0000 | 110.0000 | 2384.8000 | (32) |
| Party Wall to Unit 22 | | | 22.5700 | 0.0000 | 0.0000 | 110.0000 | 2482.7000 | (32) |
| Party Floor | | | 74.8700 | | | 80.0000 | 5989.6000 | (32d) |
| Party Ceiling | | | 45.0100 | | | 100.0000 | 4501.0000 | (32b) |
| Internal Walls | | | 182.4600 | | | 9.0000 | 1642.1400 | (32c) |

| | | | |
|---|---|---|---|
| Heat capacity Cm = Sum(A x k) | (28)...(30) + (32) + (32a)...(32e) = | 24255.9800 | (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | | 323.9746 | (35) |

List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E1 Steel lintel with perforated steel base plate | 8.8500 | 0.0500 | 0.4425 |
| E3 Sill | 1.8100 | 0.0500 | 0.0905 |
| E4 Jamb | 25.6300 | 0.0500 | 1.2815 |
| E7 Party floor between dwellings (in blocks of flats) | 14.5200 | 0.0350 | 0.5082 |
| E16 Corner (normal) | 9.0000 | 0.0900 | 0.8100 |
| E7 Party floor between dwellings (in blocks of flats) | 1.6700 | 0.0350 | 0.0585 |
| E15 Flat roof with parapet | 20.1400 | 0.5600 | 11.2784 |
| E17 Corner (inverted - internal area greater than external area) | 6.0000 | -0.0900 | -0.5400 |
| E18 Party wall between dwellings | 3.0000 | 0.0300 | 0.0900 |
| E25 Staggered party wall between dwellings | 3.0000 | 0.0300 | 0.0900 |
| E24 Eaves (insulation at ceiling level - inverted) | 22.7625 | 0.1200 | 2.7315 |

| | | | |
|---|---|---|---|
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | 16.8411 | (36) |
| Point Thermal bridges | (36a) = | 0.0000 | |
| Total fabric heat loss | (33) + (36) + (36a) = | 48.5647 | (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 21.2172 | 20.9393 | 20.6613 | 19.2715 | 18.9936 | 17.6038 | 17.6038 | 17.3259 | 18.1597 | 18.9936 | 19.5495 | 20.1054 | (38) |
| Heat transfer coeff | 69.7819 | 69.5040 | 69.2260 | 67.8362 | 67.5583 | 66.1685 | 66.1685 | 65.8905 | 66.7244 | 67.5583 | 68.1142 | 68.6701 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 67.7667 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 0.9320 | 0.9283 | 0.9246 | 0.9061 | 0.9023 | 0.8838 | 0.8838 | 0.8801 | 0.8912 | 0.9023 | 0.9098 | 0.9172 | (40) |
| HLP (average) | | | | | | | | | | | | 0.9051 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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4. Water heating energy requirements (kWh/year)

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| | | | |
|---|---|---|---|
| Assumed occupancy | | 2.3583 | (42) |

Hot water usage for mixer showers

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 62.1503 | 61.1987 | 59.7965 | 57.6393 | 55.7065 | 53.0026 | 50.8639 | 53.3641 | 54.6216 | 57.2998 | 60.0888 | 62.0942 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 26.9286 | 26.5221 | 25.9438 | 25.0778 | 24.2973 | 23.2229 | 22.4077 | 23.4045 | 23.9276 | 24.9922 | 26.0991 | 26.9073 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 38.7817 | 37.3714 | 35.9612 | 34.5510 | 33.1407 | 31.7305 | 31.7305 | 33.1407 | 34.5510 | 35.9612 | 37.3714 | 38.7817 | (42c) |

| | | |
|---|---|---|
| Average daily hot water use (litres/day) | 117.5230 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 127.8606 | 125.0923 | 121.7015 | 117.2680 | 113.1445 | 107.9559 | 105.0021 | 109.9093 | 113.1002 | 118.2532 | 123.5593 | 127.7832 | (44) |
| Energy conte | 188.2328 | 165.5224 | 173.9089 | 153.1814 | 145.7982 | 124.8474 | 116.0304 | 129.3653 | 131.1906 | 152.3812 | 166.9945 | 187.6590 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1835.1121 | |

Distribution loss (46)m = 0.15 x (45)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 28.2349 | 24.8284 | 26.0863 | 22.9772 | 21.8697 | 18.7271 | 17.4046 | 19.4048 | 19.6786 | 22.8572 | 25.0492 | 28.1488 | (46) |

| | | |
|---|---|---|
| Water storage loss: | | |
| Store volume | 110.0000 | (47) |
| b) If manufacturer declared loss factor is not known : | | |
| Hot water storage loss factor from Table 2 (kWh/litre/day) | 0.0152 | (51) |
| Volume factor from Table 2a | 1.0294 | (52) |
| Temperature factor from Table 2b | 0.6000 | (53) |
| Enter (49) or (54) in (55) | 1.0327 | (55) |

Total storage loss

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (56) |

If cylinder contains dedicated solar storage

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (57) |
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |

Total heat required for water heating calculated for each month

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 243.5096 | 215.4499 | 229.1857 | 206.6750 | 201.0750 | 178.3411 | 171.3072 | 184.6421 | 184.6843 | 207.6580 | 220.4882 | 242.9358 | (62) |
| WWHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |

Output from w/h

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 243.5096 | 215.4499 | 229.1857 | 206.6750 | 201.0750 | 178.3411 | 171.3072 | 184.6421 | 184.6843 | 207.6580 | 220.4882 | 242.9358 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2485.9519 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2486 | (64) |

Electric shower(s)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |

| | | |
|---|---|---|
| Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | 0.0000 | (64a) |

Heat gains from water heating, kWh/month

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 106.8089 | 94.9782 | 102.0462 | 93.7277 | 92.6993 | 84.3067 | 82.8016 | 87.2354 | 86.4158 | 94.8882 | 98.3206 | 106.6180 | (65) |

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5. Internal gains (see Table 5 and 5a)

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Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 117.9167 | 117.9167 | 117.9167 | 117.9167 | 117.9167 | 117.9167 | 117.9167 | 117.9167 | 117.9167 | 117.9167 | 117.9167 | 117.9167 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 105.0863 | 116.3455 | 105.0863 | 108.5892 | 105.0863 | 108.5892 | 105.0863 | 105.0863 | 108.5892 | 105.0863 | 108.5892 | 105.0863 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 208.3868 | 210.5492 | 205.1000 | 193.4994 | 178.8556 | 165.0925 | 155.8980 | 153.7355 | 159.1847 | 170.7854 | 185.4292 | 199.1922 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 34.7917 | 34.7917 | 34.7917 | 34.7917 | 34.7917 | 34.7917 | 34.7917 | 34.7917 | 34.7917 | 34.7917 | 34.7917 | 34.7917 | (69) |
| Pumps, fans | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | -94.3333 | -94.3333 | -94.3333 | -94.3333 | -94.3333 | -94.3333 | -94.3333 | -94.3333 | -94.3333 | -94.3333 | -94.3333 | -94.3333 | (71) |
| Water heating gains (Table 5) | 143.5603 | 141.3365 | 137.1588 | 130.1774 | 124.5959 | 117.0926 | 111.2924 | 117.2519 | 120.0220 | 127.5379 | 136.5564 | 143.3038 | (72) |
| Total internal gains | 515.4084 | 526.6063 | 505.7201 | 490.6409 | 466.9128 | 449.1493 | 430.6517 | 434.4487 | 446.1708 | 461.7846 | 488.9497 | 505.9573 | (73) |

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6. Solar gains

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| [Jan] | Area m2 | Solar flux Table 6a | g Specific data | FF Specific data | Access factor | Gains W |
|---|---|---|---|---|---|---|

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | W/m2 | or Table 6b | | or Table 6c | | Table 6d | | | |
| Southeast | | | | | 7.9600 | 36.7938 | | 0.4500 | 0.7000 | 0.7700 | | 63.9340 | (77) |
| Southwest | | | | | 4.3300 | 36.7938 | | 0.4500 | 0.7000 | 0.7700 | | 34.7782 | (79) |
| Southeast | | | | | 2.2900 | 36.7938 | | 0.4500 | 0.7000 | 0.7700 | | 18.3931 | (77) |
| Southwest | | | | | 2.4000 | 36.7938 | | 0.4500 | 0.7000 | 0.7700 | | 19.2766 | (79) |
| Solar gains | 136.3818 | 232.3087 | 317.8549 | 393.8376 | 441.1310 | 437.9409 | 422.2218 | 386.9389 | 344.1696 | 256.7506 | 163.3540 | 116.7144 | (83) |
| Total gains | 651.7902 | 758.9150 | 823.5750 | 884.4786 | 908.0437 | 887.0903 | 852.8735 | 821.3876 | 790.3405 | 718.5352 | 652.3037 | 622.6718 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| tau | 96.5547 | 96.9408 | 97.3301 | 99.3241 | 99.7328 | 101.8275 | 101.8275 | 102.2570 | 100.9791 | 99.7328 | 98.9188 | 98.1180 | |
| alpha | 7.4370 | 7.4627 | 7.4887 | 7.6216 | 7.6489 | 7.7885 | 7.7885 | 7.8171 | 7.7319 | 7.6489 | 7.5946 | 7.5412 | |
| util living area | 0.9941 | 0.9816 | 0.9499 | 0.8484 | 0.6786 | 0.4766 | 0.3413 | 0.3689 | 0.5788 | 0.8742 | 0.9809 | 0.9956 | (86) |
| MIT | 20.3797 | 20.5512 | 20.7341 | 20.9152 | 20.9855 | 20.9992 | 20.9999 | 20.9999 | 20.9964 | 20.9103 | 20.6307 | 20.3586 | (87) |
| Th 2 | 20.1404 | 20.1435 | 20.1466 | 20.1624 | 20.1655 | 20.1813 | 20.1813 | 20.1845 | 20.1750 | 20.1655 | 20.1592 | 20.1529 | (88) |
| util rest of house | 0.9918 | 0.9750 | 0.9333 | 0.8100 | 0.6229 | 0.4160 | 0.2778 | 0.3036 | 0.5114 | 0.8324 | 0.9728 | 0.9939 | (89) |
| MIT 2 | 19.4344 | 19.6516 | 19.8755 | 20.0889 | 20.1558 | 20.1809 | 20.1813 | 20.1845 | 20.1732 | 20.0911 | 19.7657 | 19.4180 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.5237 | (91) |
| MIT | 19.9294 | 20.1228 | 20.3252 | 20.5217 | 20.5903 | 20.6094 | 20.6100 | 20.6115 | 20.6043 | 20.5202 | 20.2187 | 19.9106 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.9294 | 20.1228 | 20.3252 | 20.5217 | 20.5903 | 20.6094 | 20.6100 | 20.6115 | 20.6043 | 20.5202 | 20.2187 | 19.9106 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9911 | 0.9748 | 0.9372 | 0.8273 | 0.6517 | 0.4478 | 0.3111 | 0.3378 | 0.5467 | 0.8513 | 0.9735 | 0.9932 | (94) |
| Useful gains | 646.0135 | 739.7939 | 771.8177 | 731.7009 | 591.7516 | 397.2121 | 265.3171 | 277.4607 | 432.0880 | 611.6981 | 635.0109 | 618.4613 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | 1090.6508 | 1058.0415 | 957.0607 | 788.3706 | 600.6134 | 397.6362 | 265.3377 | 277.4988 | 433.9980 | 670.1888 | 893.5689 | 1078.8484 | (97) |
| Space heating kWh | 330.8102 | 213.8624 | 137.8208 | 40.8022 | 6.5931 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 43.5171 | 186.1618 | 342.5280 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 1302.0956 | |
| Solar heating kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | 330.8102 | 213.8624 | 137.8208 | 40.8022 | 6.5931 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 43.5171 | 186.1618 | 342.5280 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 1302.0956 | |
| Space heating per m2 | | | | | | | | | | (98c) / (4) = | | 17.3914 | (99) |

## 8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ext. temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | |
| Heat loss rate W | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 621.9839 | 489.6469 | 500.7681 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (100) |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.9894 | 0.9971 | 0.9958 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (101) |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 615.4039 | 488.2430 | 498.6499 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (102) |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 983.0807 | 945.9112 | 910.3281 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 264.7273 | 340.5052 | 306.2886 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (104) |
| Cooled fraction | | | | | | | | | | fC = cooled area / (4) = | | 0.9884 | (105) |
| Intermittency factor (Table 10b) | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | (106) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 65.4128 | 84.1371 | 75.6824 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) |
| Space cooling requirement | | | | | | | | | | | | 225.2323 | (107) |

## 9b. Energy requirements

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | 0.0000 | (301) |
| Fraction of space heat from community system | | | | | | | | | | | | 1.0000 | (302) |
| Fraction of heat from community Heat pump-Space and Water | | | | | | | | | | | | 1.0000 | (303a) |
| Factor for control and charging method (Table 4c(3)) for space heating | | | | | | | | | | | | 1.0000 | (305) |
| Factor for charging method (Table 4c(3)) for water heating | | | | | | | | | | | | 1.0000 | (305a) |
| Distribution loss factor (Table 12c) for community heating system | | | | | | | | | | | | 2.0000 | (306) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 | (208) |
| Space heating: | | | | | | | | | | | | | |
| Space heating requirement | 330.8102 | 213.8624 | 137.8208 | 40.8022 | 6.5931 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 43.5171 | 186.1618 | 342.5280 | (98) |
| Space heat from Heat pump = (98) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 307a | 661.6204 | 427.7248 | 275.6417 | 81.6044 | 13.1862 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 87.0342 | 372.3235 | 685.0560 | |
| Space heating requirement | 661.6204 | 427.7248 | 275.6417 | 81.6044 | 13.1862 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 87.0342 | 372.3235 | 685.0560 | (307) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | | | | | | | | | | | 0.0000 | (308) |
| Space heating fuel for secondary/supplementary system | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (309) |
| Water heating | | | | | | | | | | | | | |
| Annual water heating requirement | 243.5096 | 215.4499 | 229.1857 | 206.6750 | 201.0750 | 178.3411 | 171.3072 | 184.6421 | 184.6843 | 207.6580 | 220.4882 | 242.9358 | (64) |
| Water heat from Heat pump = (64) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 310a | 487.0193 | 430.8997 | 458.3715 | 413.3501 | 402.1500 | 356.6822 | 342.6145 | 369.2842 | 369.3685 | 415.3160 | 440.9764 | 485.8715 | |
| Water heating fuel | 487.0193 | 430.8997 | 458.3715 | 413.3501 | 402.1500 | 356.6822 | 342.6145 | 369.2842 | 369.3685 | 415.3160 | 440.9764 | 485.8715 | (310) |
| Cooling System Energy Efficiency Ratio | | | | | | | | | | | | 2.6000 | (314) |
| Space coolin | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 25.1588 | 32.3604 | 29.1086 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (315) |
| Pumps and Fa | 20.5270 | 18.5406 | 20.5270 | 19.8649 | 20.5270 | 19.8649 | 20.5270 | 20.5270 | 19.8649 | 20.5270 | 19.8649 | 20.5270 | (331) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lighting | 22.8960 | 18.3680 | 16.5384 | 12.1167 | 9.3593 | 7.6466 | 8.5379 | 11.0978 | 14.4150 | 18.9132 | 21.3625 | 23.5323 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333a)m | -4.8142 | -7.8318 | -13.0703 | -17.0128 | -20.4079 | -19.8354 | -19.5533 | -17.3483 | -13.8820 | -9.8068 | -5.6258 | -4.0374 | (333a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335a) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (333b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335b) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - community heating | 2604.1912 | (307) |
| Space heating fuel - secondary | 0.0000 | (309) |
| Water heating fuel - community heating | 4971.9038 | (310) |
| Efficiency of water heater | 0.0000 | (311) |
| Electricity used for heat distribution | 26.0419 | (313) |
| Space cooling fuel | 86.6278 | (321) |
| | | |
| Electricity for pumps and fans: | | |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8820) | | |
| mechanical ventilation fans (SFP = 0.8820) | 241.6893 | (330a) |
| Total electricity for the above, kWh/year | 241.6893 | (331) |
| Electricity for lighting (calculated in Appendix L) | 184.7837 | (332) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -153.2260 | (333) |
| Wind generation | 0.0000 | (334) |
| Hydro-electric generation (Appendix N) | 0.0000 | (335a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (335) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (336) |
| Energy used | 0.0000 | (337) |
| Total delivered energy for all uses | 7935.9698 | (338) |

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12b. Carbon dioxide emissions - Community heating scheme

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (367) |
| Space and Water heating from Heat pump | 2705.7482 | 0.1580 | 146.9946 | (367) |
| Electrical energy for heat distribution (space & water) | 26.0419 | 0.0000 | 11.1176 | (372) |
| Overall CO2 factor for heat network | | | 0.0539 | (386) |
| Total CO2 associated with community systems | | | 408.1744 | (373) |
| Space and water heating | | | 408.1744 | (376) |
| Space cooling | 86.6278 | 0.1139 | 9.8712 | (377) |
| Pumps, fans and electric keep-hot | 241.6893 | 0.1387 | 33.5253 | (378) |
| Energy for lighting | 184.7837 | 0.1443 | 26.6700 | (379) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -153.2260 | 0.1318 | -20.1928 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -20.1928 | (380) |
| Total CO2, kg/year | | | 458.0481 | (383) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 6.1200 | (384) |

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13b. Primary energy - Community heating scheme

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| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (467a) |
| Space and Water heating from Heat pump | 2705.7482 | 1.5850 | 1474.1999 | (467) |
| Electrical energy for heat distribution (space & water) | 26.0419 | 0.0000 | 116.8863 | (472) |
| Overall CO2 factor for heat network | | | 0.5664 | (486) |
| Total CO2 associated with community systems | | | 4291.3971 | (473) |
| Space and water heating | | | 4291.3971 | (476) |
| Space cooling | 86.6278 | 1.4200 | 123.0124 | (477) |
| Pumps, fans and electric keep-hot | 241.6893 | 1.5128 | 365.6276 | (478) |
| Energy for lighting | 184.7837 | 1.5338 | 283.4274 | (479) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -153.2260 | 1.4869 | -227.8303 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -227.8303 | (480) |
| Total Primary energy kWh/year | | | 4835.6342 | (483) |
| Dwelling Primary energy Rate (DPER) | | | 64.5900 | (484) |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

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| | | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | |
| Ground floor | | 74.8700 | (1b) | x 3.0000 | (2b) = | 224.6100 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 74.8700 | | | | | | (4) |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | | 224.6100 | (5) |

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## 2. Ventilation rate

| | | | |
|---|---|---|---|
| | | m3 per hour | |
| Number of open chimneys | 0 * 80 = | 0.0000 | (6a) |
| Number of open flues | 0 * 20 = | 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | 3 * 10 = | 30.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |
| | Air changes per hour | | |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 30.0000 / (5) = | 0.1336 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3836 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.3836 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.4890 | 0.4795 | 0.4699 | 0.4219 | 0.4123 | 0.3644 | 0.3644 | 0.3548 | 0.3836 | 0.4123 | 0.4315 | 0.4507 | (22b) |
| Effective ac | 0.6196 | 0.6149 | 0.6104 | 0.5890 | 0.5850 | 0.5664 | 0.5664 | 0.5629 | 0.5736 | 0.5850 | 0.5931 | 0.6016 | (25) |

## 3. Heat losses and heat loss parameter

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| TER Opaque door | | | 1.8900 | 1.0000 | 1.8900 | | | (26) |
| TER Opening Type | | | 16.8300 | 1.1450 | 19.2710 | | | (27) |
| External Walls | 60.4400 | 16.8300 | 43.6100 | 0.1800 | 7.8498 | | | (29a) |
| to Communal Corridor | 5.0100 | 1.8900 | 3.1200 | 0.1800 | 0.5616 | | | (29a) |
| External Roof | 29.8600 | | 29.8600 | 0.1100 | 3.2846 | | | (30) |
| Total net area of external elements Aum(A, m2) | | | 95.3100 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 32.8570 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to unit 20 | | | 21.6800 | 0.0000 | 0.0000 | | | (32) |
| Party Wall to Unit 22 | | | 22.5700 | 0.0000 | 0.0000 | | | (32) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 311.9511 (35)

List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E1 Steel lintel with perforated steel base plate | 8.8500 | 0.0500 | 0.4425 |
| E3 Sill | 1.8100 | 0.0500 | 0.0905 |
| E4 Jamb | 25.6300 | 0.0500 | 1.2815 |
| E7 Party floor between dwellings (in blocks of flats) | 14.5200 | 0.0700 | 1.0164 |
| E16 Corner (normal) | 9.0000 | 0.0900 | 0.8100 |
| E7 Party floor between dwellings (in blocks of flats) | 1.6700 | 0.0700 | 0.1169 |
| E15 Flat roof with parapet | 20.1400 | 0.5600 | 11.2784 |
| E17 Corner (inverted - internal area greater than external area) | 6.0000 | -0.0900 | -0.5400 |
| E18 Party wall between dwellings | 3.0000 | 0.0600 | 0.1800 |
| E25 Staggered party wall between dwellings | 3.0000 | 0.0600 | 0.1800 |
| E24 Eaves (insulation at ceiling level - inverted) | 22.7625 | 0.2400 | 5.4630 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 20.3192 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 53.1762 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 45.9243 | 45.5801 | 45.2427 | 43.6581 | 43.3616 | 41.9815 | 41.9815 | 41.7259 | 42.5131 | 43.3616 | 43.9614 | 44.5884 | (38) |
| Heat transfer coeff | 99.1005 | 98.7563 | 98.4189 | 96.8343 | 96.5378 | 95.1577 | 95.1577 | 94.9021 | 95.6893 | 96.5378 | 97.1376 | 97.7646 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 96.8329 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.3236 | 1.3190 | 1.3145 | 1.2934 | 1.2894 | 1.2710 | 1.2710 | 1.2676 | 1.2781 | 1.2894 | 1.2974 | 1.3058 | (40) |
| HLP (average) | | | | | | | | | | | | 1.2933 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

## 4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.3583 (42)

Hot water usage for mixer showers

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 63.7612 | 62.8030 | 61.4067 | 58.7351 | 56.7636 | 54.5649 | 53.3152 | 54.7009 | 56.2200 | 58.5806 | 61.3096 | 63.5169 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 27.5426 | 27.1336 | 26.5575 | 25.4955 | 24.7002 | 23.8184 | 23.3420 | 23.9140 | 24.5368 | 25.4804 | 26.5644 | 27.4495 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 38.7817 | 37.3714 | 35.9612 | 34.5510 | 33.1407 | 31.7305 | 31.7305 | 33.1407 | 34.5510 | 35.9612 | 37.3714 | 38.7817 | (42c) |

Average daily hot water use (litres/day) 119.5781 (43)

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | | | | | | | | | | | | |
| 130.0855 | 127.3080 | 123.9254 | 118.7815 | 114.6045 | 110.1138 | 108.3877 | 111.7557 | 115.3077 | 120.0223 | 125.2454 | 129.7481 | (44) |
| Energy conte 206.0236 | 181.2849 | 190.4688 | 162.6060 | 154.2797 | 135.3977 | 131.0856 | 138.3769 | 142.1860 | 162.8691 | 178.4350 | 203.1541 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1986.1672 | |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | | |
| 30.9035 | 27.1927 | 28.5703 | 24.3909 | 23.1419 | 20.3097 | 19.6628 | 20.7565 | 21.3279 | 24.4304 | 26.7653 | 30.4731 | (46) |

Water storage loss:

Store volume 150.0000 (47)

a) If manufacturer declared loss factor is known (kWh/day): 1.3938 (48)

Temperature factor from Table 2b 0.5400 (49)

Enter (49) or (54) in (55) 0.7527 (55)

Total storage loss

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (56) |

If cylinder contains dedicated solar storage

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (57) |
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | | | | | | | | | | | | | |
| | 252.6185 | 223.3706 | 237.0637 | 207.6978 | 200.8746 | 180.4895 | 177.6805 | 184.9718 | 187.2778 | 209.4640 | 223.5269 | 249.7490 | (62) |
| WWHRS | -29.1489 | -25.7796 | -26.9949 | -22.3528 | -20.8320 | -17.8261 | -16.7091 | -17.7685 | -18.4436 | -21.7430 | -24.6321 | -28.6092 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | | | | | | | | | | | | | |
| | 223.4696 | 197.5910 | 210.0688 | 185.3450 | 180.0425 | 162.6634 | 160.9713 | 167.2033 | 168.8342 | 187.7210 | 198.8947 | 221.1399 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2263.9448 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2264 | (64) |
| Electric shower(s) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | | | | | | | | | | | | | |
| | 105.7788 | 93.9458 | 100.6068 | 90.1400 | 88.5739 | 81.0932 | 80.8619 | 83.2862 | 83.3503 | 91.4299 | 95.4031 | 104.8247 | (65) |

## 5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 117.9167 | 117.9167 | 117.9167 | 117.9167 | 117.9167 | 117.9167 | 117.9167 | 117.9167 | 117.9167 | 117.9167 | 117.9167 | 117.9167 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 105.0935 | 116.3536 | 105.0935 | 108.5967 | 105.0935 | 108.5967 | 105.0935 | 105.0935 | 108.5967 | 105.0935 | 108.5967 | 105.0935 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 208.3868 | 210.5492 | 205.1000 | 193.4994 | 178.8556 | 165.0925 | 155.8980 | 153.7355 | 159.1847 | 170.7854 | 185.4292 | 199.1922 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 34.7917 | 34.7917 | 34.7917 | 34.7917 | 34.7917 | 34.7917 | 34.7917 | 34.7917 | 34.7917 | 34.7917 | 34.7917 | 34.7917 | (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.0000 | 3.0000 | 3.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | | | | | | | | | | | | | |
| | -94.3333 | -94.3333 | -94.3333 | -94.3333 | -94.3333 | -94.3333 | -94.3333 | -94.3333 | -94.3333 | -94.3333 | -94.3333 | -94.3333 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 142.1758 | 139.8003 | 135.2242 | 125.1944 | 119.0509 | 112.6295 | 108.6853 | 111.9439 | 115.7643 | 122.8896 | 132.5043 | 140.8934 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 517.0311 | 528.0781 | 506.7927 | 488.6654 | 464.3751 | 444.6936 | 428.0518 | 429.1479 | 441.9207 | 460.1436 | 487.9052 | 506.5542 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Southeast | 10.1600 | 36.7938 | 0.6300 | 0.7000 | 0.7700 | 114.2459 | (77) |
| Southwest | 6.6700 | 36.7938 | 0.6300 | 0.7000 | 0.7700 | 75.0020 | (79) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 189.2479 | 322.3591 | 441.0658 | 546.5019 | 612.1277 | 607.7011 | 585.8887 | 536.9289 | 477.5810 | 356.2755 | 226.6753 | 161.9567 | (83) |
| Total gains | 706.2790 | 850.4372 | 947.8585 | 1035.1673 | 1076.5028 | 1052.3947 | 1013.9405 | 966.0769 | 919.5017 | 816.4191 | 714.5805 | 668.5109 | (84) |

## 7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 65.4661 | 65.6942 | 65.9194 | 66.9981 | 67.2039 | 68.1786 | 68.1786 | 68.3622 | 67.7998 | 67.2039 | 66.7889 | 66.3606 | |
| alpha | 5.3644 | 5.3796 | 5.3946 | 5.4665 | 5.4803 | 5.5452 | 5.5452 | 5.5575 | 5.5200 | 5.4803 | 5.4526 | 5.4240 | |
| util living area | | | | | | | | | | | | | |
| | 0.9940 | 0.9836 | 0.9602 | 0.8926 | 0.7600 | 0.5666 | 0.4111 | 0.4489 | 0.6813 | 0.9185 | 0.9851 | 0.9955 | (86) |
| MIT | 19.8885 | 20.1206 | 20.3962 | 20.7098 | 20.9066 | 20.9851 | 20.9979 | 20.9966 | 20.9603 | 20.7021 | 20.2432 | 19.8574 | (87) |
| Th 2 | 19.8224 | 19.8260 | 19.8295 | 19.8460 | 19.8491 | 19.8636 | 19.8636 | 19.8663 | 19.8581 | 19.8491 | 19.8429 | 19.8363 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9916 | 0.9774 | 0.9451 | 0.8552 | 0.6902 | 0.4718 | 0.3060 | 0.3399 | 0.5845 | 0.8809 | 0.9782 | 0.9936 | (89) |
| MIT 2 | 18.5683 | 18.8632 | 19.2059 | 19.5834 | 19.7834 | 19.8571 | 19.8632 | 19.8655 | 19.8376 | 19.5878 | 19.0333 | 18.5391 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.5237 | (91) |
| MIT | 19.2597 | 19.5217 | 19.8292 | 20.1733 | 20.3716 | 20.4478 | 20.4574 | 20.4579 | 20.4256 | 20.1714 | 19.6670 | 19.2295 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.2597 | 19.5217 | 19.8292 | 20.1733 | 20.3716 | 20.4478 | 20.4574 | 20.4579 | 20.4256 | 20.1714 | 19.6670 | 19.2295 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9901 | 0.9753 | 0.9451 | 0.8669 | 0.7234 | 0.5214 | 0.3612 | 0.3972 | 0.6343 | 0.8929 | 0.9769 | 0.9923 | (94) |
| Useful gains | 699.2901 | 829.4604 | 895.7847 | 897.3822 | 778.7891 | 548.6890 | 366.2250 | 383.7000 | 583.2772 | 728.9793 | 698.0779 | 663.3920 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | | | | | | | | | | | | | |
| | 1482.5130 | 1443.9829 | 1311.8497 | 1091.6407 | 837.1391 | 556.4667 | 367.0628 | 385.0992 | 605.2897 | 924.0005 | 1220.7243 | 1469.3552 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 582.7178 | 412.9591 | 309.5524 | 139.8661 | 43.4124 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 145.0958 | 376.3054 | 599.6366 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 2609.5456 | |
| Solar heating kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | | | | | | | | | | | | | |
| | 582.7178 | 412.9591 | 309.5524 | 139.8661 | 43.4124 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 145.0958 | 376.3054 | 599.6366 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 2609.5456 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 34.8544 | (99) |

## 9a. Energy requirements - Individual heating systems, including micro-CHP

| | | |
|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | 0.0000 | (201) |
| Fraction of space heat from main system(s) | 1.0000 | (202) |
| Efficiency of main space heating system 1 (in %) | 92.3000 | (206) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Efficiency of main space heating system 2 (in %) | | | | | | | | | | | | 0.0000 | (207) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 | (208) |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| Space heating requirement | | | | | | | | | | | | | |
| | 582.7178 | 412.9591 | 309.5524 | 139.8661 | 43.4124 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 145.0958 | 376.3054 | 599.6366 | (98) |
| Space heating efficiency (main heating system 1) | | | | | | | | | | | | | |
| | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.3000 | 92.3000 | 92.3000 | (210) |
| Space heating fuel (main heating system) | | | | | | | | | | | | | |
| | 631.3302 | 447.4096 | 335.3764 | 151.5342 | 47.0340 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 157.2002 | 407.6981 | 649.6605 | (211) |
| Space heating efficiency (main heating system 2) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (212) |
| Space heating fuel (main heating system 2) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (213) |
| Space heating fuel (secondary) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (215) |
| Water heating | | | | | | | | | | | | | |
| Water heating requirement | | | | | | | | | | | | | |
| | 223.4696 | 197.5910 | 210.0688 | 185.3450 | 180.0425 | 162.6634 | 160.9713 | 167.2033 | 168.8342 | 187.7210 | 198.8947 | 221.1399 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 | (216) |
| (217)m | 86.1081 | 85.6730 | 84.9277 | 83.4369 | 81.4029 | 79.8000 | 79.8000 | 79.8000 | 79.8000 | 83.4890 | 85.4669 | 86.1812 | (217) |
| Fuel for water heating, kWh/month | | | | | | | | | | | | | |
| | 259.5222 | 230.6340 | 247.3500 | 222.1379 | 221.1747 | 203.8389 | 201.7184 | 209.5279 | 211.5717 | 224.8452 | 232.7154 | 256.5986 | (219) |
| Space cooling fuel requirement | | | | | | | | | | | | | |
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (221) |
| Pumps and Fa | 7.3041 | 6.5973 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | (231) |
| Lighting | 21.8364 | 17.5179 | 15.7730 | 11.5559 | 8.9261 | 7.2927 | 8.1427 | 10.5842 | 13.7479 | 18.0379 | 20.3738 | 22.4433 | (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233a)m | -16.5608 | -24.8196 | -37.8978 | -45.3513 | -51.3337 | -48.8077 | -48.2107 | -44.2965 | -37.8389 | -29.5564 | -18.7209 | -14.1512 | (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233b)m | -5.3641 | -11.5829 | -23.5913 | -36.2874 | -48.8326 | -49.3818 | -48.8041 | -40.9322 | -29.4930 | -16.8432 | -7.2494 | -4.2201 | (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235d) |
| Annual totals kWh/year | | | | | | | | | | | | | |
| Space heating fuel - main system 1 | | | | | | | | | | | | 2827.2433 | (211) |
| Space heating fuel - main system 2 | | | | | | | | | | | | 0.0000 | (213) |
| Space heating fuel - secondary | | | | | | | | | | | | 0.0000 | (215) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 | |
| Water heating fuel used | | | | | | | | | | | | 2721.6349 | (219) |
| Space cooling fuel | | | | | | | | | | | | 0.0000 | (221) |
| Electricity for pumps and fans: | | | | | | | | | | | | | |
| Total electricity for the above, kWh/year | | | | | | | | | | | | 86.0000 | (231) |
| Electricity for lighting (calculated in Appendix L) | | | | | | | | | | | | 176.2319 | (232) |
| Energy saving/generation technologies (Appendices M ,N and Q) | | | | | | | | | | | | | |
| PV generation | | | | | | | | | | | | -740.1275 | (233) |
| Wind generation | | | | | | | | | | | | 0.0000 | (234) |
| Hydro-electric generation (Appendix N) | | | | | | | | | | | | 0.0000 | (235a) |
| Electricity generated - Micro CHP (Appendix N) | | | | | | | | | | | | 0.0000 | (235) |
| Appendix Q - special features | | | | | | | | | | | | | |
| Energy saved or generated | | | | | | | | | | | | -0.0000 | (236) |
| Energy used | | | | | | | | | | | | 0.0000 | (237) |
| Total delivered energy for all uses | | | | | | | | | | | | 5070.9828 | (238) |

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 2827.2433 | 0.2100 | 593.7211 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2721.6349 | 0.2100 | 571.5433 | (264) |
| Space and water heating | | | 1165.2644 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 176.2319 | 0.1443 | 25.4357 | (268) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -417.5454 | 0.1333 | -55.6692 | |
| PV Unit electricity exported | -322.5820 | 0.1252 | -40.3882 | |
| Total | | | -96.0574 | (269) |
| Total CO2, kg/year | | | 1106.5720 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 14.7800 | (273) |

13a. Primary energy - Individual heating systems including micro-CHP

| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 2827.2433 | 1.1300 | 3194.7850 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2721.6349 | 1.1300 | 3075.4475 | (278) |
| Space and water heating | | | 6270.2325 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 176.2319 | 1.5338 | 270.3104 | (282) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -417.5454 | 1.4927 | -623.2594 | |
| PV Unit electricity exported | -322.5820 | 0.4595 | -148.2416 | |
| Total | | | -771.5010 | (283) |
| Total Primary energy kWh/year | | | 5899.1427 | (286) |
| Target Primary Energy Rate (TPER) | | | 78.7900 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Property Reference** | Unit 22 | **Issued on Date** | 17/05/2025 |
| **Assessment Reference** | 00001 | **Prop Type Ref** | Unit 22 |
| **Property** | | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 78 C | **DER** | 5.87 | **TER** | 14.22 |
| **Environmental** | 95 A | **% DER < TER** | | | 58.72 |
| **$CO_2$ Emissions (t/year)** | 0.35 | **DFEE** | 35.29 | **TFEE** | 37.71 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 6.43 |
| **% DPER < TPER** | 17.85 | **DPER** | 62.33 | **TPER** | 75.88 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Robert Arnold | **Assessor ID** | BA04-0001 |
| **Client** | | | |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

## 1. Overall dwelling characteristics

| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 66.6900 | (1b) | x 3.0000 | (2b) = | 200.0700 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 66.6900 | | | | | (4) |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | 200.0700 | (5) |

## 2. Ventilation rate

| | m3 per hour | |
|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 (6a) |
| Number of open flues | 0 * 20 = | 0.0000 (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 (6f) |
| Number of intermittent extract fans | 0 * 10 = | 0.0000 (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 (7c) |

| | Air changes per hour | |
|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 0.0000 / (5) = | 0.0000 (8) |
| Pressure test | | Yes |
| Pressure Test Method | | Blower Door |
| Measured/design AP50 | | 3.0000 (17) |
| Infiltration rate | | 0.1500 (18) |
| Number of sides sheltered | | 0 (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.1500 (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.1912 | 0.1875 | 0.1837 | 0.1650 | 0.1612 | 0.1425 | 0.1425 | 0.1388 | 0.1500 | 0.1612 | 0.1687 | 0.1762 | (22b) |

Balanced mechanical ventilation with heat recovery

| | | |
|---|---|---|
| If mechanical ventilation | | 0.5000 (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | | 0.5000 (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | | 81.0000 (23c) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective ac | 0.2862 | 0.2825 | 0.2787 | 0.2600 | 0.2562 | 0.2375 | 0.2375 | 0.2337 | 0.2450 | 0.2562 | 0.2637 | 0.2712 | (25) |

## 3. Heat losses and heat loss parameter

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| Windows | | | 15.1900 | 1.0536 | 16.0048 | | | (27) |
| Front Door | | | 1.8900 | 1.4000 | 2.6460 | | | (26) |
| Glass Door | | | 2.2900 | 1.3258 | 3.0360 | | | (27) |
| External Walls | 52.1700 | 17.4800 | 34.6900 | 0.1500 | 5.2035 | 150.0000 | 5203.5000 | (29a) |
| Wall to Communal Corridor | 11.2900 | 1.8900 | 9.4000 | 0.1300 | 1.2220 | 150.0000 | 1410.0000 | (29a) |
| External Roof | 7.5200 | | 7.5200 | 0.1000 | 0.7520 | 9.0000 | 67.6800 | (30) |
| Total net area of external elements Aum(A, m2) | | | 70.9800 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 28.8643 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 21 | | | 22.5700 | 0.0000 | 0.0000 | 110.0000 | 2482.7000 | (32) |
| Party Wall to Unit 25 | | | 8.5900 | 0.0000 | 0.0000 | 110.0000 | 944.9000 | (32) |
| Party Floor | | | 66.6900 | | | 80.0000 | 5335.2000 | (32d) |
| Party Ceiling | | | 59.1600 | | | 100.0000 | 5916.0000 | (32b) |
| Internal Walls | | | 166.7700 | | | 9.0000 | 1500.9300 | (32c) |

| | | | |
|---|---|---|---|
| Heat capacity Cm = Sum(A x k) | (28)...(30) + (32) + (32a)...(32e) = | 22860.9100 | (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | | 342.7937 | (35) |

List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E1 Steel lintel with perforated steel base plate | 9.0800 | 0.0500 | 0.4540 |
| E3 Sill | 1.8100 | 0.0500 | 0.0905 |
| E4 Jamb | 25.6300 | 0.0500 | 1.2815 |
| E7 Party floor between dwellings (in blocks of flats) | 23.6300 | 0.0350 | 0.8271 |
| E16 Corner (normal) | 3.0000 | 0.0900 | 0.2700 |
| E18 Party wall between dwellings | 3.0000 | 0.0300 | 0.0900 |
| E7 Party floor between dwellings (in blocks of flats) | 12.3800 | 0.0350 | 0.4333 |
| E15 Flat roof with parapet | 6.3600 | 0.5600 | 3.5616 |
| E17 Corner (inverted - internal area greater than external area) | 3.0000 | -0.0900 | -0.2700 |
| E25 Staggered party wall between dwellings | 3.0000 | 0.0300 | 0.0900 |
| E24 Eaves (insulation at ceiling level - inverted) | 9.5750 | 0.1200 | 1.1490 |

| | | | |
|---|---|---|---|
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | 7.9770 | (36) |
| Point Thermal bridges | (36a) = | 0.0000 | |
| Total fabric heat loss | (33) + (36) + (36a) = | 36.8412 | (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 18.8991 | 18.6515 | 18.4039 | 17.1660 | 16.9184 | 15.6805 | 15.6805 | 15.4329 | 16.1757 | 16.9184 | 17.4136 | 17.9088 | (38) |
| Heat transfer coeff | 55.7403 | 55.4927 | 55.2452 | 54.0072 | 53.7596 | 52.5217 | 52.5217 | 52.2741 | 53.0169 | 53.7596 | 54.2548 | 54.7500 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 53.9453 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 0.8358 | 0.8321 | 0.8284 | 0.8098 | 0.8061 | 0.7876 | 0.7876 | 0.7838 | 0.7950 | 0.8061 | 0.8135 | 0.8210 | (40) |
| HLP (average) | | | | | | | | | | | | 0.8089 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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4. Water heating energy requirements (kWh/year)

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Assumed occupancy | | | | | | | | | | | | 2.1632 | (42) |
| Hot water usage for mixer showers | 58.9605 | 58.0579 | 56.7276 | 54.6811 | 52.8475 | 50.2823 | 48.2535 | 50.6253 | 51.8183 | 54.3590 | 57.0049 | 58.9074 | (42a) |
| Hot water usage for baths | 25.5528 | 25.1670 | 24.6183 | 23.7965 | 23.0559 | 22.0363 | 21.2629 | 22.2087 | 22.7051 | 23.7153 | 24.7656 | 25.5325 | (42b) |
| Hot water usage for other uses | 36.7830 | 35.4454 | 34.1078 | 32.7703 | 31.4327 | 30.0952 | 30.0952 | 31.4327 | 32.7703 | 34.1078 | 35.4454 | 36.7830 | (42c) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 111.4896 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 121.2963 | 118.6703 | 115.4537 | 111.2479 | 107.3361 | 102.4138 | 99.6115 | 104.2668 | 107.2937 | 112.1821 | 117.2159 | 121.2228 | (44) |
| Energy conte | 178.5691 | 157.0248 | 164.9810 | 145.3175 | 138.3134 | 118.4382 | 110.0736 | 122.7239 | 124.4553 | 144.5580 | 158.4212 | 178.0246 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1740.9007 | |
| Distribution loss (46)m = 0.15 x (45)m | 26.7854 | 23.5537 | 24.7471 | 21.7976 | 20.7470 | 17.7657 | 16.5110 | 18.4086 | 18.6683 | 21.6837 | 23.7632 | 26.7037 | (46) |
| Water storage loss: | | | | | | | | | | | | | |
| Store volume | | | | | | | | | | | | 110.0000 | (47) |
| b) If manufacturer declared loss factor is not known : | | | | | | | | | | | | | |
| Hot water storage loss factor from Table 2 (kWh/litre/day) | | | | | | | | | | | | 0.0152 | (51) |
| Volume factor from Table 2a | | | | | | | | | | | | 1.0294 | (52) |
| Temperature factor from Table 2b | | | | | | | | | | | | 0.6000 | (53) |
| Enter (49) or (54) in (55) | | | | | | | | | | | | 1.0327 | (55) |
| Total storage loss | 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (56) |
| If cylinder contains dedicated solar storage | 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (57) |
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | 233.8459 | 206.9523 | 220.2578 | 198.8112 | 193.5902 | 171.9319 | 165.3504 | 178.0007 | 177.9490 | 199.8348 | 211.9149 | 233.3014 | (62) |
| WWHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | 233.8459 | 206.9523 | 220.2578 | 198.8112 | 193.5902 | 171.9319 | 165.3504 | 178.0007 | 177.9490 | 199.8348 | 211.9149 | 233.3014 | (64) |
| | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | | 2391.7404 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2392 | (64) |
| Electric shower(s) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | 103.5957 | 92.1527 | 99.0776 | 91.1130 | 90.2107 | 82.1756 | 80.8209 | 85.0271 | 84.1763 | 92.2870 | 95.4700 | 103.4146 | (65) |

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5. Internal gains (see Table 5 and 5a)

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Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 108.1583 | 108.1583 | 108.1583 | 108.1583 | 108.1583 | 108.1583 | 108.1583 | 108.1583 | 108.1583 | 108.1583 | 108.1583 | 108.1583 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 95.5567 | 105.7949 | 95.5567 | 98.7420 | 95.5567 | 98.7420 | 95.5567 | 95.5567 | 98.7420 | 95.5567 | 98.7420 | 95.5567 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 189.4519 | 191.4178 | 186.4638 | 175.9172 | 162.6040 | 150.0915 | 141.7324 | 139.7665 | 144.7205 | 155.2671 | 168.5803 | 181.0928 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 33.8158 | 33.8158 | 33.8158 | 33.8158 | 33.8158 | 33.8158 | 33.8158 | 33.8158 | 33.8158 | 33.8158 | 33.8158 | 33.8158 | (69) |
| Pumps, fans | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | -86.5266 | -86.5266 | -86.5266 | -86.5266 | -86.5266 | -86.5266 | -86.5266 | -86.5266 | -86.5266 | -86.5266 | -86.5266 | -86.5266 | (71) |
| Water heating gains (Table 5) | 139.2415 | 137.1320 | 133.1688 | 126.5459 | 121.2509 | 114.1328 | 108.6303 | 114.2838 | 116.9116 | 124.0416 | 132.5972 | 138.9982 | (72) |
| Total internal gains | 479.6976 | 489.7922 | 470.6368 | 456.6525 | 434.8591 | 418.4138 | 401.3669 | 405.0545 | 415.8215 | 430.3130 | 455.3669 | 471.0951 | (73) |

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6. Solar gains

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| [Jan] | Area m2 | Solar flux Table 6a | g Specific data | FF Specific data | Access factor | Gains W |
|---|---|---|---|---|---|---|

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | W/m2 | or Table 6b | | or Table 6c | | Table 6d | | | |
| Northeast | | | | 9.8000 | 11.2829 | 0.4500 | | 0.7000 | | 0.7700 | | 24.1375 | (75) |
| Southeast | | | | 5.3900 | 36.7938 | 0.4500 | | 0.7000 | | 0.7700 | | 43.2920 | (77) |
| Southeast | | | | 2.2900 | 36.7938 | 0.4500 | | 0.7000 | | 0.7700 | | 18.3931 | (77) |
| Solar gains | 85.8226 | 154.2051 | 232.2860 | 323.5089 | 394.9378 | 406.4131 | 385.8616 | 330.3814 | 263.5314 | 176.1714 | 104.2557 | 72.5015 | (83) |
| Total gains | 565.5201 | 643.9973 | 702.9228 | 780.1613 | 829.7969 | 824.8269 | 787.2284 | 735.4358 | 679.3529 | 606.4843 | 559.6226 | 543.5966 | (84) |

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| tau | 113.9256 | 114.4339 | 114.9468 | 117.5815 | 118.1230 | 120.9072 | 120.9072 | 121.4799 | 119.7779 | 118.1230 | 117.0450 | 115.9864 | |
| alpha | 8.5950 | 8.6289 | 8.6631 | 8.8388 | 8.8749 | 9.0605 | 9.0605 | 9.0987 | 8.9852 | 8.8749 | 8.8030 | 8.7324 | |
| util living area | 0.9945 | 0.9827 | 0.9449 | 0.8032 | 0.5998 | 0.4075 | 0.2936 | 0.3270 | 0.5375 | 0.8585 | 0.9803 | 0.9958 | (86) |
| MIT | 20.5209 | 20.6610 | 20.8219 | 20.9649 | 20.9971 | 20.9999 | 21.0000 | 21.0000 | 20.9991 | 20.9498 | 20.7318 | 20.5068 | (87) |
| Th 2 | 20.2224 | 20.2256 | 20.2288 | 20.2448 | 20.2480 | 20.2641 | 20.2641 | 20.2674 | 20.2577 | 20.2480 | 20.2416 | 20.2352 | (88) |
| util rest of house | 0.9924 | 0.9763 | 0.9272 | 0.7634 | 0.5525 | 0.3606 | 0.2445 | 0.2749 | 0.4802 | 0.8159 | 0.9719 | 0.9942 | (89) |
| MIT 2 | 19.6779 | 19.8555 | 20.0506 | 20.2161 | 20.2462 | 20.2641 | 20.2641 | 20.2674 | 20.2573 | 20.2081 | 19.9585 | 19.6708 | (90) |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.3762 | (91) |
| MIT | 19.9951 | 20.1585 | 20.3407 | 20.4978 | 20.5287 | 20.5409 | 20.5410 | 20.5430 | 20.5364 | 20.4872 | 20.2495 | 19.9853 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.9951 | 20.1585 | 20.3407 | 20.4978 | 20.5287 | 20.5409 | 20.5410 | 20.5430 | 20.5364 | 20.4872 | 20.2495 | 19.9853 | (93) |

8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9916 | 0.9757 | 0.9300 | 0.7772 | 0.5703 | 0.3783 | 0.2629 | 0.2945 | 0.5018 | 0.8303 | 0.9720 | 0.9935 | (94) |
| Useful gains | 560.7454 | 628.3404 | 653.7508 | 606.3245 | 473.1949 | 311.9990 | 206.9862 | 216.5689 | 340.8880 | 503.5530 | 543.9413 | 540.0396 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | 874.8498 | 846.7383 | 764.6340 | 626.3676 | 474.6283 | 312.0280 | 206.9870 | 216.5712 | 341.2376 | 531.5297 | 713.4216 | 864.2476 | (97) |
| Space heating kWh | 233.6937 | 146.7634 | 82.4971 | 14.4310 | 1.0664 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 20.8146 | 122.0258 | 241.2108 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 862.5028 | |
| Solar heating kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | 233.6937 | 146.7634 | 82.4971 | 14.4310 | 1.0664 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 20.8146 | 122.0258 | 241.2108 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 862.5028 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 12.9330 | (99) |

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ext. temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | |
| Heat loss rate W | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 493.7041 | 388.6607 | 397.2833 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (100) |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.9983 | 0.9996 | 0.9992 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (101) |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 492.8497 | 388.5197 | 396.9840 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (102) |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 914.4881 | 873.1245 | 813.5578 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 303.5796 | 360.5460 | 309.9308 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (104) |
| Cooled fraction | | | | | | | | | fC = cooled area / (4) = | | | 0.9897 | (105) |
| Intermittency factor (Table 10b) | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | (106) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 75.1097 | 89.2039 | 76.6810 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) |
| Space cooling requirement | | | | | | | | | | | | 240.9946 | (107) |

9b. Energy requirements

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | 0.0000 | (301) |
| Fraction of space heat from community system | | | | | | | | | | | | 1.0000 | (302) |
| Fraction of heat from community Heat pump-Space and Water | | | | | | | | | | | | 1.0000 | (303a) |
| Factor for control and charging method (Table 4c(3)) for space heating | | | | | | | | | | | | 1.0000 | (305) |
| Factor for charging method (Table 4c(3)) for water heating | | | | | | | | | | | | 1.0000 | (305a) |
| Distribution loss factor (Table 12c) for community heating system | | | | | | | | | | | | 2.0000 | (306) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 | (208) |
| Space heating: | | | | | | | | | | | | | |
| Space heating requirement | 233.6937 | 146.7634 | 82.4971 | 14.4310 | 1.0664 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 20.8146 | 122.0258 | 241.2108 | (98) |
| Space heat from Heat pump = (98) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 307a | 467.3873 | 293.5267 | 164.9941 | 28.8621 | 2.1329 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 41.6293 | 244.0517 | 482.4216 | |
| Space heating requirement | 467.3873 | 293.5267 | 164.9941 | 28.8621 | 2.1329 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 41.6293 | 244.0517 | 482.4216 | (307) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | | | | | | | | | | | 0.0000 | (308) |
| Space heating fuel for secondary/supplementary system | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (309) |
| Water heating | | | | | | | | | | | | | |
| Annual water heating requirement | 233.8459 | 206.9523 | 220.2578 | 198.8112 | 193.5902 | 171.9319 | 165.3504 | 178.0007 | 177.9490 | 199.8348 | 211.9149 | 233.3014 | (64) |
| Water heat from Heat pump = (64) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 310a | 467.6918 | 413.9045 | 440.5155 | 397.6224 | 387.1805 | 343.8638 | 330.7008 | 356.0014 | 355.8980 | 399.6696 | 423.8297 | 466.6029 | |
| Water heating fuel | 467.6918 | 413.9045 | 440.5155 | 397.6224 | 387.1805 | 343.8638 | 330.7008 | 356.0014 | 355.8980 | 399.6696 | 423.8297 | 466.6029 | (310) |
| Cooling System Energy Efficiency Ratio | | | | | | | | | | | | 2.6000 | (314) |
| Space coolin | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 28.8883 | 34.3092 | 29.4927 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (315) |
| Pumps and Fa | 18.2843 | 16.5149 | 18.2843 | 17.6945 | 18.2843 | 17.6945 | 18.2843 | 18.2843 | 17.6945 | 18.2843 | 17.6945 | 18.2843 | (331) |
| Lighting | 20.0479 | 16.0832 | 14.4811 | 10.6095 | 8.1951 | 6.6954 | 7.4758 | 9.7173 | 12.6219 | 16.5606 | 18.7051 | 20.6051 | (332) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (333a)m | -4.7818 | -7.7591 | -12.9147 | -16.7644 | -20.0685 | -19.4913 | -19.2150 | -17.0682 | -13.6859 | -9.6995 | -5.5817 | -4.0122 (333a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (334a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (334a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (335a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (335a) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (333b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (333b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (334b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (334b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (335b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (335b) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - community heating | 1725.0056 | (307) |
| Space heating fuel - secondary | 0.0000 | (309) |
| Water heating fuel - community heating | 4783.4809 | (310) |
| Efficiency of water heater | 0.0000 | (311) |
| Electricity used for heat distribution | 17.2501 | (313) |
| Space cooling fuel | 92.6902 | (321) |
| Electricity for pumps and fans: | | |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8820) | | |
| mechanical ventilation fans (SFP = 0.8820) | 215.2833 | (330a) |
| Total electricity for the above, kWh/year | 215.2833 | (331) |
| Electricity for lighting (calculated in Appendix L) | 161.7979 | (332) |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -151.0423 | (333) |
| Wind generation | 0.0000 | (334) |
| Hydro-electric generation (Appendix N) | 0.0000 | (335a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (335) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (336) |
| Energy used | 0.0000 | (337) |
| Total delivered energy for all uses | 6827.2156 | (338) |

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12b. Carbon dioxide emissions - Community heating scheme

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (367) |
| Space and Water heating from Heat pump | 2324.4595 | 0.1588 | 97.8391 | (367) |
| Electrical energy for heat distribution (space & water) | 17.2501 | 0.0000 | 9.4745 | (372) |
| Overall CO2 factor for heat network | | | 0.0534 | (386) |
| Total CO2 associated with community systems | | | 347.8485 | (373) |
| Space and water heating | | | 347.8485 | (376) |
| Space cooling | 92.6902 | 0.1141 | 10.5781 | (377) |
| Pumps, fans and electric keep-hot | 215.2833 | 0.1387 | 29.8625 | (378) |
| Energy for lighting | 161.7979 | 0.1443 | 23.3524 | (379) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -151.0423 | 0.1318 | -19.9123 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -19.9123 | (380) |
| Total CO2, kg/year | | | 391.7292 | (383) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 5.8700 | (384) |

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13b. Primary energy - Community heating scheme

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| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (467a) |
| Space and Water heating from Heat pump | 2324.4595 | 1.5878 | 978.2254 | (467) |
| Electrical energy for heat distribution (space & water) | 17.2501 | 0.0000 | 100.1283 | (472) |
| Overall CO2 factor for heat network | | | 0.5648 | (486) |
| Total CO2 associated with community systems | | | 3676.1405 | (473) |
| Space and water heating | | | 3676.1405 | (476) |
| Space cooling | 92.6902 | 1.4206 | 131.6773 | (477) |
| Pumps, fans and electric keep-hot | 215.2833 | 1.5128 | 325.6806 | (478) |
| Energy for lighting | 161.7979 | 1.5338 | 248.1710 | (479) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -151.0423 | 1.4871 | -224.6106 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -224.6106 | (480) |
| Total Primary energy kWh/year | | | 4157.0587 | (483) |
| Dwelling Primary energy Rate (DPER) | | | 62.3300 | (484) |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

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| | | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | |
| Ground floor | | 66.6900 | (1b) | x 3.0000 | (2b) = | 200.0700 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 66.6900 | | | | | | (4) |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | | 200.0700 | (5) |

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2. Ventilation rate

| | | | |
|---|---|---|---|
| | | m3 per hour | |
| Number of open chimneys | 0 * 80 = | 0.0000 | (6a) |
| Number of open flues | 0 * 20 = | 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | 2 * 10 = | 20.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |
| | | Air changes per hour | |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 20.0000 / (5) = | 0.1000 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3500 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.3500 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.4462 | 0.4375 | 0.4287 | 0.3850 | 0.3762 | 0.3325 | 0.3325 | 0.3237 | 0.3500 | 0.3762 | 0.3937 | 0.4112 | (22b) |
| Effective ac | 0.5995 | 0.5957 | 0.5919 | 0.5741 | 0.5708 | 0.5553 | 0.5553 | 0.5524 | 0.5612 | 0.5708 | 0.5775 | 0.5845 | (25) |

## 3. Heat losses and heat loss parameter

| Element | Gross | Openings | NetArea | U-value | A x U | K-value | A x K | |
|---|---|---|---|---|---|---|---|---|
| | m2 | m2 | m2 | W/m2K | W/K | kJ/m2K | kJ/K | |
| Main dwelling | | | | | | | | |
| TER Opaque door | | | 1.8900 | 1.0000 | 1.8900 | | | (26) |
| TER Opening Type | | | 14.7800 | 1.1450 | 16.9237 | | | (27) |
| External Walls | 52.1700 | 14.7800 | 37.3900 | 0.1800 | 6.7302 | | | (29a) |
| Wall to Communal Corridor | 11.2900 | 1.8900 | 9.4000 | 0.1800 | 1.6920 | | | (29a) |
| External Roof | 7.5200 | | 7.5200 | 0.1100 | 0.8272 | | | (30) |
| Total net area of external elements Aum(A, m2) | | | 70.9800 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 28.0631 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 21 | | | 22.5700 | 0.0000 | 0.0000 | | | (32) |
| Party Wall to Unit 25 | | | 8.5900 | 0.0000 | 0.0000 | | | (32) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 325.0519 (35)

List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E1 Steel lintel with perforated steel base plate | 9.0800 | 0.0500 | 0.4540 |
| E3 Sill | 1.8100 | 0.0500 | 0.0905 |
| E4 Jamb | 25.6300 | 0.0500 | 1.2815 |
| E7 Party floor between dwellings (in blocks of flats) | 23.6300 | 0.0700 | 1.6541 |
| E16 Corner (normal) | 3.0000 | 0.0900 | 0.2700 |
| E18 Party wall between dwellings | 3.0000 | 0.0600 | 0.1800 |
| E7 Party floor between dwellings (in blocks of flats) | 12.3800 | 0.0700 | 0.8666 |
| E15 Flat roof with parapet | 6.3600 | 0.5600 | 3.5616 |
| E17 Corner (inverted - internal area greater than external area) | 3.0000 | -0.0900 | -0.2700 |
| E25 Staggered party wall between dwellings | 3.0000 | 0.0600 | 0.1800 |
| E24 Eaves (insulation at ceiling level - inverted) | 9.5750 | 0.2400 | 2.2980 |

| | | |
|---|---|---|
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | 10.5663 | (36) |
| Point Thermal bridges | (36a) = 0.0000 | |
| Total fabric heat loss | (33) + (36) + (36a) = 38.6294 | (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 39.5841 | 39.3289 | 39.0787 | 37.9037 | 37.6839 | 36.6605 | 36.6605 | 36.4709 | 37.0547 | 37.6839 | 38.1286 | 38.5936 | (38) |
| Heat transfer coeff | 78.2135 | 77.9583 | 77.7081 | 76.5331 | 76.3132 | 75.2898 | 75.2898 | 75.1003 | 75.6840 | 76.3132 | 76.7580 | 77.2229 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 76.5320 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.1728 | 1.1690 | 1.1652 | 1.1476 | 1.1443 | 1.1290 | 1.1290 | 1.1261 | 1.1349 | 1.1443 | 1.1510 | 1.1579 | (40) |
| HLP (average) | | | | | | | | | | | | 1.1476 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

## 4. Water heating energy requirements (kWh/year)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Assumed occupancy | | | | | | | | | | | 2.1632 | (42) |
| Hot water usage for mixer showers | 60.4888 | 59.5798 | 58.2551 | 55.7207 | 53.8503 | 51.7645 | 50.5789 | 51.8935 | 53.3346 | 55.5741 | 58.1630 | 60.2570 | (42a) |
| Hot water usage for baths | 26.1354 | 25.7472 | 25.2006 | 24.1928 | 23.4382 | 22.6014 | 22.1494 | 22.6922 | 23.2832 | 24.1785 | 25.2071 | 26.0470 | (42b) |
| Hot water usage for other uses | 36.7830 | 35.4454 | 34.1078 | 32.7703 | 31.4327 | 30.0952 | 30.0952 | 31.4327 | 32.7703 | 34.1078 | 35.4454 | 36.7830 | (42c) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 113.4393 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 123.4071 | 120.7724 | 117.5636 | 112.6838 | 108.7212 | 104.4611 | 102.8235 | 106.0185 | 109.3881 | 113.8605 | 118.8155 | 123.0870 | (44) |
| Energy conte | 195.4468 | 171.9783 | 180.6909 | 154.2585 | 146.3597 | 128.4471 | 124.3561 | 131.2730 | 134.8864 | 154.5077 | 169.2745 | 192.7245 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1884.2035 | |
| Distribution loss (46)m = 0.15 x (45)m | 29.3170 | 25.7967 | 27.1036 | 23.1388 | 21.9540 | 19.2671 | 18.6534 | 19.6910 | 20.2330 | 23.1761 | 25.3912 | 28.9087 | (46) |
| Water storage loss: | | | | | | | | | | | | | |
| Store volume | | | | | | | | | | | | 150.0000 | (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | | | | | | | | | | | | 1.3938 | (48) |
| Temperature factor from Table 2b | | | | | | | | | | | | 0.5400 | (49) |
| Enter (49) or (54) in (55) | | | | | | | | | | | | 0.7527 | (55) |
| Total storage loss | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (56) |
| If cylinder contains dedicated solar storage | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (57) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | | | | | | | | | | | | | |
| | 242.0417 | 214.0640 | 227.2858 | 199.3503 | 192.9546 | 173.5389 | 170.9510 | 177.8679 | 179.9783 | 201.1026 | 214.3664 | 239.3195 | (62) |
| WWHRS | -27.6529 | -24.4565 | -25.6094 | -21.2056 | -19.7629 | -16.9112 | -15.8516 | -16.8566 | -17.4970 | -20.6271 | -23.3679 | -27.1409 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | | | | | | | | | | | | | |
| | 214.3887 | 189.6075 | 201.6764 | 178.1447 | 173.1917 | 156.6277 | 155.0995 | 161.0113 | 162.4812 | 180.4755 | 190.9984 | 212.1786 | (64) |
| | | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | 2175.8812 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2176 | (64) |
| Electric shower(s) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | | | | | | | | | | | | | |
| | 102.2620 | 90.8514 | 97.3556 | 87.3644 | 85.9405 | 78.7821 | 78.6243 | 80.9242 | 80.9232 | 88.6497 | 92.3573 | 101.3568 | (65) |

## 5. Internal gains (see Table 5 and 5a)

| Metabolic gains (Table 5), Watts | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 108.1583 | 108.1583 | 108.1583 | 108.1583 | 108.1583 | 108.1583 | 108.1583 | 108.1583 | 108.1583 | 108.1583 | 108.1583 | 108.1583 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 95.5696 | 105.8092 | 95.5696 | 98.7553 | 95.5696 | 98.7553 | 95.5696 | 95.5696 | 98.7553 | 95.5696 | 98.7553 | 95.5696 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 189.4519 | 191.4178 | 186.4638 | 175.9172 | 162.6040 | 150.0915 | 141.7324 | 139.7665 | 144.7205 | 155.2671 | 168.5803 | 181.0928 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 33.8158 | 33.8158 | 33.8158 | 33.8158 | 33.8158 | 33.8158 | 33.8158 | 33.8158 | 33.8158 | 33.8158 | 33.8158 | 33.8158 | (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.0000 | 3.0000 | 3.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | | | | | | | | | | | | | |
| | -86.5266 | -86.5266 | -86.5266 | -86.5266 | -86.5266 | -86.5266 | -86.5266 | -86.5266 | -86.5266 | -86.5266 | -86.5266 | -86.5266 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 137.4489 | 135.1955 | 130.8544 | 121.3395 | 115.5114 | 109.4196 | 105.6779 | 108.7691 | 112.3933 | 119.1528 | 128.2740 | 136.2323 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 480.9179 | 490.8700 | 471.3352 | 454.4594 | 432.1325 | 413.7139 | 398.4273 | 399.5526 | 411.3166 | 428.4370 | 454.0570 | 471.3422 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Northeast | 8.2900 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 28.5857 | (75) |
| Southeast | 6.4900 | 36.7938 | 0.6300 | 0.7000 | 0.7700 | 72.9779 | (77) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 101.5636 | 182.4954 | 274.9187 | 382.9109 | 467.4772 | 481.0690 | 456.7387 | 391.0537 | 311.9077 | 208.4964 | 123.3789 | 85.7984 | (83) |
| Total gains | 582.4815 | 673.3654 | 746.2539 | 837.3703 | 899.6098 | 894.7828 | 855.1661 | 790.6063 | 723.2242 | 636.9334 | 577.4359 | 557.1406 | (84) |

## 7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 76.9891 | 77.2411 | 77.4898 | 78.6795 | 78.9062 | 79.9788 | 79.9788 | 80.1806 | 79.5622 | 78.9062 | 78.4490 | 77.9767 | |
| alpha | 6.1326 | 6.1494 | 6.1660 | 6.2453 | 6.2604 | 6.3319 | 6.3319 | 6.3454 | 6.3041 | 6.2604 | 6.2299 | 6.1984 | |
| util living area | | | | | | | | | | | | | |
| | 0.9961 | 0.9898 | 0.9719 | 0.9014 | 0.7429 | 0.5335 | 0.3868 | 0.4357 | 0.6937 | 0.9375 | 0.9899 | 0.9970 | (86) |
| MIT | 20.0601 | 20.2375 | 20.4796 | 20.7774 | 20.9462 | 20.9942 | 20.9993 | 20.9987 | 20.9733 | 20.7445 | 20.3566 | 20.0373 | (87) |
| Th 2 | 19.9418 | 19.9449 | 19.9479 | 19.9622 | 19.9648 | 19.9773 | 19.9773 | 19.9796 | 19.9725 | 19.9648 | 19.9594 | 19.9538 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9944 | 0.9857 | 0.9606 | 0.8667 | 0.6765 | 0.4508 | 0.2972 | 0.3398 | 0.6032 | 0.9066 | 0.9850 | 0.9957 | (89) |
| MIT 2 | 18.8716 | 19.0985 | 19.4021 | 19.7605 | 19.9280 | 19.9748 | 19.9771 | 19.9793 | 19.9588 | 19.7359 | 19.2622 | 18.8519 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.3762 | (91) |
| MIT | 19.3187 | 19.5270 | 19.8075 | 20.1431 | 20.3111 | 20.3583 | 20.3617 | 20.3628 | 20.3404 | 20.1154 | 19.6740 | 19.2979 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.3187 | 19.5270 | 19.8075 | 20.1431 | 20.3111 | 20.3583 | 20.3617 | 20.3628 | 20.3404 | 20.1154 | 19.6740 | 19.2979 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9931 | 0.9836 | 0.9588 | 0.8734 | 0.6998 | 0.4820 | 0.3310 | 0.3760 | 0.6369 | 0.9119 | 0.9832 | 0.9946 | (94) |
| Useful gains | 578.4769 | 662.3024 | 715.4925 | 731.3798 | 629.5190 | 431.2578 | 283.0445 | 297.2285 | 460.6164 | 580.8331 | 567.7465 | 554.1340 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | | | | | | | | | | | | | |
| | 1174.6676 | 1140.2974 | 1034.1013 | 860.4701 | 657.1379 | 433.5425 | 283.2178 | 297.6056 | 472.3020 | 726.1489 | 965.1510 | 1165.9014 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 443.5659 | 321.2126 | 237.0450 | 92.9451 | 20.5485 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 108.1150 | 286.1312 | 455.1549 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 1964.7182 | |
| Solar heating kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | | | | | | | | | | | | | |
| | 443.5659 | 321.2126 | 237.0450 | 92.9451 | 20.5485 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 108.1150 | 286.1312 | 455.1549 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 1964.7182 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 29.4605 | (99) |

## 9a. Energy requirements - Individual heating systems, including micro-CHP

| | | |
|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | 0.0000 | (201) |
| Fraction of space heat from main system(s) | 1.0000 | (202) |
| Efficiency of main space heating system 1 (in %) | 92.3000 | (206) |
| Efficiency of main space heating system 2 (in %) | 0.0000 | (207) |

Efficiency of secondary/supplementary heating system, % 0.0000 (208)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement | 443.5659 | 321.2126 | 237.0450 | 92.9451 | 20.5485 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 108.1150 | 286.1312 | 455.1549 | (98) |
| Space heating efficiency (main heating system 1) | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.3000 | 92.3000 | 92.3000 | (210) |
| Space heating fuel (main heating system) | 480.5698 | 348.0093 | 256.8201 | 100.6989 | 22.2627 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 117.1344 | 310.0013 | 493.1255 | (211) |
| Space heating efficiency (main heating system 2) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (212) |
| Space heating fuel (main heating system 2) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (213) |
| Space heating fuel (secondary) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (215) |
| Water heating | | | | | | | | | | | | | |
| Water heating requirement | 214.3887 | 189.6075 | 201.6764 | 178.1447 | 173.1917 | 156.6277 | 155.0995 | 161.0113 | 162.4812 | 180.4755 | 190.9984 | 212.1786 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 | (216) |
| (217)m | 85.6524 | 85.2320 | 84.4231 | 82.6728 | 80.6671 | 79.8000 | 79.8000 | 79.8000 | 79.8000 | 82.9495 | 84.9641 | 85.7260 | (217) |
| Fuel for water heating, kWh/month | 250.3010 | 222.4606 | 238.8877 | 215.4816 | 214.6992 | 196.2753 | 194.3602 | 201.7686 | 203.6106 | 217.5726 | 224.7990 | 247.5080 | (219) |
| Space cooling fuel requirement | | | | | | | | | | | | | |
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (221) |
| Pumps and Fa | 7.3041 | 6.5973 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | (231) |
| Lighting | 19.8575 | 15.9304 | 14.3436 | 10.5087 | 8.1172 | 6.6318 | 7.4048 | 9.6250 | 12.5020 | 16.4033 | 18.5275 | 20.4094 | (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233a)m | -14.8092 | -22.2262 | -33.9877 | -40.7373 | -46.1742 | -43.9317 | -43.4009 | -39.8501 | -33.9963 | -26.5013 | -16.7537 | -12.6514 | (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233b)m | -4.7202 | -10.1991 | -20.7834 | -31.9819 | -43.0483 | -43.5300 | -43.0145 | -36.0668 | -25.9792 | -14.8288 | -6.3791 | -3.7127 | (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235d) |

Annual totals kWh/year

| | | |
|---|---|---|
| Space heating fuel - main system 1 | 2128.6221 | (211) |
| Space heating fuel - main system 2 | 0.0000 | (213) |
| Space heating fuel - secondary | 0.0000 | (215) |
| Efficiency of water heater | 79.8000 | |
| Water heating fuel used | 2627.7244 | (219) |
| Space cooling fuel | 0.0000 | (221) |
| Electricity for pumps and fans: | | |
| Total electricity for the above, kWh/year | 86.0000 | (231) |
| Electricity for lighting (calculated in Appendix L) | 160.2612 | (232) |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -659.2641 | (233) |
| Wind generation | 0.0000 | (234) |
| Hydro-electric generation (Appendix N) | 0.0000 | (235a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (235) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (236) |
| Energy used | 0.0000 | (237) |
| Total delivered energy for all uses | 4343.3436 | (238) |

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 2128.6221 | 0.2100 | 447.0106 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2627.7244 | 0.2100 | 551.8221 | (264) |
| Space and water heating | | | 998.8328 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 160.2612 | 0.1443 | 23.1306 | (268) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -375.0200 | 0.1333 | -49.9869 | |
| PV Unit electricity exported | -284.2441 | 0.1252 | -35.5858 | |
| Total | | | -85.5727 | (269) |
| Total CO2, kg/year | | | 948.3200 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 14.2200 | (273) |

13a. Primary energy - Individual heating systems including micro-CHP

| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 2128.6221 | 1.1300 | 2405.3429 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2627.7244 | 1.1300 | 2969.3286 | (278) |
| Space and water heating | | | 5374.6715 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 160.2612 | 1.5338 | 245.8140 | (282) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -375.0200 | 1.4925 | -559.7352 | |
| PV Unit electricity exported | -284.2441 | 0.4595 | -130.6149 | |
| Total | | | -690.3501 | (283) |
| Total Primary energy kWh/year | | | 5060.2362 | (286) |
| Target Primary Energy Rate (TPER) | | | 75.8800 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Property Reference** | Unit 23 | **Issued on Date** | 17/05/2025 |
| **Assessment Reference** | 00001 | **Prop Type Ref** | Unit 23 |
| **Property** | | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 78 C | **DER** | 5.82 | **TER** | 15.77 |
| **Environmental** | 96 A | **% DER < TER** | | | 63.09 |
| **$CO_2$ Emissions (t/year)** | 0.33 | **DFEE** | 35.46 | **TFEE** | 43.83 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 19.10 |
| **% DPER < TPER** | 26.71 | **DPER** | 61.75 | **TPER** | 84.26 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Robert Arnold | **Assessor ID** | BA04-0001 |
| **Client** | | | |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 64.6000 | (1b) | x 3.0000 | (2b) = | 193.8000 | (1b) - (3b) (4) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 64.6000 | | | | | |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | | 193.8000 | (5) |

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2. Ventilation rate

---

| | m3 per hour | |
|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 (6a) |
| Number of open flues | 0 * 20 = | 0.0000 (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 (6f) |
| Number of intermittent extract fans | 0 * 10 = | 0.0000 (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 (7c) |

| | Air changes per hour | |
|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 0.0000 / (5) = | 0.0000 (8) |
| Pressure test | | Yes |
| Pressure Test Method | | Blower Door |
| Measured/design AP50 | | 3.0000 (17) |
| Infiltration rate | | 0.1500 (18) |
| Number of sides sheltered | | 0 (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.1500 (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.1912 | 0.1875 | 0.1837 | 0.1650 | 0.1612 | 0.1425 | 0.1425 | 0.1388 | 0.1500 | 0.1612 | 0.1687 | 0.1762 | (22b) |
| Balanced mechanical ventilation with heat recovery | | | | | | | | | | | | | |
| If mechanical ventilation | | | | | | | | | | | | 0.5000 | (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | | | | | | | | | | | | 0.5000 | (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | | | | | | | | | | | | 81.0000 | (23c) |
| Effective ac | 0.2862 | 0.2825 | 0.2787 | 0.2600 | 0.2562 | 0.2375 | 0.2375 | 0.2337 | 0.2450 | 0.2562 | 0.2637 | 0.2712 | (25) |

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3. Heat losses and heat loss parameter

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| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| Windows | | | 9.9900 | 1.0536 | 10.5259 | | | (27) |
| Front Door | | | 1.8900 | 1.4000 | 2.6460 | | | (26) |
| Glass Door | | | 2.2900 | 1.3258 | 3.0360 | | | (27) |
| External Walls | 41.8800 | 12.2800 | 29.6000 | 0.1500 | 4.4400 | 150.0000 | 4440.0000 | (29a) |
| Wall to Communal Corridor | 30.2900 | 1.8900 | 28.4000 | 0.0000 | 0.0000 | 150.0000 | 4260.0000 | (29a) |
| External Roof | 14.5000 | | 14.5000 | 0.1000 | 1.4500 | 9.0000 | 130.5000 | (30) |
| Total net area of external elements Aum(A, m2) | | | 58.2700 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 22.0978 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 19 | | | 19.6100 | 0.0000 | 0.0000 | 110.0000 | 2157.1000 | (32) |
| Party Wall to Unit 24 | | | 19.6100 | 0.0000 | 0.0000 | 110.0000 | 2157.1000 | (32) |
| Party Floor | | | 64.6000 | | | 80.0000 | 5168.0000 | (32d) |
| Party Ceiling | | | 49.9900 | | | 100.0000 | 4999.0000 | (32b) |
| Internal Walls | | | 163.5600 | | | 9.0000 | 1472.0400 | (32c) |

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 24783.7400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 383.6492 (35)
List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E1 Steel lintel with perforated steel base plate | 6.3600 | 0.0500 | 0.3180 |
| E4 Jamb | 17.6400 | 0.0500 | 0.8820 |
| E7 Party floor between dwellings (in blocks of flats) | 10.1400 | 0.0350 | 0.3549 |
| E18 Party wall between dwellings | 6.0000 | 0.0600 | 0.3600 |
| E24 Eaves (insulation at ceiling level - inverted) | 5.4000 | 0.1200 | 0.6480 |
| E24 Eaves (insulation at ceiling level - inverted) | 10.1400 | 0.1200 | 1.2168 |
| E15 Flat roof with parapet | 8.5600 | 0.5600 | 4.7936 |
| E7 Party floor between dwellings (in blocks of flats) | 10.0000 | 0.0350 | 0.3500 |
| E16 Corner (normal) | 3.0000 | 0.0900 | 0.2700 |
| E17 Corner (inverted - internal area greater than external area) | 6.0000 | -0.0900 | -0.5400 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 8.6533 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 30.7511 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 18.3068 | 18.0670 | 17.8272 | 16.6280 | 16.3882 | 15.1891 | 15.1891 | 14.9492 | 15.6687 | 16.3882 | 16.8679 | 17.3475 | (38) |
| Heat transfer coeff | 49.0580 | 48.8182 | 48.5783 | 47.3792 | 47.1394 | 45.9402 | 45.9402 | 45.7004 | 46.4199 | 47.1394 | 47.6190 | 48.0987 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 47.3192 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 0.7594 | 0.7557 | 0.7520 | 0.7334 | 0.7297 | 0.7111 | 0.7111 | 0.7074 | 0.7186 | 0.7297 | 0.7371 | 0.7446 | (40) |
| HLP (average) | | | | | | | | | | | | 0.7325 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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## 4. Water heating energy requirements (kWh/year)

---

Assumed occupancy 2.1083 (42)
Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 58.0634 | 57.1744 | 55.8644 | 53.8490 | 52.0434 | 49.5172 | 47.5192 | 49.8550 | 51.0298 | 53.5318 | 56.1375 | 58.0110 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 25.1658 | 24.7859 | 24.2454 | 23.4361 | 22.7067 | 21.7026 | 20.9408 | 21.8724 | 22.3612 | 23.3561 | 24.3905 | 25.1458 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 36.2208 | 34.9037 | 33.5866 | 32.2694 | 30.9523 | 29.6352 | 29.6352 | 30.9523 | 32.2694 | 33.5866 | 34.9037 | 36.2208 | (42c) |

Average daily hot water use (litres/day) 109.7926 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 119.4499 | 116.8640 | 113.6964 | 109.5546 | 105.7024 | 100.8550 | 98.0952 | 102.6797 | 105.6605 | 110.4745 | 115.4317 | 119.3776 | (44) |
| Energy conte | 175.8510 | 154.6347 | 162.4698 | 143.1057 | 136.2082 | 116.6355 | 108.3981 | 120.8559 | 122.5609 | 142.3576 | 156.0098 | 175.3148 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1714.4017 | |
| Distribution loss (46)m = 0.15 x (45)m | 26.3776 | 23.1952 | 24.3705 | 21.4658 | 20.4312 | 17.4953 | 16.2597 | 18.1284 | 18.3841 | 21.3536 | 23.4015 | 26.2972 | (46) |

Water storage loss:
Store volume 110.0000 (47)
b) If manufacturer declared loss factor is not known :
Hot water storage loss factor from Table 2 (kWh/litre/day) 0.0152 (51)
Volume factor from Table 2a 1.0294 (52)
Temperature factor from Table 2b 0.6000 (53)
Enter (49) or (54) in (55) 1.0327 (55)
Total storage loss

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (56) |

If cylinder contains dedicated solar storage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (57) |
| Primary loss 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |

Total heat required for water heating calculated for each month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 231.1278 | 204.5621 | 217.7466 | 196.5993 | 191.4850 | 170.1292 | 163.6749 | 176.1327 | 176.0545 | 197.6344 | 209.5034 | 230.5916 | (62) |
| WWHRS 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63a) |
| PV diverter -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |

Output from w/h

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 231.1278 | 204.5621 | 217.7466 | 196.5993 | 191.4850 | 170.1292 | 163.6749 | 176.1327 | 176.0545 | 197.6344 | 209.5034 | 230.5916 | (64) |

Total per year (kWh/year) = Sum(64)m = 2365.2415 (64)
12Total per year (kWh/year) 2365 (64)
Electric shower(s)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)
Heat gains from water heating, kWh/month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 102.6919 | 91.3580 | 98.2426 | 90.3776 | 89.5107 | 81.5762 | 80.2638 | 84.4060 | 83.5464 | 91.5553 | 94.6682 | 102.5136 | (65) |

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## 5. Internal gains (see Table 5 and 5a)

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Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 105.4135 | 105.4135 | 105.4135 | 105.4135 | 105.4135 | 105.4135 | 105.4135 | 105.4135 | 105.4135 | 105.4135 | 105.4135 | 105.4135 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 94.2253 | 104.3209 | 94.2253 | 97.3662 | 94.2253 | 97.3662 | 94.2253 | 94.2253 | 97.3662 | 94.2253 | 97.3662 | 94.2253 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 184.3817 | 186.2950 | 181.4736 | 171.2092 | 158.2524 | 146.0747 | 137.9393 | 136.0260 | 140.8475 | 151.1118 | 164.0687 | 176.2463 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 33.5413 | 33.5413 | 33.5413 | 33.5413 | 33.5413 | 33.5413 | 33.5413 | 33.5413 | 33.5413 | 33.5413 | 33.5413 | 33.5413 | (69) |
| Pumps, fans | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | -84.3308 | -84.3308 | -84.3308 | -84.3308 | -84.3308 | -84.3308 | -84.3308 | -84.3308 | -84.3308 | -84.3308 | -84.3308 | -84.3308 | (71) |
| Water heating gains (Table 5) | 138.0267 | 135.9494 | 132.0466 | 125.5244 | 120.3100 | 113.3003 | 107.8815 | 113.4489 | 116.0367 | 123.0583 | 131.4836 | 137.7871 | (72) |
| Total internal gains | 471.2579 | 481.1894 | 462.3695 | 448.7239 | 427.4118 | 411.3653 | 394.6702 | 398.3243 | 408.8744 | 423.0195 | 447.5425 | 462.8828 | (73) |

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## 6. Solar gains

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| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W |
|---|---|---|---|---|---|---|

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northwest | | | | 9.9900 | | 11.2829 | | 0.4500 | | 0.7000 | | 0.7700 | | 24.6055 (81) |
| Northwest | | | | 2.2900 | | 11.2829 | | 0.4500 | | 0.7000 | | 0.7700 | | 5.6403 (81) |
| Solar gains | 30.2458 | 61.5661 | 110.9226 | 182.1667 | 244.8678 | 261.0550 | 244.2116 | 194.6883 | 135.1609 | 75.2387 | 38.0570 | 24.7002 (83) | |
| Total gains | 501.5036 | 542.7555 | 573.2921 | 630.8906 | 672.2796 | 672.4203 | 638.8818 | 593.0127 | 544.0353 | 498.2581 | 485.5995 | 487.5830 (84) | |

## 7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 (85) | |
| Utilisation factor for gains for living area, ni1,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 140.3313 | 141.0207 | 141.7170 | 145.3037 | 146.0430 | 149.8550 | 149.8550 | 150.6414 | 148.3066 | 146.0430 | 144.5719 | 143.1302 | |
| alpha | 10.3554 | 10.4014 | 10.4478 | 10.6869 | 10.7362 | 10.9903 | 10.9903 | 11.0428 | 10.8871 | 10.7362 | 10.6381 | 10.5420 | |
| util living area | 0.9976 | 0.9933 | 0.9761 | 0.8644 | 0.6498 | 0.4372 | 0.3164 | 0.3545 | 0.5880 | 0.9072 | 0.9899 | 0.9981 (86) | |
| MIT | 20.6083 | 20.6968 | 20.8220 | 20.9656 | 20.9981 | 21.0000 | 21.0000 | 21.0000 | 20.9995 | 20.9529 | 20.7768 | 20.6046 (87) | |
| Th 2 | 20.2886 | 20.2919 | 20.2951 | 20.3114 | 20.3147 | 20.3310 | 20.3310 | 20.3343 | 20.3245 | 20.3147 | 20.3081 | 20.3016 (88) | |
| util rest of house | 0.9965 | 0.9903 | 0.9660 | 0.8288 | 0.6030 | 0.3915 | 0.2683 | 0.3032 | 0.5308 | 0.8713 | 0.9847 | 0.9972 (89) | |
| MIT 2 | 19.8402 | 19.9547 | 20.1117 | 20.2833 | 20.3135 | 20.3310 | 20.3310 | 20.3343 | 20.3242 | 20.2770 | 20.0699 | 19.8465 (90) | |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.3525 (91) | |
| MIT | 20.1109 | 20.2163 | 20.3621 | 20.5238 | 20.5548 | 20.5668 | 20.5668 | 20.5689 | 20.5622 | 20.5152 | 20.3190 | 20.1137 (92) | |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 20.1109 | 20.2163 | 20.3621 | 20.5238 | 20.5548 | 20.5668 | 20.5668 | 20.5689 | 20.5622 | 20.5152 | 20.3190 | 20.1137 (93) | |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9961 | 0.9899 | 0.9671 | 0.8403 | 0.6195 | 0.4076 | 0.2852 | 0.3213 | 0.5510 | 0.8827 | 0.9848 | 0.9969 (94) | |
| Useful gains | 499.5519 | 537.3005 | 554.4456 | 530.1432 | 416.4581 | 274.1072 | 182.2357 | 190.5210 | 299.7704 | 439.7892 | 478.2191 | 486.0498 (95) | |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 (96) | |
| Heat loss rate W | 775.6530 | 747.7125 | 673.3952 | 550.7248 | 417.4102 | 274.1157 | 182.2358 | 190.5214 | 299.9767 | 467.3964 | 629.4776 | 765.4292 (97) | |
| Space heating kWh | 205.4193 | 141.3968 | 88.4985 | 14.8187 | 0.7084 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 20.5398 | 108.9061 | 207.8583 (98a) | |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 788.1459 | |
| Solar heating kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (98b) | |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | 205.4193 | 141.3968 | 88.4985 | 14.8187 | 0.7084 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 20.5398 | 108.9061 | 207.8583 (98c) | |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 788.1459 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 12.2004 (99) | |

## 8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ext. temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | |
| Heat loss rate W | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 431.8381 | 339.9576 | 347.3230 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (100) | |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.9988 | 0.9998 | 0.9995 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (101) | |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 431.3288 | 339.8947 | 347.1552 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (102) | |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 736.0802 | 699.4524 | 646.7762 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (103) | |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 219.4210 | 267.5109 | 222.9180 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (104) | |
| Cooled fraction | | | | | | | | | | fC = cooled area / (4) = | | 0.9907 (105) | |
| Intermittency factor (Table 10b) | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 (106) | |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 54.3457 | 66.2566 | 55.2119 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (107) | |
| Space cooling requirement | | | | | | | | | | | | 175.8142 (107) | |

## 9b. Energy requirements

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | 0.0000 (301) | |
| Fraction of space heat from community system | | | | | | | | | | | | 1.0000 (302) | |
| Fraction of heat from community Heat pump-Space and Water | | | | | | | | | | | | 1.0000 (303a) | |
| Factor for control and charging method (Table 4c(3)) for space heating | | | | | | | | | | | | 1.0000 (305) | |
| Factor for charging method (Table 4c(3)) for water heating | | | | | | | | | | | | 1.0000 (305a) | |
| Distribution loss factor (Table 12c) for community heating system | | | | | | | | | | | | 2.0000 (306) | |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 (208) | |
| Space heating: | | | | | | | | | | | | | |
| Space heating requirement | | | | | | | | | | | | | |
| | 205.4193 | 141.3968 | 88.4985 | 14.8187 | 0.7084 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 20.5398 | 108.9061 | 207.8583 (98) | |
| Space heat from Heat pump = (98) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 307a | 410.8385 | 282.7937 | 176.9970 | 29.6375 | 1.4168 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 41.0795 | 217.8122 | 415.7166 | |
| Space heating requirement | | | | | | | | | | | | | |
| | 410.8385 | 282.7937 | 176.9970 | 29.6375 | 1.4168 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 41.0795 | 217.8122 | 415.7166 (307) | |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | | | | | | | | | | | 0.0000 (308) | |
| Space heating fuel for secondary/supplementary system | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (309) | |
| Water heating | | | | | | | | | | | | | |
| Annual water heating requirement | | | | | | | | | | | | | |
| | 231.1278 | 204.5621 | 217.7466 | 196.5993 | 191.4850 | 170.1292 | 163.6749 | 176.1327 | 176.0545 | 197.6344 | 209.5034 | 230.5916 (64) | |
| Water heat from Heat pump = (64) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 310a | 462.2555 | 409.1242 | 435.4932 | 393.1987 | 382.9700 | 340.2583 | 327.3499 | 352.2653 | 352.1091 | 395.2688 | 419.0069 | 461.1832 | |
| Water heating fuel | | | | | | | | | | | | | |
| | 462.2555 | 409.1242 | 435.4932 | 393.1987 | 382.9700 | 340.2583 | 327.3499 | 352.2653 | 352.1091 | 395.2688 | 419.0069 | 461.1832 (310) | |
| Cooling System Energy Efficiency Ratio | | | | | | | | | | | | 2.6000 (314) | |
| Space coolin | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 20.9022 | 25.4833 | 21.2353 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (315) | |
| Pumps and Fa | 17.7113 | 15.9973 | 17.7113 | 17.1400 | 17.7113 | 17.1400 | 17.7113 | 17.7113 | 17.1400 | 17.7113 | 17.1400 | 17.7113 (331) | |
| Lighting | 19.5432 | 15.6783 | 14.1165 | 10.3424 | 7.9888 | 6.5269 | 7.2876 | 9.4727 | 12.3041 | 16.1437 | 18.2342 | 20.0864 (332) | |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333a)m | -4.7727 | -7.7387 | -12.8708 | -16.6940 | -19.9722 | -19.3936 | -19.1192 | -16.9892 | -13.6309 | -9.6695 | -5.5693 | -4.0052 (333a) | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335a) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (333b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335b) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - community heating | 1576.2918 | (307) |
| Space heating fuel - secondary | 0.0000 | (309) |
| Water heating fuel - community heating | 4730.4830 | (310) |
| Efficiency of water heater | 0.0000 | (311) |
| Electricity used for heat distribution | 15.7629 | (313) |
| Space cooling fuel | 67.6208 | (321) |
| | | |
| Electricity for pumps and fans: | | |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8820) | | |
| mechanical ventilation fans (SFP = 0.8820) | 208.5366 | (330a) |
| Total electricity for the above, kWh/year | 208.5366 | (331) |
| Electricity for lighting (calculated in Appendix L) | 157.7247 | (332) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -150.4253 | (333) |
| Wind generation | 0.0000 | (334) |
| Hydro-electric generation (Appendix N) | 0.0000 | (335a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (335) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (336) |
| Energy used | 0.0000 | (337) |
| Total delivered energy for all uses | 6590.2316 | (338) |

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12b. Carbon dioxide emissions - Community heating scheme

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (367) |
| Space and Water heating from Heat pump | 2252.4196 | 0.1586 | 89.2706 | (367) |
| Electrical energy for heat distribution (space & water) | 15.7629 | 0.0000 | 9.1595 | (372) |
| Overall CO2 factor for heat network | | | 0.0533 | (386) |
| Total CO2 associated with community systems | | | 336.2854 | (373) |
| Space and water heating | | | 336.2854 | (376) |
| Space cooling | 67.6208 | 0.1141 | 7.7153 | (377) |
| Pumps, fans and electric keep-hot | 208.5366 | 0.1387 | 28.9266 | (378) |
| Energy for lighting | 157.7247 | 0.1443 | 22.7646 | (379) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -150.4253 | 0.1318 | -19.8330 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -19.8330 | (380) |
| Total CO2, kg/year | | | 375.8588 | (383) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 5.8200 | (384) |

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13b. Primary energy - Community heating scheme

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| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (467a) |
| Space and Water heating from Heat pump | 2252.4196 | 1.5870 | 893.4220 | (467) |
| Electrical energy for heat distribution (space & water) | 15.7629 | 0.0000 | 96.9464 | (472) |
| Overall CO2 factor for heat network | | | 0.5644 | (486) |
| Total CO2 associated with community systems | | | 3559.3181 | (473) |
| Space and water heating | | | 3559.3181 | (476) |
| Space cooling | 67.6208 | 1.4205 | 96.0571 | (477) |
| Pumps, fans and electric keep-hot | 208.5366 | 1.5128 | 315.4741 | (478) |
| Energy for lighting | 157.7247 | 1.5338 | 241.9234 | (479) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -150.4253 | 1.4871 | -223.7009 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -223.7009 | (480) |
| Total Primary energy kWh/year | | | 3989.0718 | (483) |
| Dwelling Primary energy Rate (DPER) | | | 61.7500 | (484) |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 64.6000 | (1b) | x 3.0000 | (2b) = | 193.8000 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 64.6000 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | | 193.8000 | (5) |

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2. Ventilation rate

---

m3 per hour

| | | |
|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 (6a) |
| Number of open flues | 0 * 20 = | 0.0000 (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 (6f) |
| Number of intermittent extract fans | 2 * 10 = | 20.0000 (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 (7c) |

| | | Air changes per hour | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 20.0000 / (5) = | 0.1032 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3532 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.3532 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.4503 | 0.4415 | 0.4327 | 0.3885 | 0.3797 | 0.3355 | 0.3355 | 0.3267 | 0.3532 | 0.3797 | 0.3973 | 0.4150 | (22b) |
| Effective ac | 0.6014 | 0.5975 | 0.5936 | 0.5755 | 0.5721 | 0.5563 | 0.5563 | 0.5534 | 0.5624 | 0.5721 | 0.5789 | 0.5861 | (25) |

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## 3. Heat losses and heat loss parameter

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| Element | Gross | Openings | NetArea | U-value | A x U | K-value | A x K | |
|---|---|---|---|---|---|---|---|---|
| | m2 | m2 | m2 | W/m2K | W/K | kJ/m2K | kJ/K | |
| Main dwelling | | | | | | | | |
| TER Opaque door | | | 1.8900 | 1.0000 | 1.8900 | | | (26) |
| TER Opening Type | | | 12.2800 | 1.1450 | 14.0611 | | | (27) |
| External Walls | 41.8800 | 12.2800 | 29.6000 | 0.1800 | 5.3280 | | | (29a) |
| Wall to Communal Corridor | 30.2900 | 1.8900 | 28.4000 | 0.1800 | 5.1120 | | | (29a) |
| External Roof | 14.5000 | | 14.5000 | 0.1100 | 1.5950 | | | (30) |
| Total net area of external elements Aum(A, m2) | | | 86.6700 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 27.9861 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 19 | | | 19.6100 | 0.0000 | 0.0000 | | | (32) |
| Party Wall to Unit 24 | | | 19.6100 | 0.0000 | 0.0000 | | | (32) |

| | | |
|---|---|---|
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | 368.1724 | (35) |

List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E1 Steel lintel with perforated steel base plate | 6.3600 | 0.0500 | 0.3180 |
| E4 Jamb | 17.6400 | 0.0500 | 0.8820 |
| E7 Party floor between dwellings (in blocks of flats) | 10.1400 | 0.0700 | 0.7098 |
| E18 Party wall between dwellings | 6.0000 | 0.0600 | 0.3600 |
| E24 Eaves (insulation at ceiling level - inverted) | 5.4000 | 0.2400 | 1.2960 |
| E24 Eaves (insulation at ceiling level - inverted) | 10.1400 | 0.2400 | 2.4336 |
| E15 Flat roof with parapet | 8.5600 | 0.5600 | 4.7936 |
| E7 Party floor between dwellings (in blocks of flats) | 10.0000 | 0.0700 | 0.7000 |
| E16 Corner (normal) | 3.0000 | 0.0900 | 0.2700 |
| E17 Corner (inverted - internal area greater than external area) | 6.0000 | -0.0900 | -0.5400 |

| | | |
|---|---|---|
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | 11.2230 | (36) |
| Point Thermal bridges | (36a) = 0.0000 | |
| Total fabric heat loss | (33) + (36) + (36a) = 39.2091 | (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 38.4618 | 38.2100 | 37.9632 | 36.8038 | 36.5869 | 35.5772 | 35.5772 | 35.3902 | 35.9661 | 36.5869 | 37.0257 | 37.4845 | (38) |
| Heat transfer coeff | 77.6709 | 77.4191 | 77.1722 | 76.0129 | 75.7960 | 74.7862 | 74.7862 | 74.5993 | 75.1752 | 75.7960 | 76.2348 | 76.6935 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 76.0119 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.2023 | 1.1984 | 1.1946 | 1.1767 | 1.1733 | 1.1577 | 1.1577 | 1.1548 | 1.1637 | 1.1733 | 1.1801 | 1.1872 | (40) |
| HLP (average) | | | | | | | | | | | | 1.1767 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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## 4. Water heating energy requirements (kWh/year)

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| | | |
|---|---|---|
| Assumed occupancy | 2.1083 | (42) |

Hot water usage for mixer showers

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 59.5684 | 58.6732 | 57.3687 | 54.8728 | 53.0309 | 50.9768 | 49.8093 | 51.1039 | 52.5230 | 54.7285 | 57.2780 | 59.3401 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 25.7396 | 25.3573 | 24.8190 | 23.8264 | 23.0832 | 22.2591 | 21.8140 | 22.3485 | 22.9305 | 23.8124 | 24.8254 | 25.6526 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 36.2208 | 34.9037 | 33.5866 | 32.2694 | 30.9523 | 29.6352 | 29.6352 | 30.9523 | 32.2694 | 33.5866 | 34.9037 | 36.2208 | (42c) |

| | | |
|---|---|---|
| Average daily hot water use (litres/day) | 111.7127 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 121.5287 | 118.9341 | 115.7742 | 110.9687 | 107.0664 | 102.8711 | 101.2585 | 104.4047 | 107.7230 | 112.1274 | 117.0070 | 121.2135 | (44) |
| Energy conte | 192.4718 | 169.3606 | 177.9407 | 151.9106 | 144.1320 | 126.4921 | 122.4634 | 129.2749 | 132.8333 | 152.1558 | 166.6979 | 189.7910 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1855.5241 | |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | | |
| | 28.8708 | 25.4041 | 26.6911 | 22.7866 | 21.6198 | 18.9738 | 18.3695 | 19.3912 | 19.9250 | 22.8234 | 25.0047 | 28.4687 | (46) |

| | | |
|---|---|---|
| Water storage loss: | | |
| Store volume | 150.0000 | (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | 1.3938 | (48) |
| Temperature factor from Table 2b | 0.5400 | (49) |
| Enter (49) or (54) in (55) | 0.7527 | (55) |

Total storage loss

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (56) |

If cylinder contains dedicated solar storage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (57) |
| Primary loss 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |

Total heat required for water heating calculated for each month

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 239.0667 | 211.4464 | 224.5356 | 197.0024 | 190.7269 | 171.5839 | 169.0583 | 175.8698 | 177.9251 | 198.7507 | 211.7898 | 236.3859 | (62) |
| WWHRS | -27.2322 | -24.0844 | -25.2197 | -20.8829 | -19.4622 | -16.6539 | -15.6104 | -16.6001 | -17.2308 | -20.3132 | -23.0124 | -26.7279 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | | | | | | | | | | | | | |
| | 211.8345 | 187.3620 | 199.3158 | 176.1195 | 171.2648 | 154.9300 | 153.4479 | 159.2697 | 160.6943 | 178.4376 | 188.7774 | 209.6580 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2151.1116 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2151 | (64) |
| Electric shower(s) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | | | | | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | | | | | | | | | | | | | |
| | 101.2728 | 89.9810 | 96.4412 | 86.5837 | 85.1998 | 78.1321 | 77.9950 | 80.2598 | 80.2405 | 87.8677 | 91.5005 | 100.3814 | (65) |

## 5. Internal gains (see Table 5 and 5a)

| Metabolic gains (Table 5), Watts | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 105.4135 | 105.4135 | 105.4135 | 105.4135 | 105.4135 | 105.4135 | 105.4135 | 105.4135 | 105.4135 | 105.4135 | 105.4135 | 105.4135 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 94.2253 | 104.3209 | 94.2253 | 97.3662 | 94.2253 | 97.3662 | 94.2253 | 94.2253 | 97.3662 | 94.2253 | 97.3662 | 94.2253 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 184.3817 | 186.2950 | 181.4736 | 171.2092 | 158.2524 | 146.0747 | 137.9393 | 136.0260 | 140.8475 | 151.1118 | 164.0687 | 176.2463 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 33.5413 | 33.5413 | 33.5413 | 33.5413 | 33.5413 | 33.5413 | 33.5413 | 33.5413 | 33.5413 | 33.5413 | 33.5413 | 33.5413 | (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.0000 | 3.0000 | 3.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | | | | | | | | | | | | | |
| | -84.3308 | -84.3308 | -84.3308 | -84.3308 | -84.3308 | -84.3308 | -84.3308 | -84.3308 | -84.3308 | -84.3308 | -84.3308 | -84.3308 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 136.1193 | 133.9003 | 129.6253 | 120.2552 | 114.5159 | 108.5168 | 104.8320 | 107.8761 | 111.4452 | 118.1018 | 127.0841 | 134.9213 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 472.3505 | 482.1403 | 462.9482 | 446.4547 | 424.6176 | 406.5817 | 391.6207 | 392.7515 | 404.2829 | 421.0630 | 446.1430 | 463.0170 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Northwest | 12.2800 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 42.3441 | (81) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 42.3441 | 86.1926 | 155.2916 | 255.0334 | 342.8149 | 365.4770 | 341.8962 | 272.5636 | 189.2252 | 105.3341 | 53.2798 | 34.5803 | (83) |
| Total gains | 514.6945 | 568.3328 | 618.2398 | 701.4881 | 767.4326 | 772.0587 | 733.5169 | 665.3151 | 593.5081 | 526.3971 | 499.4228 | 497.5973 | (84) |

## 7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 85.0595 | 85.3362 | 85.6091 | 86.9148 | 87.1636 | 88.3404 | 88.3404 | 88.5619 | 87.8834 | 87.1636 | 86.6619 | 86.1435 | |
| alpha | 6.6706 | 6.6891 | 6.7073 | 6.7943 | 6.8109 | 6.8894 | 6.8894 | 6.9041 | 6.8589 | 6.8109 | 6.7775 | 6.7429 | |
| util living area | | | | | | | | | | | | | |
| | 0.9987 | 0.9971 | 0.9915 | 0.9571 | 0.8320 | 0.6110 | 0.4476 | 0.5132 | 0.8070 | 0.9778 | 0.9968 | 0.9990 | (86) |
| MIT | 20.0606 | 20.1841 | 20.3924 | 20.7011 | 20.9201 | 20.9917 | 20.9991 | 20.9979 | 20.9521 | 20.6706 | 20.3240 | 20.0487 | (87) |
| Th 2 | 19.9181 | 19.9213 | 19.9243 | 19.9387 | 19.9414 | 19.9540 | 19.9540 | 19.9563 | 19.9491 | 19.9414 | 19.9359 | 19.9302 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9981 | 0.9957 | 0.9871 | 0.9355 | 0.7674 | 0.5159 | 0.3418 | 0.3983 | 0.7138 | 0.9622 | 0.9948 | 0.9985 | (89) |
| MIT 2 | 18.8415 | 19.0017 | 19.2683 | 19.6562 | 19.8861 | 19.9507 | 19.9538 | 19.9559 | 19.9243 | 19.6300 | 19.1922 | 18.8358 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.3525 | (91) |
| MIT | 19.2712 | 19.4185 | 19.6645 | 20.0245 | 20.2506 | 20.3176 | 20.3223 | 20.3232 | 20.2865 | 19.9968 | 19.5912 | 19.2633 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.2712 | 19.4185 | 19.6645 | 20.0245 | 20.2506 | 20.3176 | 20.3223 | 20.3232 | 20.2865 | 19.9968 | 19.5912 | 19.2633 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9976 | 0.9948 | 0.9857 | 0.9376 | 0.7878 | 0.5496 | 0.3792 | 0.4390 | 0.7463 | 0.9633 | 0.9940 | 0.9981 | (94) |
| Useful gains | 513.4433 | 565.3825 | 609.3974 | 657.6880 | 604.6072 | 424.3146 | 278.1574 | 292.1010 | 442.9177 | 507.0561 | 496.4105 | 496.6284 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | | | | | | | | | | | | | |
| | 1162.8286 | 1124.0079 | 1015.9349 | 845.6072 | 648.0997 | 427.6013 | 278.3755 | 292.6671 | 465.0746 | 712.2364 | 952.2606 | 1155.2593 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 483.1427 | 375.3962 | 302.4639 | 135.3018 | 32.3584 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 152.6542 | 328.2121 | 490.0214 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 2299.5507 | |
| Solar heating kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | | | | | | | | | | | | | |
| | 483.1427 | 375.3962 | 302.4639 | 135.3018 | 32.3584 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 152.6542 | 328.2121 | 490.0214 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 2299.5507 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 35.5968 | (99) |

## 9a. Energy requirements - Individual heating systems, including micro-CHP

| | | |
|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | 0.0000 | (201) |
| Fraction of space heat from main system(s) | 1.0000 | (202) |
| Efficiency of main space heating system 1 (in %) | 92.3000 | (206) |
| Efficiency of main space heating system 2 (in %) | 0.0000 | (207) |
| Efficiency of secondary/supplementary heating system, % | 0.0000 | (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement | | | | | | | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 483.1427 | 375.3962 | 302.4639 | 135.3018 | 32.3584 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 152.6542 | 328.2121 | 490.0214 (98) |
| Space heating efficiency (main heating system 1) | | | | | | | | | | | | |
| | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.3000 | 92.3000 | 92.3000 (210) |
| Space heating fuel (main heating system) | | | | | | | | | | | | |
| | 523.4482 | 406.7131 | 327.6966 | 146.5892 | 35.0578 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 165.3891 | 355.5927 | 530.9007 (211) |
| Space heating efficiency (main heating system 2) | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (212) |
| Space heating fuel (main heating system 2) | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (213) |
| Space heating fuel (secondary) | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (215) |
| Water heating | | | | | | | | | | | | |
| Water heating requirement | | | | | | | | | | | | |
| | 211.8345 | 187.3620 | 199.3158 | 176.1195 | 171.2648 | 154.9300 | 153.4479 | 159.2697 | 160.6943 | 178.4376 | 188.7774 | 209.6580 (64) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 (216) |
| (217)m | 85.8488 | 85.5863 | 84.9924 | 83.4757 | 81.1063 | 79.8000 | 79.8000 | 79.8000 | 79.8000 | 83.7118 | 85.2877 | 85.8971 (217) |
| Fuel for water heating, kWh/month | | | | | | | | | | | | |
| | 246.7531 | 218.9158 | 234.5101 | 210.9828 | 211.1608 | 194.1479 | 192.2906 | 199.5861 | 201.3713 | 213.1570 | 221.3420 | 244.0804 (219) |
| Space cooling fuel requirement | | | | | | | | | | | | |
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (221) |
| Pumps and Fa | 7.3041 | 6.5973 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 (231) |
| Lighting | 19.5782 | 15.7063 | 14.1418 | 10.3609 | 8.0031 | 6.5386 | 7.3007 | 9.4897 | 12.3261 | 16.1726 | 18.2669 | 20.1223 (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (233a)m | -14.3609 | -21.5616 | -32.9837 | -39.5497 | -44.8429 | -42.6723 | -42.1594 | -38.7052 | -33.0095 | -25.7186 | -16.2503 | -12.2677 (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | |
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (233b)m | -4.5565 | -9.8475 | -20.0709 | -30.8905 | -41.5834 | -42.0485 | -41.5478 | -34.8326 | -25.0864 | -14.3163 | -6.1576 | -3.5835 (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | |
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235d) |

| | |
|---|---|
| Annual totals kWh/year | |
| Space heating fuel - main system 1 | 2491.3876 (211) |
| Space heating fuel - main system 2 | 0.0000 (213) |
| Space heating fuel - secondary | 0.0000 (215) |
| Efficiency of water heater | 79.8000 |
| Water heating fuel used | 2588.2980 (219) |
| Space cooling fuel | 0.0000 (221) |
| Electricity for pumps and fans: | |
| Total electricity for the above, kWh/year | 86.0000 (231) |
| Electricity for lighting (calculated in Appendix L) | 158.0070 (232) |
| Energy saving/generation technologies (Appendices M ,N and Q) | |
| PV generation | -638.6034 (233) |
| Wind generation | 0.0000 (234) |
| Hydro-electric generation (Appendix N) | 0.0000 (235a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 (235) |
| Appendix Q - special features | |
| Energy saved or generated | -0.0000 (236) |
| Energy used | 0.0000 (237) |
| Total delivered energy for all uses | 4685.0892 (238) |

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 2491.3876 | 0.2100 | 523.1914 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2588.2980 | 0.2100 | 543.5426 | (264) |
| Space and water heating | | | 1066.7340 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 158.0070 | 0.1443 | 22.8053 | (268) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -364.0819 | 0.1333 | -48.5257 | |
| PV Unit electricity exported | -274.5215 | 0.1252 | -34.3677 | |
| Total | | | -82.8935 | (269) |
| Total CO2, kg/year | | | 1018.5751 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 15.7700 | (273) |

13a. Primary energy - Individual heating systems including micro-CHP

| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 2491.3876 | 1.1300 | 2815.2680 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2588.2980 | 1.1300 | 2924.7767 | (278) |
| Space and water heating | | | 5740.0447 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 158.0070 | 1.5338 | 242.3564 | (282) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -364.0819 | 1.4925 | -543.3976 | |
| PV Unit electricity exported | -274.5215 | 0.4595 | -126.1439 | |
| Total | | | -669.5415 | (283) |
| Total Primary energy kWh/year | | | 5442.9604 | (286) |
| Target Primary Energy Rate (TPER) | | | 84.2600 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Property Reference** | Unit 24 | **Issued on Date** | 17/05/2025 |
| **Assessment Reference** | 00001 | **Prop Type Ref** | Unit 24 |
| **Property** | | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 79 C | **DER** | 5.70 | **TER** | 15.72 |
| **Environmental** | 96 A | **% DER < TER** | | | 63.74 |
| **$CO_2$ Emissions (t/year)** | 0.33 | **DFEE** | 33.64 | **TFEE** | 43.63 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 22.89 |
| **% DPER < TPER** | 27.75 | **DPER** | 60.70 | **TPER** | 84.01 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Robert Arnold | **Assessor ID** | BA04-0001 |
| **Client** | | | |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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## 1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 64.6000 | (1b) | x 3.0000 | (2b) = | 193.8000 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 64.6000 | | | | | (4) |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | 193.8000 | (5) |

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## 2. Ventilation rate

---

| | | m3 per hour | |
|---|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 | (6a) |
| Number of open flues | 0 * 20 = | 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | 0 * 10 = | 0.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |

| | Air changes per hour | | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 0.0000 / (5) = | 0.0000 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 3.0000 | (17) |
| Infiltration rate | | 0.1500 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.1500 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.1912 | 0.1875 | 0.1837 | 0.1650 | 0.1612 | 0.1425 | 0.1425 | 0.1388 | 0.1500 | 0.1612 | 0.1687 | 0.1762 | (22b) |

Balanced mechanical ventilation with heat recovery

| | |
|---|---|
| If mechanical ventilation | 0.5000 (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | 0.5000 (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | 81.0000 (23c) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective ac | 0.2862 | 0.2825 | 0.2787 | 0.2600 | 0.2562 | 0.2375 | 0.2375 | 0.2337 | 0.2450 | 0.2562 | 0.2637 | 0.2712 | (25) |

---

## 3. Heat losses and heat loss parameter

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| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| Windows | | | 9.9900 | 1.0536 | 10.5259 | | | (27) |
| Front Door | | | 1.8900 | 1.4000 | 2.6460 | | | (26) |
| Glass Door | | | 2.2900 | 1.3258 | 3.0360 | | | (27) |
| External Walls | 41.8800 | 12.2800 | 29.6000 | 0.1500 | 4.4400 | 150.0000 | 4440.0000 | (29a) |
| Wall to Communal Corridor | 30.2900 | 1.8900 | 28.4000 | 0.0000 | 0.0000 | 150.0000 | 4260.0000 | (29a) |
| External Roof | 14.5000 | | 14.5000 | 0.1000 | 1.4500 | 9.0000 | 130.5000 | (30) |
| Total net area of external elements Aum(A, m2) | | | 58.2700 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 22.0978 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 23 | | | 19.6100 | 0.0000 | 0.0000 | 110.0000 | 2157.1000 | (32) |
| Party Wall to Unit 26 | | | 19.6100 | 0.0000 | 0.0000 | 110.0000 | 2157.1000 | (32) |
| Party Floor | | | 64.6000 | | | 80.0000 | 5168.0000 | (32d) |
| Party Ceiling | | | 49.9900 | | | 100.0000 | 4999.0000 | (32b) |
| Internal Walls | | | 163.5600 | | | 9.0000 | 1472.0400 | (32c) |

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 24783.7400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 383.6492 (35)
List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E1 Steel lintel with perforated steel base plate | 6.3600 | 0.0500 | 0.3180 |
| E4 Jamb | 17.6400 | 0.0500 | 0.8820 |
| E7 Party floor between dwellings (in blocks of flats) | 10.1400 | 0.0350 | 0.3549 |
| E18 Party wall between dwellings | 6.0000 | 0.0600 | 0.3600 |
| E24 Eaves (insulation at ceiling level - inverted) | 9.2125 | 0.1200 | 1.1055 |
| E15 Flat roof with parapet | 8.5600 | 0.5600 | 4.7936 |
| E7 Party floor between dwellings (in blocks of flats) | 10.0000 | 0.0350 | 0.3500 |
| E16 Corner (normal) | 3.0000 | 0.0900 | 0.2700 |
| E17 Corner (inverted - internal area greater than external area) | 6.0000 | -0.0900 | -0.5400 |
| E24 Eaves (insulation at ceiling level - inverted) | 5.3750 | 0.1200 | 0.6450 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 8.5390 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 30.6368 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 18.3068 | 18.0670 | 17.8272 | 16.6280 | 16.3882 | 15.1891 | 15.1891 | 14.9492 | 15.6687 | 16.3882 | 16.8679 | 17.3475 | (38) |
| Heat transfer coeff | 48.9437 | 48.7039 | 48.4640 | 47.2649 | 47.0251 | 45.8259 | 45.8259 | 45.5861 | 46.3056 | 47.0251 | 47.5047 | 47.9844 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 47.2049 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 0.7576 | 0.7539 | 0.7502 | 0.7317 | 0.7279 | 0.7094 | 0.7094 | 0.7057 | 0.7168 | 0.7279 | 0.7354 | 0.7428 | (40) |
| HLP (average) | | | | | | | | | | | | 0.7307 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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4. Water heating energy requirements (kWh/year)

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Assumed occupancy 2.1083 (42)
Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 58.0634 | 57.1744 | 55.8644 | 53.8490 | 52.0434 | 49.5172 | 47.5192 | 49.8550 | 51.0298 | 53.5318 | 56.1375 | 58.0110 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 25.1658 | 24.7859 | 24.2454 | 23.4361 | 22.7067 | 21.7026 | 20.9408 | 21.8724 | 22.3612 | 23.3561 | 24.3905 | 25.1458 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 36.2208 | 34.9037 | 33.5866 | 32.2694 | 30.9523 | 29.6352 | 29.6352 | 30.9523 | 32.2694 | 33.5866 | 34.9037 | 36.2208 | (42c) |

Average daily hot water use (litres/day) 109.7926 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 119.4499 | 116.8640 | 113.6964 | 109.5546 | 105.7024 | 100.8550 | 98.0952 | 102.6797 | 105.6605 | 110.4745 | 115.4317 | 119.3776 | (44) |
| Energy conte | 175.8510 | 154.6347 | 162.4698 | 143.1057 | 136.2082 | 116.6355 | 108.3981 | 120.8559 | 122.5609 | 142.3576 | 156.0098 | 175.3148 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1714.4017 | |
| Distribution loss (46)m = 0.15 x (45)m | 26.3776 | 23.1952 | 24.3705 | 21.4658 | 20.4312 | 17.4953 | 16.2597 | 18.1284 | 18.3841 | 21.3536 | 23.4015 | 26.2972 | (46) |

Water storage loss:
Store volume 110.0000 (47)
b) If manufacturer declared loss factor is not known :
Hot water storage loss factor from Table 2 (kWh/litre/day) 0.0152 (51)
Volume factor from Table 2a 1.0294 (52)
Temperature factor from Table 2b 0.6000 (53)
Enter (49) or (54) in (55) 1.0327 (55)
Total storage loss

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (56) |

If cylinder contains dedicated solar storage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (57) |
| Primary loss 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |

Total heat required for water heating calculated for each month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 231.1278 | 204.5621 | 217.7466 | 196.5993 | 191.4850 | 170.1292 | 163.6749 | 176.1327 | 176.0545 | 197.6344 | 209.5034 | 230.5916 | (62) |
| WWHRS 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63a) |
| PV diverter -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | 231.1278 | 204.5621 | 217.7466 | 196.5993 | 191.4850 | 170.1292 | 163.6749 | 176.1327 | 176.0545 | 197.6344 | 209.5034 | 230.5916 | (64) |
| | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | | | 2365.2415 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2365 | (64) |
| Electric shower(s) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | | | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | 102.6919 | 91.3580 | 98.2426 | 90.3776 | 89.5107 | 81.5762 | 80.2638 | 84.4060 | 83.5464 | 91.5553 | 94.6682 | 102.5136 | (65) |

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5. Internal gains (see Table 5 and 5a)

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Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 105.4135 | 105.4135 | 105.4135 | 105.4135 | 105.4135 | 105.4135 | 105.4135 | 105.4135 | 105.4135 | 105.4135 | 105.4135 | 105.4135 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 94.2253 | 104.3209 | 94.2253 | 97.3662 | 94.2253 | 97.3662 | 94.2253 | 94.2253 | 97.3662 | 94.2253 | 97.3662 | 94.2253 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 184.3817 | 186.2950 | 181.4736 | 171.2092 | 158.2524 | 146.0747 | 137.9393 | 136.0260 | 140.8475 | 151.1118 | 164.0687 | 176.2463 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 33.5413 | 33.5413 | 33.5413 | 33.5413 | 33.5413 | 33.5413 | 33.5413 | 33.5413 | 33.5413 | 33.5413 | 33.5413 | 33.5413 | (69) |
| Pumps, fans 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | -84.3308 | -84.3308 | -84.3308 | -84.3308 | -84.3308 | -84.3308 | -84.3308 | -84.3308 | -84.3308 | -84.3308 | -84.3308 | -84.3308 | (71) |
| Water heating gains (Table 5) | 138.0267 | 135.9494 | 132.0466 | 125.5244 | 120.3100 | 113.3003 | 107.8815 | 113.4489 | 116.0367 | 123.0583 | 131.4836 | 137.7871 | (72) |
| Total internal gains | 471.2579 | 481.1894 | 462.3695 | 448.7239 | 427.4118 | 411.3653 | 394.6702 | 398.3243 | 408.8744 | 423.0195 | 447.5425 | 462.8828 | (73) |

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6. Solar gains

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| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W |
|---|---|---|---|---|---|---|

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northwest | | | | 9.9900 | 11.2829 | 0.7200 | 0.7000 | 0.7700 | 39.3687 | (81) | | | |
| Northwest | | | | 2.2900 | 11.2829 | 0.4500 | 0.7000 | 0.7700 | 5.6403 | (81) | | | |
| Solar gains | 45.0090 | 91.6172 | 165.0651 | 271.0842 | 364.3904 | 388.4787 | 363.4139 | 289.7178 | 201.1344 | 111.9635 | 56.6330 | 36.7566 | (83) |
| Total gains | 516.2669 | 572.8066 | 627.4346 | 719.8081 | 791.8022 | 799.8440 | 758.0841 | 688.0421 | 610.0088 | 534.9829 | 504.1755 | 499.6395 | (84) |

7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 140.6591 | 141.3517 | 142.0512 | 145.6551 | 146.3979 | 150.2288 | 150.2288 | 151.0191 | 148.6726 | 146.3979 | 144.9198 | 143.4711 | |
| alpha | 10.3773 | 10.4234 | 10.4701 | 10.7103 | 10.7599 | 11.0153 | 11.0153 | 11.0679 | 10.9115 | 10.7599 | 10.6613 | 10.5647 | |
| util living area | | | | | | | | | | | | | |
| | 0.9969 | 0.9895 | 0.9550 | 0.7796 | 0.5519 | 0.3667 | 0.2660 | 0.3048 | 0.5236 | 0.8683 | 0.9861 | 0.9976 | (86) |
| MIT | 20.6282 | 20.7329 | 20.8728 | 20.9868 | 20.9996 | 21.0000 | 21.0000 | 21.0000 | 20.9998 | 20.9698 | 20.7990 | 20.6213 | (87) |
| Th 2 | 20.2902 | 20.2934 | 20.2967 | 20.3130 | 20.3162 | 20.3326 | 20.3326 | 20.3358 | 20.3260 | 20.3162 | 20.3097 | 20.3032 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9954 | 0.9850 | 0.9389 | 0.7406 | 0.5115 | 0.3284 | 0.2256 | 0.2608 | 0.4725 | 0.8270 | 0.9793 | 0.9964 | (89) |
| MIT 2 | 19.8667 | 20.0010 | 20.1712 | 20.3029 | 20.3160 | 20.3326 | 20.3326 | 20.3358 | 20.3259 | 20.2933 | 20.0983 | 19.8692 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.3525 | (91) |
| MIT | 20.1351 | 20.2590 | 20.4185 | 20.5439 | 20.5569 | 20.5678 | 20.5678 | 20.5699 | 20.5635 | 20.5317 | 20.3453 | 20.1343 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 20.1351 | 20.2590 | 20.4185 | 20.5439 | 20.5569 | 20.5678 | 20.5678 | 20.5699 | 20.5635 | 20.5317 | 20.3453 | 20.1343 | (93) |

8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9950 | 0.9848 | 0.9420 | 0.7540 | 0.5258 | 0.3419 | 0.2399 | 0.2763 | 0.4905 | 0.8408 | 0.9797 | 0.9961 | (94) |
| Useful gains | 513.6980 | 564.0863 | 591.0357 | 542.7103 | 416.3016 | 273.4792 | 181.8287 | 190.0909 | 299.2306 | 449.7932 | 493.9629 | 497.6920 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | | | | | | | | | | | | | |
| | 775.0295 | 748.0416 | 674.5447 | 550.3494 | 416.4982 | 273.4805 | 181.8287 | 190.0910 | 299.2950 | 467.0410 | 629.2120 | 764.5976 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 194.4306 | 123.6180 | 62.1306 | 5.5002 | 0.1463 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 12.8323 | 97.3794 | 198.5777 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 694.6151 | |
| Solar heating kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | | | | | | | | | | | | | |
| | 194.4306 | 123.6180 | 62.1306 | 5.5002 | 0.1463 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 12.8323 | 97.3794 | 198.5777 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 694.6151 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 10.7526 | (99) |

8c. Space cooling requirement

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Calculated for June, July and August. See Table 10b | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| Ext. temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | |
| Heat loss rate W | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 430.7637 | 339.1118 | 346.4543 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (100) |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.9998 | 1.0000 | 0.9999 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (101) |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 430.6842 | 339.1024 | 346.4218 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (102) |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 885.0170 | 838.7797 | 757.8496 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103) |
| Space cooling kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 327.1196 | 371.7599 | 306.1023 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (104) |
| Cooled fraction | | | | | | | | | | fC = cooled area / (4) = | | 0.9907 | (105) |
| Intermittency factor (Table 10b) | | | | | | | | | | | | | |
| | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | (106) |
| Space cooling kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 81.0203 | 92.0768 | 75.8148 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) |
| Space cooling requirement | | | | | | | | | | | | 248.9119 | (107) |

9b. Energy requirements

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | 0.0000 | (301) |
| Fraction of space heat from community system | | | | | | | | | | | | 1.0000 | (302) |
| Fraction of heat from community Heat pump-Space and Water | | | | | | | | | | | | 1.0000 | (303a) |
| Factor for control and charging method (Table 4c(3)) for space heating | | | | | | | | | | | | 1.0000 | (305) |
| Factor for charging method (Table 4c(3)) for water heating | | | | | | | | | | | | 1.0000 | (305a) |
| Distribution loss factor (Table 12c) for community heating system | | | | | | | | | | | | 2.0000 | (306) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 | (208) |
| Space heating: | | | | | | | | | | | | | |
| Space heating requirement | | | | | | | | | | | | | |
| | 194.4306 | 123.6180 | 62.1306 | 5.5002 | 0.1463 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 12.8323 | 97.3794 | 198.5777 | (98) |
| Space heat from Heat pump = (98) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 307a | 388.8613 | 247.2360 | 124.2613 | 11.0003 | 0.2925 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 25.6646 | 194.7587 | 397.1554 | |
| Space heating requirement | | | | | | | | | | | | | |
| | 388.8613 | 247.2360 | 124.2613 | 11.0003 | 0.2925 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 25.6646 | 194.7587 | 397.1554 | (307) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | | | | | | | | | | | 0.0000 | (308) |
| Space heating fuel for secondary/supplementary system | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (309) |
| Water heating | | | | | | | | | | | | | |
| Annual water heating requirement | | | | | | | | | | | | | |
| | 231.1278 | 204.5621 | 217.7466 | 196.5993 | 191.4850 | 170.1292 | 163.6749 | 176.1327 | 176.0545 | 197.6344 | 209.5034 | 230.5916 | (64) |
| Water heat from Heat pump = (64) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 310a | 462.2555 | 409.1242 | 435.4932 | 393.1987 | 382.9700 | 340.2583 | 327.3499 | 352.2653 | 352.1091 | 395.2688 | 419.0069 | 461.1832 | |
| Water heating fuel | | | | | | | | | | | | | |
| | 462.2555 | 409.1242 | 435.4932 | 393.1987 | 382.9700 | 340.2583 | 327.3499 | 352.2653 | 352.1091 | 395.2688 | 419.0069 | 461.1832 | (310) |
| Cooling System Energy Efficiency Ratio | | | | | | | | | | | | 2.6000 | (314) |
| Space coolin | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 31.1617 | 35.4141 | 29.1595 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (315) |
| Pumps and Fa | 17.7113 | 15.9973 | 17.7113 | 17.1400 | 17.7113 | 17.1400 | 17.7113 | 17.7113 | 17.1400 | 17.7113 | 17.1400 | 17.7113 | (331) |
| Lighting | 19.5432 | 15.6783 | 14.1165 | 10.3424 | 7.9888 | 6.5269 | 7.2876 | 9.4727 | 12.3041 | 16.1437 | 18.2342 | 20.0864 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333a)m | -4.7727 | -7.7387 | -12.8708 | -16.6940 | -19.9722 | -19.3936 | -19.1192 | -16.9892 | -13.6309 | -9.6695 | -5.5693 | -4.0052 | (333a) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335a) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (333b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335b) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - community heating | 1389.2302 | (307) |
| Space heating fuel - secondary | 0.0000 | (309) |
| Water heating fuel - community heating | 4730.4830 | (310) |
| Efficiency of water heater | 0.0000 | (311) |
| Electricity used for heat distribution | 13.8923 | (313) |
| Space cooling fuel | 95.7353 | (321) |
| | | |
| Electricity for pumps and fans: | | |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8820) | | |
| mechanical ventilation fans (SFP = 0.8820) | 208.5366 | (330a) |
| Total electricity for the above, kWh/year | 208.5366 | (331) |
| Electricity for lighting (calculated in Appendix L) | 157.7247 | (332) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -150.4253 | (333) |
| Wind generation | 0.0000 | (334) |
| Hydro-electric generation (Appendix N) | 0.0000 | (335a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (335) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (336) |
| Energy used | 0.0000 | (337) |
| Total delivered energy for all uses | 6431.2846 | (338) |

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12b. Carbon dioxide emissions - Community heating scheme

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (367) |
| Space and Water heating from Heat pump | 2185.6119 | 0.1592 | 79.0004 | (367) |
| Electrical energy for heat distribution (space & water) | 13.8923 | 0.0000 | 8.8720 | (372) |
| Overall CO2 factor for heat network | | | 0.0532 | (386) |
| Total CO2 associated with community systems | | | 325.7276 | (373) |
| Space and water heating | | | 325.7276 | (376) |
| Space cooling | 95.7353 | 0.1142 | 10.9362 | (377) |
| Pumps, fans and electric keep-hot | 208.5366 | 0.1387 | 28.9266 | (378) |
| Energy for lighting | 157.7247 | 0.1443 | 22.7646 | (379) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -150.4253 | 0.1318 | -19.8330 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -19.8330 | (380) |
| Total CO2, kg/year | | | 368.5220 | (383) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 5.7000 | (384) |

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13b. Primary energy - Community heating scheme

---

| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (467a) |
| Space and Water heating from Heat pump | 2185.6119 | 1.5894 | 788.5646 | (467) |
| Electrical energy for heat distribution (space & water) | 13.8923 | 0.0000 | 94.0104 | (472) |
| Overall CO2 factor for heat network | | | 0.5640 | (486) |
| Total CO2 associated with community systems | | | 3451.5247 | (473) |
| Space and water heating | | | 3451.5247 | (476) |
| Space cooling | 95.7353 | 1.4210 | 136.0403 | (477) |
| Pumps, fans and electric keep-hot | 208.5366 | 1.5128 | 315.4741 | (478) |
| Energy for lighting | 157.7247 | 1.5338 | 241.9234 | (479) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -150.4253 | 1.4871 | -223.7009 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -223.7009 | (480) |
| Total Primary energy kWh/year | | | 3921.2617 | (483) |
| Dwelling Primary energy Rate (DPER) | | | 60.7000 | (484) |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 64.6000 | (1b) x | 3.0000 | (2b) = | 193.8000 | (1b) - (3b) (4) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 64.6000 | | | | | |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | | 193.8000 | (5) |

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2. Ventilation rate

---

m3 per hour

| | | |
|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 (6a) |
| Number of open flues | 0 * 20 = | 0.0000 (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 (6f) |
| Number of intermittent extract fans | 2 * 10 = | 20.0000 (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 (7c) |

| | | Air changes per hour | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 20.0000 / (5) = | 0.1032 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3532 | (18) |
| Number of sides sheltered | | 0 | (19) |

| | | | |
|---|---|---|---|
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.3532 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.4503 | 0.4415 | 0.4327 | 0.3885 | 0.3797 | 0.3355 | 0.3355 | 0.3267 | 0.3532 | 0.3797 | 0.3973 | 0.4150 | (22b) |
| Effective ac | 0.6014 | 0.5975 | 0.5936 | 0.5755 | 0.5721 | 0.5563 | 0.5563 | 0.5534 | 0.5624 | 0.5721 | 0.5789 | 0.5861 | (25) |

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## 3. Heat losses and heat loss parameter

---

| Element | Gross | Openings | NetArea | U-value | A x U | K-value | A x K | |
|---|---|---|---|---|---|---|---|---|
| | m2 | m2 | m2 | W/m2K | W/K | kJ/m2K | kJ/K | |
| Main dwelling | | | | | | | | |
| TER Opaque door | | | 1.8900 | 1.0000 | 1.8900 | | | (26) |
| TER Opening Type | | | 12.2800 | 1.1450 | 14.0611 | | | (27) |
| External Walls | 41.8800 | 12.2800 | 29.6000 | 0.1800 | 5.3280 | | | (29a) |
| Wall to Communal Corridor | 30.2900 | 1.8900 | 28.4000 | 0.1800 | 5.1120 | | | (29a) |
| External Roof | 14.5000 | | 14.5000 | 0.1100 | 1.5950 | | | (30) |
| Total net area of external elements Aum(A, m2) | | | 86.6700 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 27.9861 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 23 | | | 19.6100 | 0.0000 | 0.0000 | | | (32) |
| Party Wall to Unit 26 | | | 19.6100 | 0.0000 | 0.0000 | | | (32) |

| | |
|---|---|
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | 368.1724 (35) |

List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E1 Steel lintel with perforated steel base plate | 6.3600 | 0.0500 | 0.3180 |
| E4 Jamb | 17.6400 | 0.0500 | 0.8820 |
| E7 Party floor between dwellings (in blocks of flats) | 10.1400 | 0.0700 | 0.7098 |
| E18 Party wall between dwellings | 6.0000 | 0.0600 | 0.3600 |
| E24 Eaves (insulation at ceiling level - inverted) | 9.2125 | 0.2400 | 2.2110 |
| E15 Flat roof with parapet | 8.5600 | 0.5600 | 4.7936 |
| E7 Party floor between dwellings (in blocks of flats) | 10.0000 | 0.0700 | 0.7000 |
| E16 Corner (normal) | 3.0000 | 0.0900 | 0.2700 |
| E17 Corner (inverted - internal area greater than external area) | 6.0000 | -0.0900 | -0.5400 |
| E24 Eaves (insulation at ceiling level - inverted) | 5.3750 | 0.2400 | 1.2900 |

| | | |
|---|---|---|
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | 10.9944 (36) |
| Point Thermal bridges | (36a) = | 0.0000 |
| Total fabric heat loss | (33) + (36) + (36a) = | 38.9805 (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 38.4618 | 38.2100 | 37.9632 | 36.8038 | 36.5869 | 35.5772 | 35.5772 | 35.3902 | 35.9661 | 36.5869 | 37.0257 | 37.4845 | (38) |
| Heat transfer coeff | 77.4423 | 77.1905 | 76.9436 | 75.7843 | 75.5674 | 74.5576 | 74.5576 | 74.3707 | 74.9466 | 75.5674 | 76.0062 | 76.4649 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 75.7833 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.1988 | 1.1949 | 1.1911 | 1.1731 | 1.1698 | 1.1541 | 1.1541 | 1.1512 | 1.1602 | 1.1698 | 1.1766 | 1.1837 | (40) |
| HLP (average) | | | | | | | | | | | | 1.1731 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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## 4. Water heating energy requirements (kWh/year)

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| | | |
|---|---|---|
| Assumed occupancy | | 2.1083 (42) |

Hot water usage for mixer showers

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 59.5684 | 58.6732 | 57.3687 | 54.8728 | 53.0309 | 50.9768 | 49.8093 | 51.1039 | 52.5230 | 54.7285 | 57.2780 | 59.3401 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 25.7396 | 25.3573 | 24.8190 | 23.8264 | 23.0832 | 22.2591 | 21.8140 | 22.3485 | 22.9305 | 23.8124 | 24.8254 | 25.6526 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 36.2208 | 34.9037 | 33.5866 | 32.2694 | 30.9523 | 29.6352 | 29.6352 | 30.9523 | 32.2694 | 33.5866 | 34.9037 | 36.2208 | (42c) |

| | |
|---|---|
| Average daily hot water use (litres/day) | 111.7127 (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 121.5287 | 118.9341 | 115.7742 | 110.9687 | 107.0664 | 102.8711 | 101.2585 | 104.4047 | 107.7230 | 112.1274 | 117.0070 | 121.2135 | (44) |
| Energy conte | 192.4718 | 169.3606 | 177.9407 | 151.9106 | 144.1320 | 126.4921 | 122.4634 | 129.2749 | 132.8333 | 152.1558 | 166.6979 | 189.7910 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1855.5241 | |

Distribution loss (46)m = 0.15 x (45)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 28.8708 | 25.4041 | 26.6911 | 22.7866 | 21.6198 | 18.9738 | 18.3695 | 19.3912 | 19.9250 | 22.8234 | 25.0047 | 28.4687 | (46) |

| | |
|---|---|
| Water storage loss: | |
| Store volume | 150.0000 (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | 1.3938 (48) |
| Temperature factor from Table 2b | 0.5400 (49) |
| Enter (49) or (54) in (55) | 0.7527 (55) |

Total storage loss

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (56) |

If cylinder contains dedicated solar storage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (57) |
| Primary loss 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |

Total heat required for water heating calculated for each month

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 239.0667 | 211.4464 | 224.5356 | 197.0024 | 190.7269 | 171.5839 | 169.0583 | 175.8698 | 177.9251 | 198.7507 | 211.7898 | 236.3859 | (62) |
| WWHRS | -27.2322 | -24.0844 | -25.2197 | -20.8829 | -19.4622 | -16.6539 | -15.6104 | -16.6001 | -17.2308 | -20.3132 | -23.0124 | -26.7279 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | | | | | | | | | | | | | |
| | 211.8345 | 187.3620 | 199.3158 | 176.1195 | 171.2648 | 154.9300 | 153.4479 | 159.2697 | 160.6943 | 178.4376 | 188.7774 | 209.6580 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2151.1116 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2151 | (64) |
| Electric shower(s) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | | | | | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | | | | | | | | | | | | | |
| | 101.2728 | 89.9810 | 96.4412 | 86.5837 | 85.1998 | 78.1321 | 77.9950 | 80.2598 | 80.2405 | 87.8677 | 91.5005 | 100.3814 | (65) |

## 5. Internal gains (see Table 5 and 5a)

| Metabolic gains (Table 5), Watts | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 105.4135 | 105.4135 | 105.4135 | 105.4135 | 105.4135 | 105.4135 | 105.4135 | 105.4135 | 105.4135 | 105.4135 | 105.4135 | 105.4135 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 94.2253 | 104.3209 | 94.2253 | 97.3662 | 94.2253 | 97.3662 | 94.2253 | 94.2253 | 97.3662 | 94.2253 | 97.3662 | 94.2253 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 184.3817 | 186.2950 | 181.4736 | 171.2092 | 158.2524 | 146.0747 | 137.9393 | 136.0260 | 140.8475 | 151.1118 | 164.0687 | 176.2463 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 33.5413 | 33.5413 | 33.5413 | 33.5413 | 33.5413 | 33.5413 | 33.5413 | 33.5413 | 33.5413 | 33.5413 | 33.5413 | 33.5413 | (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.0000 | 3.0000 | 3.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | | | | | | | | | | | | | |
| | -84.3308 | -84.3308 | -84.3308 | -84.3308 | -84.3308 | -84.3308 | -84.3308 | -84.3308 | -84.3308 | -84.3308 | -84.3308 | -84.3308 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 136.1193 | 133.9003 | 129.6253 | 120.2552 | 114.5159 | 108.5168 | 104.8320 | 107.8761 | 111.4452 | 118.1018 | 127.0841 | 134.9213 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 472.3505 | 482.1403 | 462.9482 | 446.4547 | 424.6176 | 406.5817 | 391.6207 | 392.7515 | 404.2829 | 421.0630 | 446.1430 | 463.0170 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Northwest | 12.2800 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 42.3441 | (81) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 42.3441 | 86.1926 | 155.2916 | 255.0334 | 342.8149 | 365.4770 | 341.8962 | 272.5636 | 189.2252 | 105.3341 | 53.2798 | 34.5803 | (83) |
| Total gains | 514.6945 | 568.3328 | 618.2398 | 701.4881 | 767.4326 | 772.0587 | 733.5169 | 665.3151 | 593.5081 | 526.3971 | 499.4228 | 497.5973 | (84) |

## 7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 85.3106 | 85.5889 | 85.8635 | 87.1770 | 87.4273 | 88.6113 | 88.6113 | 88.8341 | 88.1514 | 87.4273 | 86.9225 | 86.4010 | |
| alpha | 6.6874 | 6.7059 | 6.7242 | 6.8118 | 6.8285 | 6.9074 | 6.9074 | 6.9223 | 6.8768 | 6.8285 | 6.7948 | 6.7601 | |
| util living area | | | | | | | | | | | | | |
| | 0.9987 | 0.9971 | 0.9915 | 0.9568 | 0.8308 | 0.6094 | 0.4463 | 0.5117 | 0.8056 | 0.9776 | 0.9967 | 0.9990 | (86) |
| MIT | 20.0647 | 20.1882 | 20.3960 | 20.7040 | 20.9214 | 20.9919 | 20.9992 | 20.9980 | 20.9530 | 20.6732 | 20.3275 | 20.0529 | (87) |
| Th 2 | 19.9210 | 19.9241 | 19.9271 | 19.9416 | 19.9443 | 19.9569 | 19.9569 | 19.9592 | 19.9520 | 19.9443 | 19.9388 | 19.9331 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9981 | 0.9957 | 0.9870 | 0.9350 | 0.7661 | 0.5147 | 0.3411 | 0.3975 | 0.7124 | 0.9619 | 0.9948 | 0.9985 | (89) |
| MIT 2 | 18.8490 | 19.0091 | 19.2752 | 19.6620 | 19.8900 | 19.9537 | 19.9567 | 19.9588 | 19.9276 | 19.6354 | 19.1989 | 18.8433 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.3525 | (91) |
| MIT | 19.2775 | 19.4247 | 19.6702 | 20.0293 | 20.2536 | 20.3196 | 20.3241 | 20.3251 | 20.2890 | 20.0012 | 19.5967 | 19.2697 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.2775 | 19.4247 | 19.6702 | 20.0293 | 20.2536 | 20.3196 | 20.3241 | 20.3251 | 20.2890 | 20.0012 | 19.5967 | 19.2697 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9976 | 0.9948 | 0.9856 | 0.9371 | 0.7866 | 0.5482 | 0.3783 | 0.4379 | 0.7449 | 0.9630 | 0.9939 | 0.9981 | (94) |
| Useful gains | 513.4417 | 565.3738 | 609.3539 | 657.3860 | 603.6566 | 423.2501 | 277.4533 | 291.3628 | 442.1275 | 506.9325 | 496.4002 | 496.6275 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | | | | | | | | | | | | | |
| | 1159.8947 | 1121.1657 | 1013.3661 | 843.4230 | 646.3704 | 426.4427 | 277.6636 | 291.9104 | 463.8468 | 710.4240 | 949.8275 | 1152.3016 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 480.9610 | 373.4921 | 300.5851 | 133.9466 | 31.7791 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 151.3977 | 326.4677 | 487.8216 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 2286.4507 | |
| Solar heating kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | | | | | | | | | | | | | |
| | 480.9610 | 373.4921 | 300.5851 | 133.9466 | 31.7791 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 151.3977 | 326.4677 | 487.8216 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 2286.4507 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 35.3940 | (99) |

## 9a. Energy requirements - Individual heating systems, including micro-CHP

| | | |
|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | 0.0000 | (201) |
| Fraction of space heat from main system(s) | 1.0000 | (202) |
| Efficiency of main space heating system 1 (in %) | 92.3000 | (206) |
| Efficiency of main space heating system 2 (in %) | 0.0000 | (207) |
| Efficiency of secondary/supplementary heating system, % | 0.0000 | (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement | | | | | | | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 480.9610 | 373.4921 | 300.5851 | 133.9466 | 31.7791 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 151.3977 | 326.4677 | 487.8216 (98) |
| Space heating efficiency (main heating system 1) | | | | | | | | | | | | |
| | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.3000 | 92.3000 | 92.3000 (210) |
| Space heating fuel (main heating system) | | | | | | | | | | | | |
| | 521.0845 | 404.6502 | 325.6609 | 145.1209 | 34.4302 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 164.0278 | 353.7028 | 528.5174 (211) |
| Space heating efficiency (main heating system 2) | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (212) |
| Space heating fuel (main heating system 2) | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (213) |
| Space heating fuel (secondary) | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (215) |
| Water heating | | | | | | | | | | | | |
| Water heating requirement | | | | | | | | | | | | |
| | 211.8345 | 187.3620 | 199.3158 | 176.1195 | 171.2648 | 154.9300 | 153.4479 | 159.2697 | 160.6943 | 178.4376 | 188.7774 | 209.6580 (64) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 (216) |
| (217)m | 85.8398 | 85.5758 | 84.9787 | 83.4539 | 81.0863 | 79.8000 | 79.8000 | 79.8000 | 79.8000 | 83.6935 | 85.2763 | 85.8883 (217) |
| Fuel for water heating, kWh/month | | | | | | | | | | | | |
| | 246.7789 | 218.9427 | 234.5479 | 211.0381 | 211.2130 | 194.1479 | 192.2906 | 199.5861 | 201.3713 | 213.2035 | 221.3716 | 244.1056 (219) |
| Space cooling fuel requirement | | | | | | | | | | | | |
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (221) |
| Pumps and Fa | 7.3041 | 6.5973 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 (231) |
| Lighting | 19.5782 | 15.7063 | 14.1418 | 10.3609 | 8.0031 | 6.5386 | 7.3007 | 9.4897 | 12.3261 | 16.1726 | 18.2669 | 20.1223 (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (233a)m | -14.3609 | -21.5616 | -32.9837 | -39.5497 | -44.8429 | -42.6723 | -42.1594 | -38.7052 | -33.0095 | -25.7186 | -16.2503 | -12.2677 (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | |
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (233b)m | -4.5565 | -9.8475 | -20.0709 | -30.8905 | -41.5834 | -42.0485 | -41.5478 | -34.8326 | -25.0864 | -14.3163 | -6.1576 | -3.5835 (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | |
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235d) |

| | |
|---|---|
| Annual totals kWh/year | |
| Space heating fuel - main system 1 | 2477.1947 (211) |
| Space heating fuel - main system 2 | 0.0000 (213) |
| Space heating fuel - secondary | 0.0000 (215) |
| Efficiency of water heater | 79.8000 |
| Water heating fuel used | 2588.5973 (219) |
| Space cooling fuel | 0.0000 (221) |
| Electricity for pumps and fans: | |
| Total electricity for the above, kWh/year | 86.0000 (231) |
| Electricity for lighting (calculated in Appendix L) | 158.0070 (232) |
| Energy saving/generation technologies (Appendices M ,N and Q) | |
| PV generation | -638.6034 (233) |
| Wind generation | 0.0000 (234) |
| Hydro-electric generation (Appendix N) | 0.0000 (235a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 (235) |
| Appendix Q - special features | |
| Energy saved or generated | -0.0000 (236) |
| Energy used | 0.0000 (237) |
| Total delivered energy for all uses | 4671.1957 (238) |

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 2477.1947 | 0.2100 | 520.2109 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2588.5973 | 0.2100 | 543.6054 | (264) |
| Space and water heating | | | 1063.8163 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 158.0070 | 0.1443 | 22.8053 | (268) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -364.0819 | 0.1333 | -48.5257 | |
| PV Unit electricity exported | -274.5215 | 0.1252 | -34.3677 | |
| Total | | | -82.8935 | (269) |
| Total CO2, kg/year | | | 1015.6574 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 15.7200 | (273) |

13a. Primary energy - Individual heating systems including micro-CHP

| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 2477.1947 | 1.1300 | 2799.2301 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2588.5973 | 1.1300 | 2925.1150 | (278) |
| Space and water heating | | | 5724.3451 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 158.0070 | 1.5338 | 242.3564 | (282) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -364.0819 | 1.4925 | -543.3976 | |
| PV Unit electricity exported | -274.5215 | 0.4595 | -126.1439 | |
| Total | | | -669.5415 | (283) |
| Total Primary energy kWh/year | | | 5427.2607 | (286) |
| Target Primary Energy Rate (TPER) | | | 84.0100 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Property Reference** | Unit 25 | **Issued on Date** | 17/05/2025 |
| **Assessment Reference** | 00001 | **Prop Type Ref** | Unit 25 |
| **Property** | | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 81 B | **DER** | 4.53 | **TER** | 11.19 |
| **Environmental** | 96 A | **% DER < TER** | | | 59.52 |
| **$CO_2$ Emissions (t/year)** | 0.39 | **DFEE** | 28.98 | **TFEE** | 30.96 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 6.40 |
| **% DPER < TPER** | 19.05 | **DPER** | 48.10 | **TPER** | 59.41 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Robert Arnold | **Assessor ID** | BA04-0001 |
| **Client** | | | |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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## 1. Overall dwelling characteristics

| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 97.1600 | (1b) | x 3.0000 | (2b) = | 291.4800 | (1b) - (3b) (4) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 97.1600 | | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | 291.4800 | (5) |

## 2. Ventilation rate

| | | m3 per hour | |
|---|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 | (6a) |
| Number of open flues | 0 * 20 = | 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | 0 * 10 = | 0.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |

| | Air changes per hour | | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 0.0000 / (5) = | 0.0000 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 3.0000 | (17) |
| Infiltration rate | | 0.1500 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.1500 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.1912 | 0.1875 | 0.1837 | 0.1650 | 0.1612 | 0.1425 | 0.1425 | 0.1388 | 0.1500 | 0.1612 | 0.1687 | 0.1762 | (22b) |
| Balanced mechanical ventilation with heat recovery | | | | | | | | | | | | | |
| If mechanical ventilation | | | | | | | | | | | | 0.5000 | (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | | | | | | | | | | | | 0.5000 | (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | | | | | | | | | | | | 80.1000 | (23c) |
| Effective ac | 0.2907 | 0.2870 | 0.2833 | 0.2645 | 0.2607 | 0.2420 | 0.2420 | 0.2382 | 0.2495 | 0.2607 | 0.2682 | 0.2757 | (25) |

## 3. Heat losses and heat loss parameter

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| Windows | | | 11.0200 | 1.0536 | 11.6111 | | | (27) |
| Front Door | | | 1.8900 | 1.4000 | 2.6460 | | | (26) |
| Glass Door | | | 2.2900 | 1.3258 | 3.0360 | | | (27) |
| External Walls | 50.5200 | 13.3100 | 37.2100 | 0.1500 | 5.5815 | 150.0000 | 5581.5000 | (29a) |
| Wall to Communal Corridor | 35.7400 | 1.8900 | 33.8500 | 0.1400 | 4.7390 | 150.0000 | 5077.5000 | (29a) |
| Wall to Stairs | 10.7200 | | 10.7200 | 0.1100 | 1.1792 | 150.0000 | 1608.0000 | (29a) |
| External Roof | 4.3300 | | 4.3300 | 0.1000 | 0.4330 | 9.0000 | 38.9700 | (30) |
| Total net area of external elements Aum(A, m2) | | | 101.3100 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 29.2258 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 22 | | | 8.5900 | 0.0000 | 0.0000 | 110.0000 | 944.9000 | (32) |
| Party Wall to Unit 27 | | | 23.0300 | 0.0000 | 0.0000 | 110.0000 | 2533.3000 | (32) |
| Party Floor | | | 97.1600 | | | 80.0000 | 7772.8000 | (32d) |
| Party Ceiling | | | 91.6600 | | | 100.0000 | 9166.0000 | (32b) |
| Internal Walls | | | 232.8000 | | | 9.0000 | 2095.2000 | (32c) |

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 34818.1700 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 358.3591 (35)
List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E1 Steel lintel with perforated steel base plate | 7.1500 | 0.0500 | 0.3575 |
| E4 Jamb | 20.6600 | 0.0500 | 1.0330 |
| E7 Party floor between dwellings (in blocks of flats) | 16.4575 | 0.0700 | 1.1520 |
| E18 Party wall between dwellings | 3.0000 | 0.0600 | 0.1800 |
| E16 Corner (normal) | 9.0000 | 0.0900 | 0.8100 |
| E17 Corner (inverted - internal area greater than external area) | 6.0000 | -0.0900 | -0.5400 |
| E23 Balcony within or between dwellings, balcony support penetrates wall insulation | 5.9650 | 0.0200 | 0.1193 |
| E25 Staggered party wall between dwellings | 3.0000 | 0.0600 | 0.1800 |
| E7 Party floor between dwellings (in blocks of flats) | 15.4900 | 0.0350 | 0.5422 |
| E3 Sill | 1.0225 | 0.0500 | 0.0511 |
| E15 Flat roof with parapet | 4.2575 | 0.5600 | 2.3842 |
| E24 Eaves (insulation at ceiling level - inverted) | 2.5725 | 0.2400 | 0.6174 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 6.8867 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 36.1125 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 27.9668 | 27.6061 | 27.2454 | 25.4418 | 25.0811 | 23.2776 | 23.2776 | 22.9169 | 23.9990 | 25.0811 | 25.8025 | 26.5240 | (38) |
| Heat transfer coeff | 64.0793 | 63.7186 | 63.3579 | 61.5543 | 61.1936 | 59.3901 | 59.3901 | 59.0294 | 60.1115 | 61.1936 | 61.9150 | 62.6364 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 61.4642 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 0.6595 | 0.6558 | 0.6521 | 0.6335 | 0.6298 | 0.6113 | 0.6113 | 0.6075 | 0.6187 | 0.6298 | 0.6372 | 0.6447 | (40) |
| HLP (average) | | | | | | | | | | | | 0.6326 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

---
4. Water heating energy requirements (kWh/year)
---

Assumed occupancy 2.7116 (42)
Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 67.9244 | 66.8845 | 65.3519 | 62.9943 | 60.8820 | 57.9268 | 55.5895 | 58.3220 | 59.6963 | 62.6232 | 65.6714 | 67.8631 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 29.4193 | 28.9752 | 28.3434 | 27.3972 | 26.5446 | 25.3708 | 24.4802 | 25.5692 | 26.1407 | 27.3037 | 28.5130 | 29.3959 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 42.3998 | 40.8580 | 39.3162 | 37.7744 | 36.2326 | 34.6908 | 34.6908 | 36.2326 | 37.7744 | 39.3162 | 40.8580 | 42.3998 | (42c) |

Average daily hot water use (litres/day) 128.4449 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 139.7435 | 136.7177 | 133.0115 | 128.1660 | 123.6591 | 117.9883 | 114.7605 | 120.1237 | 123.6114 | 129.2432 | 135.0424 | 139.6589 | (44) |
| Energy conte | 205.7265 | 180.9051 | 190.0707 | 167.4168 | 159.3473 | 136.4496 | 126.8137 | 141.3878 | 143.3830 | 166.5429 | 182.5143 | 205.0993 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 2005.6572 | |
| Distribution loss (46)m = 0.15 x (45)m | 30.8590 | 27.1358 | 28.5106 | 25.1125 | 23.9021 | 20.4674 | 19.0221 | 21.2082 | 21.5075 | 24.9814 | 27.3771 | 30.7649 | (46) |
| Water storage loss: | | | | | | | | | | | | | |
| Store volume | | | | | | | | | | | | 110.0000 | (47) |
| b) If manufacturer declared loss factor is not known : | | | | | | | | | | | | | |
| Hot water storage loss factor from Table 2 (kWh/litre/day) | | | | | | | | | | | | 0.0152 | (51) |
| Volume factor from Table 2a | | | | | | | | | | | | 1.0294 | (52) |
| Temperature factor from Table 2b | | | | | | | | | | | | 0.6000 | (53) |
| Enter (49) or (54) in (55) | | | | | | | | | | | | 1.0327 | (55) |
| Total storage loss | 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (56) |
| If cylinder contains dedicated solar storage | 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (57) |
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | 261.0033 | 230.8325 | 245.3475 | 220.9105 | 214.6241 | 189.9433 | 182.0905 | 196.6647 | 196.8767 | 221.8198 | 236.0080 | 260.3761 | (62) |
| WWHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | 261.0033 | 230.8325 | 245.3475 | 220.9105 | 214.6241 | 189.9433 | 182.0905 | 196.6647 | 196.8767 | 221.8198 | 236.0080 | 260.3761 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2656.4970 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2656 | (64) |
| Electric shower(s) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | 112.6255 | 100.0929 | 107.4200 | 98.4610 | 97.2044 | 88.1644 | 86.3870 | 91.2329 | 90.4698 | 99.5970 | 103.4810 | 112.4170 | (65) |

---
5. Internal gains (see Table 5 and 5a)
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Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 135.5817 | 135.5817 | 135.5817 | 135.5817 | 135.5817 | 135.5817 | 135.5817 | 135.5817 | 135.5817 | 135.5817 | 135.5817 | 135.5817 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 136.8204 | 151.4797 | 136.8204 | 141.3810 | 136.8204 | 141.3810 | 136.8204 | 136.8204 | 141.3810 | 136.8204 | 141.3810 | 136.8204 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 251.6530 | 254.2644 | 247.6838 | 233.6746 | 215.9904 | 199.3698 | 188.2662 | 185.6548 | 192.2354 | 206.2446 | 223.9288 | 240.5494 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 36.5582 | 36.5582 | 36.5582 | 36.5582 | 36.5582 | 36.5582 | 36.5582 | 36.5582 | 36.5582 | 36.5582 | 36.5582 | 36.5582 | (69) |
| Pumps, fans | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | -108.4654 | -108.4654 | -108.4654 | -108.4654 | -108.4654 | -108.4654 | -108.4654 | -108.4654 | -108.4654 | -108.4654 | -108.4654 | -108.4654 | (71) |
| Water heating gains (Table 5) | 151.3784 | 148.9478 | 144.3817 | 136.7514 | 130.6511 | 122.4506 | 116.1116 | 122.6249 | 125.6525 | 133.8669 | 143.7235 | 151.0981 | (72) |
| Total internal gains | 603.5263 | 618.3664 | 592.5604 | 575.4816 | 547.1364 | 526.8759 | 504.8726 | 508.7746 | 522.9434 | 540.6064 | 572.7079 | 592.1424 | (73) |

---
6. Solar gains
---

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Southeast | 11.0200 | 36.7938 | 0.4500 | 0.7000 | 0.7700 | 88.5116 | (77) |
| Southeast | 2.2900 | 36.7938 | 0.4500 | 0.7000 | 0.7700 | 18.3931 | (77) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 106.9047 | 182.0983 | 249.1548 | 308.7149 | 345.7864 | 343.2859 | 330.9642 | 303.3072 | 269.7820 | 201.2574 | 128.0472 | 91.4882 | (83) |
| Total gains | 710.4310 | 800.4647 | 841.7152 | 884.1964 | 892.9228 | 870.1618 | 835.8368 | 812.0817 | 792.7254 | 741.8638 | 700.7551 | 683.6305 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| tau | 150.9336 | 151.7880 | 152.6522 | 157.1248 | 158.0510 | 162.8506 | 162.8506 | 163.8458 | 160.8962 | 158.0510 | 156.2095 | 154.4103 | |
| alpha | 11.0622 | 11.1192 | 11.1768 | 11.4750 | 11.5367 | 11.8567 | 11.8567 | 11.9231 | 11.7264 | 11.5367 | 11.4140 | 11.2940 | |
| util living area | 0.9964 | 0.9854 | 0.9519 | 0.8213 | 0.6361 | 0.4368 | 0.3126 | 0.3344 | 0.5231 | 0.8335 | 0.9807 | 0.9973 | (86) |
| MIT | 20.6811 | 20.7911 | 20.8965 | 20.9836 | 20.9990 | 21.0000 | 21.0000 | 21.0000 | 20.9999 | 20.9840 | 20.8469 | 20.6731 | (87) |
| Th 2 | 20.3767 | 20.3800 | 20.3833 | 20.3999 | 20.4032 | 20.4199 | 20.4199 | 20.4232 | 20.4132 | 20.4032 | 20.3966 | 20.3900 | (88) |
| util rest of house | 0.9949 | 0.9799 | 0.9366 | 0.7873 | 0.5958 | 0.3972 | 0.2714 | 0.2924 | 0.4787 | 0.7943 | 0.9726 | 0.9962 | (89) |
| MIT 2 | 20.0114 | 20.1518 | 20.2801 | 20.3866 | 20.4026 | 20.4199 | 20.4199 | 20.4232 | 20.4132 | 20.3912 | 20.2360 | 20.0129 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.4493 | (91) |
| MIT | 20.3123 | 20.4390 | 20.5570 | 20.6548 | 20.6705 | 20.6805 | 20.6805 | 20.6823 | 20.6768 | 20.6575 | 20.5105 | 20.3095 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 20.3123 | 20.4390 | 20.5570 | 20.6548 | 20.6705 | 20.6805 | 20.6805 | 20.6823 | 20.6768 | 20.6575 | 20.5105 | 20.3095 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9947 | 0.9805 | 0.9413 | 0.8021 | 0.6139 | 0.4150 | 0.2899 | 0.3113 | 0.4986 | 0.8115 | 0.9744 | 0.9960 | (94) |
| Useful gains | 706.6410 | 784.8645 | 792.2741 | 709.2128 | 548.1657 | 361.1149 | 242.3413 | 252.7836 | 395.2828 | 602.0091 | 682.7976 | 680.8934 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | 1026.0540 | 990.1231 | 890.6227 | 723.5591 | 548.9395 | 361.1211 | 242.3414 | 252.7838 | 395.3395 | 615.4553 | 830.3089 | 1009.0434 | (97) |
| Space heating kWh | 237.6432 | 137.9338 | 73.1714 | 10.3294 | 0.5757 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 10.0040 | 106.2081 | 244.1436 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 820.0092 | |
| Solar heating kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | 237.6432 | 137.9338 | 73.1714 | 10.3294 | 0.5757 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 10.0040 | 106.2081 | 244.1436 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 820.0092 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 8.4398 | (99) |

## 8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ext. temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | |
| Heat loss rate W | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 558.2668 | 439.4867 | 448.6233 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (100) |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.9992 | 0.9999 | 0.9998 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (101) |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 557.8064 | 439.4439 | 448.5520 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (102) |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 942.0431 | 905.7417 | 880.1030 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 276.6504 | 346.9256 | 321.0740 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (104) |
| Cooled fraction | | | | | | | | | | fC = cooled area / (4) = | | 0.9984 | (105) |
| Intermittency factor (Table 10b) | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | (106) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 69.0487 | 86.5886 | 80.1363 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) |
| Space cooling requirement | | | | | | | | | | | | 235.7736 | (107) |

## 9b. Energy requirements

| | | |
|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | 0.0000 | (301) |
| Fraction of space heat from community system | 1.0000 | (302) |
| Fraction of heat from community Heat pump-Space and Water | 1.0000 | (303a) |
| Factor for control and charging method (Table 4c(3)) for space heating | 1.0000 | (305) |
| Factor for charging method (Table 4c(3)) for water heating | 1.0000 | (305a) |
| Distribution loss factor (Table 12c) for community heating system | 2.0000 | (306) |
| Efficiency of secondary/supplementary heating system, % | 0.0000 | (208) |

Space heating:

Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 237.6432 | 137.9338 | 73.1714 | 10.3294 | 0.5757 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 10.0040 | 106.2081 | 244.1436 | (98) |
| Space heat from Heat pump = (98) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 307a | 475.2865 | 275.8675 | 146.3427 | 20.6587 | 1.1514 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 20.0080 | 212.4162 | 488.2872 | |
| Space heating requirement | | | | | | | | | | | | | |
| | 475.2865 | 275.8675 | 146.3427 | 20.6587 | 1.1514 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 20.0080 | 212.4162 | 488.2872 | (307) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | | | | | | | | | | | 0.0000 | (308) |
| Space heating fuel for secondary/supplementary system | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (309) |

Water heating

Annual water heating requirement

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 261.0033 | 230.8325 | 245.3475 | 220.9105 | 214.6241 | 189.9433 | 182.0905 | 196.6647 | 196.8767 | 221.8198 | 236.0080 | 260.3761 | (64) |
| Water heat from Heat pump = (64) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 310a | 522.0067 | 461.6651 | 490.6950 | 441.8209 | 429.2482 | 379.8865 | 364.1810 | 393.3293 | 393.7534 | 443.6395 | 472.0160 | 520.7523 | |
| Water heating fuel | | | | | | | | | | | | | |
| | 522.0067 | 461.6651 | 490.6950 | 441.8209 | 429.2482 | 379.8865 | 364.1810 | 393.3293 | 393.7534 | 443.6395 | 472.0160 | 520.7523 | (310) |
| Cooling System Energy Efficiency Ratio | | | | | | | | | | | | 2.6000 | (314) |
| Space coolin | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 26.5572 | 33.3033 | 30.8217 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (315) |
| Pumps and Fa | 25.7926 | 23.2966 | 25.7926 | 24.9606 | 25.7926 | 24.9606 | 25.7926 | 25.7926 | 24.9606 | 25.7926 | 24.9606 | 25.7926 | (331) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lighting | 31.8771 | 25.5730 | 23.0257 | 16.8696 | 13.0306 | 10.6461 | 11.8869 | 15.4510 | 20.0694 | 26.3321 | 29.7421 | 32.7631 (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (333a)m | -4.8764 | -7.9718 | -13.3697 | -17.4910 | -21.0615 | -20.4981 | -20.2061 | -17.8901 | -14.2620 | -10.0144 | -5.7111 | -4.0858 (333a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (334a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (334a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (335a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (335a) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (333b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (333b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (334b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (334b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (335b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (335b) |

| | |
|---|---|
| Annual totals kWh/year | |
| Space heating fuel - community heating | 1640.0183 (307) |
| Space heating fuel - secondary | 0.0000 (309) |
| Water heating fuel - community heating | 5312.9940 (310) |
| Efficiency of water heater | 0.0000 (311) |
| Electricity used for heat distribution | 16.4002 (313) |
| Space cooling fuel | 90.6821 (321) |
| | |
| Electricity for pumps and fans: | |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8540) | |
| mechanical ventilation fans (SFP = 0.8540) | 303.6872 (330a) |
| Total electricity for the above, kWh/year | 303.6872 (331) |
| Electricity for lighting (calculated in Appendix L) | 257.2666 (332) |
| | |
| Energy saving/generation technologies (Appendices M ,N and Q) | |
| PV generation | -157.4381 (333) |
| Wind generation | 0.0000 (334) |
| Hydro-electric generation (Appendix N) | 0.0000 (335a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 (335) |
| Appendix Q - special features | |
| Energy saved or generated | -0.0000 (336) |
| Energy used | 0.0000 (337) |
| Total delivered energy for all uses | 7447.2101 (338) |

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12b. Carbon dioxide emissions - Community heating scheme

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (367) |
| Space and Water heating from Heat pump | 2483.2187 | 0.1594 | 93.3907 | (367) |
| Electrical energy for heat distribution (space & water) | 16.4002 | 0.0000 | 10.0996 | (372) |
| Overall CO2 factor for heat network | | | 0.0533 | (386) |
| Total CO2 associated with community systems | | | 370.7989 | (373) |
| Space and water heating | | | 370.7989 | (376) |
| Space cooling | 90.6821 | 0.1140 | 10.3356 | (377) |
| Pumps, fans and electric keep-hot | 303.6872 | 0.1387 | 42.1252 | (378) |
| Energy for lighting | 257.2666 | 0.1443 | 37.1315 | (379) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -157.4381 | 0.1317 | -20.7339 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -20.7339 | (380) |
| Total CO2, kg/year | | | 439.6573 | (383) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 4.5300 | (384) |

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13b. Primary energy - Community heating scheme

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| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (467a) |
| Space and Water heating from Heat pump | 2483.2187 | 1.5902 | 931.3931 | (467) |
| Electrical energy for heat distribution (space & water) | 16.4002 | 0.0000 | 106.8843 | (472) |
| Overall CO2 factor for heat network | | | 0.5644 | (486) |
| Total CO2 associated with community systems | | | 3924.1814 | (473) |
| Space and water heating | | | 3924.1814 | (476) |
| Space cooling | 90.6821 | 1.4201 | 128.7776 | (477) |
| Pumps, fans and electric keep-hot | 303.6872 | 1.5128 | 459.4180 | (478) |
| Energy for lighting | 257.2666 | 1.5338 | 394.6041 | (479) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -157.4381 | 1.4866 | -234.0405 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -234.0405 | (480) |
| Total Primary energy kWh/year | | | 4672.9405 | (483) |
| Dwelling Primary energy Rate (DPER) | | | 48.1000 | (484) |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

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| | | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | |
| Ground floor | | 97.1600 | (1b) x | 3.0000 | (2b) = | 291.4800 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 97.1600 | | | | | | (4) |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | | 291.4800 | (5) |

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## 2. Ventilation rate

| | | | |
|---|---|---|---|
| | | m3 per hour | |
| Number of open chimneys | 0 * 80 = | 0.0000 | (6a) |
| Number of open flues | 0 * 20 = | 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | 3 * 10 = | 30.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |
| | Air changes per hour | | |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 30.0000 / (5) = | 0.1029 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3529 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.3529 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.4500 | 0.4412 | 0.4323 | 0.3882 | 0.3794 | 0.3353 | 0.3353 | 0.3265 | 0.3529 | 0.3794 | 0.3970 | 0.4147 | (22b) |
| Effective ac | 0.6012 | 0.5973 | 0.5935 | 0.5754 | 0.5720 | 0.5562 | 0.5562 | 0.5533 | 0.5623 | 0.5720 | 0.5788 | 0.5860 | (25) |

## 3. Heat losses and heat loss parameter

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| TER Opaque door | | | 1.8900 | 1.0000 | 1.8900 | | | (26) |
| TER Opening Type | | | 13.3100 | 1.1450 | 15.2405 | | | (27) |
| External Walls | 50.5200 | 13.3100 | 37.2100 | 0.1800 | 6.6978 | | | (29a) |
| Wall to Communal Corridor | 35.7400 | 1.8900 | 33.8500 | 0.1800 | 6.0930 | | | (29a) |
| Wall to Stairs | 10.7200 | | 10.7200 | 0.1800 | 1.9296 | | | (29a) |
| External Roof | 4.3300 | | 4.3300 | 0.1100 | 0.4763 | | | (30) |
| Total net area of external elements Aum(A, m2) | | | 101.3100 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 32.3272 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 22 | | | 8.5900 | 0.0000 | 0.0000 | | | (32) |
| Party Wall to Unit 27 | | | 23.0300 | 0.0000 | 0.0000 | | | (32) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K: 339.4913 (35)

List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E1 Steel lintel with perforated steel base plate | 7.1500 | 0.0500 | 0.3575 |
| E4 Jamb | 20.6600 | 0.0500 | 1.0330 |
| E7 Party floor between dwellings (in blocks of flats) | 16.4575 | 0.0700 | 1.1520 |
| E18 Party wall between dwellings | 3.0000 | 0.0600 | 0.1800 |
| E16 Corner (normal) | 9.0000 | 0.0900 | 0.8100 |
| E17 Corner (inverted - internal area greater than external area) | 6.0000 | -0.0900 | -0.5400 |
| E23 Balcony within or between dwellings, balcony support penetrates wall insulation | 5.9650 | 0.0200 | 0.1193 |
| E25 Staggered party wall between dwellings | 3.0000 | 0.0600 | 0.1800 |
| E7 Party floor between dwellings (in blocks of flats) | 15.4900 | 0.0700 | 1.0843 |
| E3 Sill | 1.0225 | 0.0500 | 0.0511 |
| E15 Flat roof with parapet | 4.2575 | 0.5600 | 2.3842 |
| E24 Eaves (insulation at ceiling level - inverted) | 2.5725 | 0.2400 | 0.6174 |

| | | | |
|---|---|---|---|
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | 7.4289 | (36) |
| Point Thermal bridges | (36a) = | 0.0000 | |
| Total fabric heat loss | (33) + (36) + (36a) = | 39.7560 | (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 57.8323 | 57.4541 | 57.0835 | 55.3425 | 55.0168 | 53.5005 | 53.5005 | 53.2197 | 54.0846 | 55.0168 | 55.6757 | 56.3646 | (38) |
| Heat transfer coeff | 97.5883 | 97.2101 | 96.8395 | 95.0985 | 94.7728 | 93.2565 | 93.2565 | 92.9757 | 93.8406 | 94.7728 | 95.4318 | 96.1206 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 95.0970 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.0044 | 1.0005 | 0.9967 | 0.9788 | 0.9754 | 0.9598 | 0.9598 | 0.9569 | 0.9658 | 0.9754 | 0.9822 | 0.9893 | (40) |
| HLP (average) | | | | | | | | | | | | 0.9788 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

## 4. Water heating energy requirements (kWh/year)

| | | | |
|---|---|---|---|
| Assumed occupancy | | 2.7116 | (42) |
| Hot water usage for mixer showers | | | |
| 69.6850 68.6377 67.1117 64.1920 62.0372 59.6343 58.2685 59.7830 61.4431 64.0231 67.0056 | | 69.4180 | (42a) |
| Hot water usage for baths | | | |
| 30.0900 29.6432 29.0139 27.8535 26.9847 26.0213 25.5009 26.1258 26.8062 27.8371 29.0213 | | 29.9883 | (42b) |
| Hot water usage for other uses | | | |
| 42.3998 40.8580 39.3162 37.7744 36.2326 34.6908 34.6908 36.2326 37.7744 39.3162 40.8580 | | 42.3998 | (42c) |
| Average daily hot water use (litres/day) | | 130.6907 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 142.1748 | 139.1389 | 135.4418 | 129.8199 | 125.2545 | 120.3464 | 118.4602 | 122.1414 | 126.0238 | 131.1764 | 136.8849 | 141.8061 | (44) |
| Energy conte | 225.1702 | 198.1320 | 208.1690 | 177.7170 | 168.6167 | 147.9800 | 143.2674 | 151.2366 | 155.3999 | 178.0052 | 195.0177 | 222.0341 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 2170.7456 | |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | | |
| | 33.7755 | 29.7198 | 31.2253 | 26.6575 | 25.2925 | 22.1970 | 21.4901 | 22.6855 | 23.3100 | 26.7008 | 29.2527 | 33.3051 | (46) |
| Water storage loss: | | | | | | | | | | | | | |
| Store volume | | | | | | | | | | | | 150.0000 | (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | | | | | | | | | | | | 1.3938 | (48) |
| Temperature factor from Table 2b | | | | | | | | | | | | 0.5400 | (49) |
| Enter (49) or (54) in (55) | | | | | | | | | | | | 0.7527 | (55) |
| Total storage loss | | | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (56) |
| If cylinder contains dedicated solar storage | | | | | | | | | | | | | |
| | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (57) |
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | | | | | | | | | | | | | |
| | 271.7651 | 240.2177 | 254.7639 | 222.8088 | 215.2116 | 193.0718 | 189.8623 | 197.8315 | 200.4917 | 224.6001 | 240.1095 | 268.6290 | (62) |
| WWHRS | -31.8571 | -28.1746 | -29.5029 | -24.4295 | -22.7674 | -19.4823 | -18.2615 | -19.4193 | -20.1571 | -23.7630 | -26.9206 | -31.2671 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | | | | | | | | | | | | | |
| | 239.9080 | 212.0430 | 225.2610 | 198.3793 | 192.4441 | 173.5895 | 171.6008 | 178.4122 | 180.3346 | 200.8371 | 213.1889 | 237.3619 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2423.3606 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2423 | (64) |
| Electric shower(s) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | | | | | | | | | | | | | |
| | 112.1450 | 99.5475 | 106.4921 | 95.1644 | 93.3410 | 85.2768 | 84.9123 | 87.5621 | 87.7439 | 96.4626 | 100.9169 | 111.1023 | (65) |

## 5. Internal gains (see Table 5 and 5a)

| Metabolic gains (Table 5), Watts | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 135.5817 | 135.5817 | 135.5817 | 135.5817 | 135.5817 | 135.5817 | 135.5817 | 135.5817 | 135.5817 | 135.5817 | 135.5817 | 135.5817 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 136.8204 | 151.4797 | 136.8204 | 141.3810 | 136.8204 | 141.3810 | 136.8204 | 136.8204 | 141.3810 | 136.8204 | 141.3810 | 136.8204 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 251.6530 | 254.2644 | 247.6838 | 233.6746 | 215.9904 | 199.3698 | 188.2662 | 185.6548 | 192.2354 | 206.2446 | 223.9288 | 240.5494 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 36.5582 | 36.5582 | 36.5582 | 36.5582 | 36.5582 | 36.5582 | 36.5582 | 36.5582 | 36.5582 | 36.5582 | 36.5582 | 36.5582 | (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.0000 | 3.0000 | 3.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | | | | | | | | | | | | | |
| | -108.4654 | -108.4654 | -108.4654 | -108.4654 | -108.4654 | -108.4654 | -108.4654 | -108.4654 | -108.4654 | -108.4654 | -108.4654 | -108.4654 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 150.7325 | 148.1361 | 143.1346 | 132.1727 | 125.4583 | 118.4400 | 114.1295 | 117.6910 | 121.8666 | 129.6541 | 140.1623 | 149.3310 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 605.8805 | 620.5547 | 594.3133 | 573.9029 | 544.9436 | 522.8654 | 502.8905 | 503.8407 | 519.1575 | 539.3936 | 572.1467 | 593.3753 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Southeast | 13.3100 | 36.7938 | 0.6300 | 0.7000 | 0.7700 | 149.6666 | (77) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 149.6666 | 254.9376 | 348.8167 | 432.2009 | 484.1010 | 480.6002 | 463.3499 | 424.6301 | 377.6948 | 281.7604 | 179.2661 | 128.0834 | (83) |
| Total gains | 755.5471 | 875.4923 | 943.1300 | 1006.1037 | 1029.0446 | 1003.4656 | 966.2404 | 928.4707 | 896.8523 | 821.1540 | 751.4128 | 721.4587 | (84) |

## 7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 93.8893 | 94.2545 | 94.6152 | 96.3473 | 96.6785 | 98.2504 | 98.2504 | 98.5472 | 97.6389 | 96.6785 | 96.0109 | 95.3228 | |
| alpha | 7.2593 | 7.2836 | 7.3077 | 7.4232 | 7.4452 | 7.5500 | 7.5500 | 7.5698 | 7.5093 | 7.4452 | 7.4007 | 7.3549 | |
| util living area | | | | | | | | | | | | | |
| | 0.9980 | 0.9935 | 0.9814 | 0.9315 | 0.8033 | 0.5900 | 0.4243 | 0.4599 | 0.7034 | 0.9455 | 0.9935 | 0.9985 | (86) |
| MIT | 20.2310 | 20.3892 | 20.5793 | 20.8118 | 20.9518 | 20.9957 | 20.9997 | 20.9994 | 20.9853 | 20.8155 | 20.4891 | 20.2129 | (87) |
| Th 2 | 20.0797 | 20.0829 | 20.0861 | 20.1011 | 20.1039 | 20.1169 | 20.1169 | 20.1194 | 20.1119 | 20.1039 | 20.0982 | 20.0923 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9971 | 0.9908 | 0.9735 | 0.9049 | 0.7446 | 0.5111 | 0.3394 | 0.3723 | 0.6217 | 0.9181 | 0.9902 | 0.9979 | (89) |
| MIT 2 | 19.1934 | 19.3969 | 19.6376 | 19.9259 | 20.0697 | 20.1151 | 20.1169 | 20.1192 | 20.1045 | 19.9378 | 19.5371 | 19.1802 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.4493 | (91) |
| MIT | 19.6596 | 19.8427 | 20.0607 | 20.3239 | 20.4660 | 20.5107 | 20.5135 | 20.5147 | 20.5002 | 20.3321 | 19.9648 | 19.6442 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.6596 | 19.8427 | 20.0607 | 20.3239 | 20.4660 | 20.5107 | 20.5135 | 20.5147 | 20.5002 | 20.3321 | 19.9648 | 19.6442 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9966 | 0.9899 | 0.9732 | 0.9122 | 0.7695 | 0.5466 | 0.3776 | 0.4117 | 0.6584 | 0.9261 | 0.9896 | 0.9974 | (94) |
| Useful gains | 752.9441 | 866.6539 | 917.8573 | 917.8038 | 791.8628 | 548.5013 | 364.8118 | 382.2904 | 590.4945 | 760.4936 | 743.5823 | 719.6161 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | | | | | | | | | | | | | |
| | 1498.9136 | 1452.5801 | 1313.2088 | 1086.4005 | 830.7757 | 551.2141 | 364.9577 | 382.5642 | 600.5975 | 922.3379 | 1227.7067 | 1484.5020 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 555.0013 | 393.7424 | 294.1415 | 121.3896 | 28.9512 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 120.4121 | 348.5696 | 569.0751 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 2431.2829 | |
| Solar heating kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | | | | | | | | | | | | | |
| | 555.0013 | 393.7424 | 294.1415 | 121.3896 | 28.9512 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 120.4121 | 348.5696 | 569.0751 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 2431.2829 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 25.0235 | (99) |

## 9a. Energy requirements - Individual heating systems, including micro-CHP

| | | |
|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | 0.0000 | (201) |
| Fraction of space heat from main system(s) | 1.0000 | (202) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Efficiency of main space heating system 1 (in %) | | | | | | | | | | | | 92.3000 | (206) |
| Efficiency of main space heating system 2 (in %) | | | | | | | | | | | | 0.0000 | (207) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 | (208) |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| Space heating requirement | | | | | | | | | | | | | |
| | 555.0013 | 393.7424 | 294.1415 | 121.3896 | 28.9512 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 120.4121 | 348.5696 | 569.0751 | (98) |
| Space heating efficiency (main heating system 1) | | | | | | | | | | | | | |
| | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.3000 | 92.3000 | 92.3000 | (210) |
| Space heating fuel (main heating system) | | | | | | | | | | | | | |
| | 601.3015 | 426.5899 | 318.6799 | 131.5164 | 31.3664 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 130.4574 | 377.6485 | 616.5495 | (211) |
| Space heating efficiency (main heating system 2) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (212) |
| Space heating fuel (main heating system 2) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (213) |
| Space heating fuel (secondary) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (215) |
| Water heating | | | | | | | | | | | | | |
| Water heating requirement | | | | | | | | | | | | | |
| | 239.9080 | 212.0430 | 225.2610 | 198.3793 | 192.4441 | 173.5895 | 171.6008 | 178.4122 | 180.3346 | 200.8371 | 213.1889 | 237.3619 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 | (216) |
| (217)m | 85.8769 | 85.4276 | 84.6591 | 82.9931 | 80.8718 | 79.8000 | 79.8000 | 79.8000 | 79.8000 | 82.9512 | 85.1553 | 85.9469 | (217) |
| Fuel for water heating, kWh/month | | | | | | | | | | | | | |
| | 279.3627 | 248.2138 | 266.0801 | 239.0309 | 237.9619 | 217.5308 | 215.0386 | 223.5742 | 225.9833 | 242.1147 | 250.3532 | 276.1726 | (219) |
| Space cooling fuel requirement | | | | | | | | | | | | | |
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (221) |
| Pumps and Fa | 7.3041 | 6.5973 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | (231) |
| Lighting | 28.4286 | 22.8065 | 20.5347 | 15.0446 | 11.6209 | 9.4944 | 10.6009 | 13.7795 | 17.8982 | 23.4834 | 26.5245 | 29.2187 | (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233a)m | -21.2456 | -31.7029 | -48.1900 | -57.3843 | -64.6856 | -61.3864 | -60.6254 | -55.8342 | -47.8890 | -37.6302 | -23.9668 | -18.1688 | (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233b)m | -7.2067 | -15.5372 | -31.6054 | -48.5595 | -65.3018 | -66.0357 | -65.2724 | -54.7685 | -39.4886 | -22.5833 | -9.7352 | -5.6720 | (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235d) |
| Annual totals kWh/year | | | | | | | | | | | | | |
| Space heating fuel - main system 1 | | | | | | | | | | | | 2634.1094 | (211) |
| Space heating fuel - main system 2 | | | | | | | | | | | | 0.0000 | (213) |
| Space heating fuel - secondary | | | | | | | | | | | | 0.0000 | (215) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 | |
| Water heating fuel used | | | | | | | | | | | | 2921.4167 | (219) |
| Space cooling fuel | | | | | | | | | | | | 0.0000 | (221) |
| Electricity for pumps and fans: | | | | | | | | | | | | | |
| Total electricity for the above, kWh/year | | | | | | | | | | | | 86.0000 | (231) |
| Electricity for lighting (calculated in Appendix L) | | | | | | | | | | | | 229.4348 | (232) |
| Energy saving/generation technologies (Appendices M ,N and Q) | | | | | | | | | | | | | |
| PV generation | | | | | | | | | | | | -960.4753 | (233) |
| Wind generation | | | | | | | | | | | | 0.0000 | (234) |
| Hydro-electric generation (Appendix N) | | | | | | | | | | | | 0.0000 | (235a) |
| Electricity generated - Micro CHP (Appendix N) | | | | | | | | | | | | 0.0000 | (235) |
| Appendix Q - special features | | | | | | | | | | | | | |
| Energy saved or generated | | | | | | | | | | | | -0.0000 | (236) |
| Energy used | | | | | | | | | | | | 0.0000 | (237) |
| Total delivered energy for all uses | | | | | | | | | | | | 4910.4856 | (238) |

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 2634.1094 | 0.2100 | 553.1630 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2921.4167 | 0.2100 | 613.4975 | (264) |
| Space and water heating | | | 1166.6605 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 229.4348 | 0.1443 | 33.1145 | (268) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -528.7090 | 0.1334 | -70.5429 | |
| PV Unit electricity exported | -431.7662 | 0.1252 | -54.0702 | |
| Total | | | -124.6131 | (269) |
| Total CO2, kg/year | | | 1087.0911 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 11.1900 | (273) |

13a. Primary energy - Individual heating systems including micro-CHP

| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 2634.1094 | 1.1300 | 2976.5436 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2921.4167 | 1.1300 | 3301.2009 | (278) |
| Space and water heating | | | 6277.7445 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 229.4348 | 1.5338 | 351.9148 | (282) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -528.7090 | 1.4930 | -789.3887 | |
| PV Unit electricity exported | -431.7662 | 0.4596 | -198.4608 | |
| Total | | | -987.8495 | (283) |
| Total Primary energy kWh/year | | | 5771.9106 | (286) |
| Target Primary Energy Rate (TPER) | | | 59.4100 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Property Reference** | Unit 26 | **Issued on Date** | 17/05/2025 |
| **Assessment Reference** | 00001 | **Prop Type Ref** | Unit 26 |
| **Property** | | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 78 C | **DER** | 5.80 | **TER** | 15.70 |
| **Environmental** | 96 A | **% DER < TER** | | | 63.06 |
| **$CO_2$ Emissions (t/year)** | 0.33 | **DFEE** | 35.30 | **TFEE** | 43.53 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 18.90 |
| **% DPER < TPER** | 26.58 | **DPER** | 61.60 | **TPER** | 83.90 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Robert Arnold | **Assessor ID** | BA04-0001 |
| **Client** | | | |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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## 1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 64.6000 | (1b) | x 3.0000 | (2b) = | 193.8000 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 64.6000 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = | 193.8000 | (5) |

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## 2. Ventilation rate

---

| | m3 per hour | | |
|---|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 | (6a) |
| Number of open flues | 0 * 20 = | 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | 0 * 10 = | 0.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |
| | Air changes per hour | | |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 0.0000 / (5) = | 0.0000 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 3.0000 | (17) |
| Infiltration rate | | 0.1500 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.1500 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.1912 | 0.1875 | 0.1837 | 0.1650 | 0.1612 | 0.1425 | 0.1425 | 0.1388 | 0.1500 | 0.1612 | 0.1687 | 0.1762 | (22b) |
| Balanced mechanical ventilation with heat recovery | | | | | | | | | | | | | |
| If mechanical ventilation | | | | | | | | | | | | 0.5000 | (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | | | | | | | | | | | | 0.5000 | (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | | | | | | | | | | | | 81.0000 | (23c) |
| Effective ac | 0.2862 | 0.2825 | 0.2787 | 0.2600 | 0.2562 | 0.2375 | 0.2375 | 0.2337 | 0.2450 | 0.2562 | 0.2637 | 0.2712 | (25) |

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## 3. Heat losses and heat loss parameter

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| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| Windows | | | 9.9900 | 1.0536 | 10.5259 | | | (27) |
| Front Door | | | 1.8900 | 1.4000 | 2.6460 | | | (26) |
| Glass Door | | | 2.2900 | 1.3258 | 3.0360 | | | (27) |
| External Walls | 41.8800 | 12.2800 | 29.6000 | 0.1500 | 4.4400 | 150.0000 | 4440.0000 | (29a) |
| Wall to Communal Corridor | 30.2900 | 1.8900 | 28.4000 | 0.0000 | 0.0000 | 150.0000 | 4260.0000 | (29a) |
| External Roof | 14.5000 | | 14.5000 | 0.1000 | 1.4500 | 9.0000 | 130.5000 | (30) |
| Total net area of external elements Aum(A, m2) | | | 58.2700 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 22.0978 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 24 | | | 19.6100 | 0.0000 | 0.0000 | 110.0000 | 2157.1000 | (32) |
| Party Wall to Unit 26 | | | 19.6100 | 0.0000 | 0.0000 | 110.0000 | 2157.1000 | (32) |
| Party Floor | | | 64.6000 | | | 80.0000 | 5168.0000 | (32d) |
| Party Ceiling | | | 49.9900 | | | 100.0000 | 4999.0000 | (32b) |
| Internal Walls | | | 163.5600 | | | 9.0000 | 1472.0400 | (32c) |

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 24783.7400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 383.6492 (35)
List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E1 Steel lintel with perforated steel base plate | 6.3600 | 0.0500 | 0.3180 |
| E4 Jamb | 17.6400 | 0.0500 | 0.8820 |
| E7 Party floor between dwellings (in blocks of flats) | 8.5620 | 0.0350 | 0.2997 |
| E18 Party wall between dwellings | 6.0000 | 0.0600 | 0.3600 |
| E24 Eaves (insulation at ceiling level - inverted) | 9.2125 | 0.1200 | 1.1055 |
| E15 Flat roof with parapet | 8.5600 | 0.5600 | 4.7936 |
| E7 Party floor between dwellings (in blocks of flats) | 10.0000 | 0.0350 | 0.3500 |
| E16 Corner (normal) | 3.0000 | 0.0900 | 0.2700 |
| E17 Corner (inverted - internal area greater than external area) | 6.0000 | -0.0900 | -0.5400 |
| E24 Eaves (insulation at ceiling level - inverted) | 5.3750 | 0.1200 | 0.6450 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 8.4838 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 30.5816 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 18.3068 | 18.0670 | 17.8272 | 16.6280 | 16.3882 | 15.1891 | 15.1891 | 14.9492 | 15.6687 | 16.3882 | 16.8679 | 17.3475 | (38) |
| Heat transfer coeff | 48.8884 | 48.6486 | 48.4088 | 47.2097 | 46.9698 | 45.7707 | 45.7707 | 45.5309 | 46.2503 | 46.9698 | 47.4495 | 47.9291 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 47.1497 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 0.7568 | 0.7531 | 0.7494 | 0.7308 | 0.7271 | 0.7085 | 0.7085 | 0.7048 | 0.7159 | 0.7271 | 0.7345 | 0.7419 | (40) |
| HLP (average) | | | | | | | | | | | | 0.7299 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

---
4. Water heating energy requirements (kWh/year)
---

Assumed occupancy 2.1083 (42)
Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 58.0634 | 57.1744 | 55.8644 | 53.8490 | 52.0434 | 49.5172 | 47.5192 | 49.8550 | 51.0298 | 53.5318 | 56.1375 | 58.0110 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 25.1658 | 24.7859 | 24.2454 | 23.4361 | 22.7067 | 21.7026 | 20.9408 | 21.8724 | 22.3612 | 23.3561 | 24.3905 | 25.1458 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 36.2208 | 34.9037 | 33.5866 | 32.2694 | 30.9523 | 29.6352 | 29.6352 | 30.9523 | 32.2694 | 33.5866 | 34.9037 | 36.2208 | (42c) |

Average daily hot water use (litres/day) 109.7926 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 119.4499 | 116.8640 | 113.6964 | 109.5546 | 105.7024 | 100.8550 | 98.0952 | 102.6797 | 105.6605 | 110.4745 | 115.4317 | 119.3776 | (44) |
| Energy conte | 175.8510 | 154.6347 | 162.4698 | 143.1057 | 136.2082 | 116.6355 | 108.3981 | 120.8559 | 122.5609 | 142.3576 | 156.0098 | 175.3148 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1714.4017 | |
| Distribution loss (46)m = 0.15 x (45)m | 26.3776 | 23.1952 | 24.3705 | 21.4658 | 20.4312 | 17.4953 | 16.2597 | 18.1284 | 18.3841 | 21.3536 | 23.4015 | 26.2972 | (46) |

Water storage loss:
Store volume 110.0000 (47)
b) If manufacturer declared loss factor is not known :
Hot water storage loss factor from Table 2 (kWh/litre/day) 0.0152 (51)
Volume factor from Table 2a 1.0294 (52)
Temperature factor from Table 2b 0.6000 (53)
Enter (49) or (54) in (55) 1.0327 (55)
Total storage loss

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (56) |

If cylinder contains dedicated solar storage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (57) |
| Primary loss 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |

Total heat required for water heating calculated for each month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 231.1278 | 204.5621 | 217.7466 | 196.5993 | 191.4850 | 170.1292 | 163.6749 | 176.1327 | 176.0545 | 197.6344 | 209.5034 | 230.5916 | (62) |
| WWHRS 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63a) |
| PV diverter -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | 231.1278 | 204.5621 | 217.7466 | 196.5993 | 191.4850 | 170.1292 | 163.6749 | 176.1327 | 176.0545 | 197.6344 | 209.5034 | 230.5916 | (64) |
| | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | | 2365.2415 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2365 | (64) |
| Electric shower(s) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | | 0.0000 | (64a) |

Heat gains from water heating, kWh/month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 102.6919 | 91.3580 | 98.2426 | 90.3776 | 89.5107 | 81.5762 | 80.2638 | 84.4060 | 83.5464 | 91.5553 | 94.6682 | 102.5136 | (65) |

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5. Internal gains (see Table 5 and 5a)
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Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 105.4135 | 105.4135 | 105.4135 | 105.4135 | 105.4135 | 105.4135 | 105.4135 | 105.4135 | 105.4135 | 105.4135 | 105.4135 | 105.4135 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 94.2253 | 104.3209 | 94.2253 | 97.3662 | 94.2253 | 97.3662 | 94.2253 | 94.2253 | 97.3662 | 94.2253 | 97.3662 | 94.2253 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 184.3817 | 186.2950 | 181.4736 | 171.2092 | 158.2524 | 146.0747 | 137.9393 | 136.0260 | 140.8475 | 151.1118 | 164.0687 | 176.2463 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 33.5413 | 33.5413 | 33.5413 | 33.5413 | 33.5413 | 33.5413 | 33.5413 | 33.5413 | 33.5413 | 33.5413 | 33.5413 | 33.5413 | (69) |
| Pumps, fans | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | -84.3308 | -84.3308 | -84.3308 | -84.3308 | -84.3308 | -84.3308 | -84.3308 | -84.3308 | -84.3308 | -84.3308 | -84.3308 | -84.3308 | (71) |
| Water heating gains (Table 5) | 138.0267 | 135.9494 | 132.0466 | 125.5244 | 120.3100 | 113.3003 | 107.8815 | 113.4489 | 116.0367 | 123.0583 | 131.4836 | 137.7871 | (72) |
| Total internal gains | 471.2579 | 481.1894 | 462.3695 | 448.7239 | 427.4118 | 411.3653 | 394.6702 | 398.3243 | 408.8744 | 423.0195 | 447.5425 | 462.8828 | (73) |

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6. Solar gains
---

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W |
|---|---|---|---|---|---|---|

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northwest | | | | 9.9900 | | 11.2829 | | 0.4500 | | 0.7000 | | 0.7700 | | 24.6055 (81) |
| Northwest | | | | 2.2900 | | 11.2829 | | 0.4500 | | 0.7000 | | 0.7700 | | 5.6403 (81) |
| Solar gains | 30.2458 | 61.5661 | 110.9226 | 182.1667 | 244.8678 | 261.0550 | 244.2116 | 194.6883 | 135.1609 | 75.2387 | 38.0570 | 24.7002 (83) | |
| Total gains | 501.5036 | 542.7555 | 573.2921 | 630.8906 | 672.2796 | 672.4203 | 638.8818 | 593.0127 | 544.0353 | 498.2581 | 485.5995 | 487.5830 (84) | |

7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 (85) | |
| Utilisation factor for gains for living area, ni1,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 140.8180 | 141.5122 | 142.2133 | 145.8255 | 146.5701 | 150.4101 | 150.4101 | 151.2023 | 148.8502 | 146.5701 | 145.0885 | 143.6365 | |
| alpha | 10.3879 | 10.4341 | 10.4809 | 10.7217 | 10.7713 | 11.0273 | 11.0273 | 11.0802 | 10.9233 | 10.7713 | 10.6726 | 10.5758 | |
| util living area | 0.9975 | 0.9932 | 0.9757 | 0.8625 | 0.6476 | 0.4356 | 0.3152 | 0.3532 | 0.5859 | 0.9057 | 0.9897 | 0.9980 (86) | |
| MIT | 20.6117 | 20.6999 | 20.8247 | 20.9666 | 20.9982 | 21.0000 | 21.0000 | 21.0000 | 20.9995 | 20.9541 | 20.7795 | 20.6079 (87) | |
| Th 2 | 20.2909 | 20.2942 | 20.2974 | 20.3137 | 20.3170 | 20.3333 | 20.3333 | 20.3366 | 20.3268 | 20.3170 | 20.3104 | 20.3039 (88) | |
| util rest of house | 0.9964 | 0.9902 | 0.9654 | 0.8268 | 0.6010 | 0.3903 | 0.2675 | 0.3022 | 0.5291 | 0.8696 | 0.9844 | 0.9971 (89) | |
| MIT 2 | 19.8464 | 19.9607 | 20.1169 | 20.2865 | 20.3159 | 20.3333 | 20.3333 | 20.3366 | 20.3266 | 20.2804 | 20.0752 | 19.8528 (90) | |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.3525 (91) | |
| MIT | 20.1161 | 20.2213 | 20.3664 | 20.5262 | 20.5564 | 20.5683 | 20.5683 | 20.5704 | 20.5638 | 20.5178 | 20.3235 | 20.1190 (92) | |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 20.1161 | 20.2213 | 20.3664 | 20.5262 | 20.5564 | 20.5683 | 20.5683 | 20.5704 | 20.5638 | 20.5178 | 20.3235 | 20.1190 (93) | |

8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9961 | 0.9898 | 0.9666 | 0.8384 | 0.6174 | 0.4062 | 0.2843 | 0.3202 | 0.5491 | 0.8811 | 0.9846 | 0.9968 (94) | |
| Useful gains | 499.5267 | 537.2198 | 554.1492 | 528.9460 | 415.0784 | 273.1649 | 181.6318 | 189.8825 | 298.7566 | 438.9955 | 478.0996 | 486.0295 (95) | |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 (96) | |
| Heat loss rate W | 773.2257 | 745.3587 | 671.2545 | 548.8704 | 415.9825 | 273.1727 | 181.6319 | 189.8829 | 298.9512 | 465.8391 | 627.4472 | 762.9817 (97) | |
| Space heating kWh | 203.6320 | 139.8693 | 87.1263 | 14.3456 | 0.6727 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 19.9716 | 107.5303 | 206.0524 (98a) | |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 779.2002 | |
| Solar heating kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (98b) | |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | 203.6320 | 139.8693 | 87.1263 | 14.3456 | 0.6727 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 19.9716 | 107.5303 | 206.0524 (98c) | |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 779.2002 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 12.0619 (99) | |

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ext. temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | |
| Heat loss rate W | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 430.2445 | 338.7031 | 346.0346 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (100) | |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.9989 | 0.9998 | 0.9995 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (101) | |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 429.7645 | 338.6443 | 345.8772 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (102) | |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 736.0802 | 699.4524 | 646.7762 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (103) | |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 220.5473 | 268.4412 | 223.8689 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (104) | |
| Cooled fraction | | | | | | | | | fC = cooled area / (4) = | | | 0.9907 (105) | |
| Intermittency factor (Table 10b) | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 (106) | |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 54.6247 | 66.4870 | 55.4474 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (107) | |
| Space cooling requirement | | | | | | | | | | | | 176.5591 (107) | |

9b. Energy requirements

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | 0.0000 (301) | |
| Fraction of space heat from community system | | | | | | | | | | | | 1.0000 (302) | |
| Fraction of heat from community Heat pump-Space and Water | | | | | | | | | | | | 1.0000 (303a) | |
| Factor for control and charging method (Table 4c(3)) for space heating | | | | | | | | | | | | 1.0000 (305) | |
| Factor for charging method (Table 4c(3)) for water heating | | | | | | | | | | | | 1.0000 (305a) | |
| Distribution loss factor (Table 12c) for community heating system | | | | | | | | | | | | 2.0000 (306) | |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 (208) | |
| Space heating: | | | | | | | | | | | | | |
| Space heating requirement | | | | | | | | | | | | | |
| | 203.6320 | 139.8693 | 87.1263 | 14.3456 | 0.6727 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 19.9716 | 107.5303 | 206.0524 (98) | |
| Space heat from Heat pump = (98) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 307a | 407.2641 | 279.7387 | 174.2526 | 28.6912 | 1.3454 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 39.9432 | 215.0605 | 412.1048 | |
| Space heating requirement | | | | | | | | | | | | | |
| | 407.2641 | 279.7387 | 174.2526 | 28.6912 | 1.3454 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 39.9432 | 215.0605 | 412.1048 (307) | |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | | | | | | | | | | | 0.0000 (308) | |
| Space heating fuel for secondary/supplementary system | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (309) | |
| Water heating | | | | | | | | | | | | | |
| Annual water heating requirement | | | | | | | | | | | | | |
| | 231.1278 | 204.5621 | 217.7466 | 196.5993 | 191.4850 | 170.1292 | 163.6749 | 176.1327 | 176.0545 | 197.6344 | 209.5034 | 230.5916 (64) | |
| Water heat from Heat pump = (64) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 310a | 462.2555 | 409.1242 | 435.4932 | 393.1987 | 382.9700 | 340.2583 | 327.3499 | 352.2653 | 352.1091 | 395.2688 | 419.0069 | 461.1832 | |
| Water heating fuel | | | | | | | | | | | | | |
| | 462.2555 | 409.1242 | 435.4932 | 393.1987 | 382.9700 | 340.2583 | 327.3499 | 352.2653 | 352.1091 | 395.2688 | 419.0069 | 461.1832 (310) | |
| Cooling System Energy Efficiency Ratio | | | | | | | | | | | | 2.6000 (314) | |
| Space coolin | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 21.0095 | 25.5719 | 21.3259 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (315) | |
| Pumps and Fa | 17.7113 | 15.9973 | 17.7113 | 17.1400 | 17.7113 | 17.1400 | 17.7113 | 17.7113 | 17.1400 | 17.7113 | 17.1400 | 17.7113 (331) | |
| Lighting | 19.5432 | 15.6783 | 14.1165 | 10.3424 | 7.9888 | 6.5269 | 7.2876 | 9.4727 | 12.3041 | 16.1437 | 18.2342 | 20.0864 (332) | |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333a)m | -4.7727 | -7.7387 | -12.8708 | -16.6940 | -19.9722 | -19.3936 | -19.1192 | -16.9892 | -13.6309 | -9.6695 | -5.5693 | -4.0052 (333a) | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335a) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (333b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335b) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - community heating | 1558.4005 | (307) |
| Space heating fuel - secondary | 0.0000 | (309) |
| Water heating fuel - community heating | 4730.4830 | (310) |
| Efficiency of water heater | 0.0000 | (311) |
| Electricity used for heat distribution | 15.5840 | (313) |
| Space cooling fuel | 67.9073 | (321) |
| | | |
| Electricity for pumps and fans: | | |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8820) | | |
| mechanical ventilation fans (SFP = 0.8820) | 208.5366 | (330a) |
| Total electricity for the above, kWh/year | 208.5366 | (331) |
| Electricity for lighting (calculated in Appendix L) | 157.7247 | (332) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -150.4253 | (333) |
| Wind generation | 0.0000 | (334) |
| Hydro-electric generation (Appendix N) | 0.0000 | (335a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (335) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (336) |
| Energy used | 0.0000 | (337) |
| Total delivered energy for all uses | 6572.6268 | (338) |

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12b. Carbon dioxide emissions - Community heating scheme

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (367) |
| Space and Water heating from Heat pump | 2246.0298 | 0.1586 | 88.2724 | (367) |
| Electrical energy for heat distribution (space & water) | 15.5840 | 0.0000 | 9.1316 | (372) |
| Overall CO2 factor for heat network | | | 0.0533 | (386) |
| Total CO2 associated with community systems | | | 335.2593 | (373) |
| Space and water heating | | | 335.2593 | (376) |
| Space cooling | 67.9073 | 0.1141 | 7.7481 | (377) |
| Pumps, fans and electric keep-hot | 208.5366 | 0.1387 | 28.9266 | (378) |
| Energy for lighting | 157.7247 | 0.1443 | 22.7646 | (379) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -150.4253 | 0.1318 | -19.8330 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -19.8330 | (380) |
| Total CO2, kg/year | | | 374.8655 | (383) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 5.8000 | (384) |

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13b. Primary energy - Community heating scheme

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| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (467a) |
| Space and Water heating from Heat pump | 2246.0298 | 1.5871 | 883.3364 | (467) |
| Electrical energy for heat distribution (space & water) | 15.5840 | 0.0000 | 96.6640 | (472) |
| Overall CO2 factor for heat network | | | 0.5643 | (486) |
| Total CO2 associated with community systems | | | 3548.9501 | (473) |
| Space and water heating | | | 3548.9501 | (476) |
| Space cooling | 67.9073 | 1.4205 | 96.4646 | (477) |
| Pumps, fans and electric keep-hot | 208.5366 | 1.5128 | 315.4741 | (478) |
| Energy for lighting | 157.7247 | 1.5338 | 241.9234 | (479) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -150.4253 | 1.4871 | -223.7009 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -223.7009 | (480) |
| Total Primary energy kWh/year | | | 3979.1114 | (483) |
| Dwelling Primary energy Rate (DPER) | | | 61.6000 | (484) |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 64.6000 | (1b) | x 3.0000 | (2b) = | 193.8000 | (1b) - (3b) (4) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 64.6000 | | | | | |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | | 193.8000 | (5) |

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2. Ventilation rate

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m3 per hour

| | | |
|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 (6a) |
| Number of open flues | 0 * 20 = | 0.0000 (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 (6f) |
| Number of intermittent extract fans | 2 * 10 = | 20.0000 (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 (7c) |

| | | Air changes per hour | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 20.0000 / (5) = | 0.1032 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3532 | (18) |
| Number of sides sheltered | | 0 | (19) |

| | | |
|---|---|---|
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.3532 (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.4503 | 0.4415 | 0.4327 | 0.3885 | 0.3797 | 0.3355 | 0.3355 | 0.3267 | 0.3532 | 0.3797 | 0.3973 | 0.4150 | (22b) |
| Effective ac | 0.6014 | 0.5975 | 0.5936 | 0.5755 | 0.5721 | 0.5563 | 0.5563 | 0.5534 | 0.5624 | 0.5721 | 0.5789 | 0.5861 | (25) |

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## 3. Heat losses and heat loss parameter

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| Element | Gross | Openings | NetArea | U-value | A x U | K-value | A x K | |
|---|---|---|---|---|---|---|---|---|
| | m2 | m2 | m2 | W/m2K | W/K | kJ/m2K | kJ/K | |
| Main dwelling | | | | | | | | |
| TER Opaque door | | | 1.8900 | 1.0000 | 1.8900 | | | (26) |
| TER Opening Type | | | 12.2800 | 1.1450 | 14.0611 | | | (27) |
| External Walls | 41.8800 | 12.2800 | 29.6000 | 0.1800 | 5.3280 | | | (29a) |
| Wall to Communal Corridor | 30.2900 | 1.8900 | 28.4000 | 0.1800 | 5.1120 | | | (29a) |
| External Roof | 14.5000 | | 14.5000 | 0.1100 | 1.5950 | | | (30) |
| Total net area of external elements Aum(A, m2) | | | 86.6700 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 27.9861 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 24 | | | 19.6100 | 0.0000 | 0.0000 | | | (32) |
| Party Wall to Unit 26 | | | 19.6100 | 0.0000 | 0.0000 | | | (32) |

| | | |
|---|---|---|
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | 368.1724 | (35) |

List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E1 Steel lintel with perforated steel base plate | 6.3600 | 0.0500 | 0.3180 |
| E4 Jamb | 17.6400 | 0.0500 | 0.8820 |
| E7 Party floor between dwellings (in blocks of flats) | 8.5620 | 0.0700 | 0.5993 |
| E18 Party wall between dwellings | 6.0000 | 0.0600 | 0.3600 |
| E24 Eaves (insulation at ceiling level - inverted) | 9.2125 | 0.2400 | 2.2110 |
| E15 Flat roof with parapet | 8.5600 | 0.5600 | 4.7936 |
| E7 Party floor between dwellings (in blocks of flats) | 10.0000 | 0.0700 | 0.7000 |
| E16 Corner (normal) | 3.0000 | 0.0900 | 0.2700 |
| E17 Corner (inverted - internal area greater than external area) | 6.0000 | -0.0900 | -0.5400 |
| E24 Eaves (insulation at ceiling level - inverted) | 5.3750 | 0.2400 | 1.2900 |

| | | |
|---|---|---|
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | 10.8839 | (36) |
| Point Thermal bridges | (36a) = 0.0000 | |
| Total fabric heat loss | (33) + (36) + (36a) = 38.8700 | (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 38.4618 | 38.2100 | 37.9632 | 36.8038 | 36.5869 | 35.5772 | 35.5772 | 35.3902 | 35.9661 | 36.5869 | 37.0257 | 37.4845 | (38) |
| Heat transfer coeff | 77.3318 | 77.0800 | 76.8332 | 75.6738 | 75.4569 | 74.4472 | 74.4472 | 74.2602 | 74.8361 | 75.4569 | 75.8957 | 76.3545 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 75.6728 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.1971 | 1.1932 | 1.1894 | 1.1714 | 1.1681 | 1.1524 | 1.1524 | 1.1495 | 1.1585 | 1.1681 | 1.1749 | 1.1820 | (40) |
| HLP (average) | | | | | | | | | | | | 1.1714 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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## 4. Water heating energy requirements (kWh/year)

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| | | |
|---|---|---|
| Assumed occupancy | 2.1083 | (42) |

Hot water usage for mixer showers

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 59.5684 | 58.6732 | 57.3687 | 54.8728 | 53.0309 | 50.9768 | 49.8093 | 51.1039 | 52.5230 | 54.7285 | 57.2780 | 59.3401 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 25.7396 | 25.3573 | 24.8190 | 23.8264 | 23.0832 | 22.2591 | 21.8140 | 22.3485 | 22.9305 | 23.8124 | 24.8254 | 25.6526 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 36.2208 | 34.9037 | 33.5866 | 32.2694 | 30.9523 | 29.6352 | 29.6352 | 30.9523 | 32.2694 | 33.5866 | 34.9037 | 36.2208 | (42c) |

| | | |
|---|---|---|
| Average daily hot water use (litres/day) | 111.7127 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 121.5287 | 118.9341 | 115.7742 | 110.9687 | 107.0664 | 102.8711 | 101.2585 | 104.4047 | 107.7230 | 112.1274 | 117.0070 | 121.2135 | (44) |
| Energy conte | 192.4718 | 169.3606 | 177.9407 | 151.9106 | 144.1320 | 126.4921 | 122.4634 | 129.2749 | 132.8333 | 152.1558 | 166.6979 | 189.7910 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1855.5241 | |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | | |
| | 28.8708 | 25.4041 | 26.6911 | 22.7866 | 21.6198 | 18.9738 | 18.3695 | 19.3912 | 19.9250 | 22.8234 | 25.0047 | 28.4687 | (46) |

| | | |
|---|---|---|
| Water storage loss: | | |
| Store volume | 150.0000 | (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | 1.3938 | (48) |
| Temperature factor from Table 2b | 0.5400 | (49) |
| Enter (49) or (54) in (55) | 0.7527 | (55) |

Total storage loss

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (56) |

If cylinder contains dedicated solar storage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (57) |
| Primary loss 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |

Total heat required for water heating calculated for each month

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 239.0667 | 211.4464 | 224.5356 | 197.0024 | 190.7269 | 171.5839 | 169.0583 | 175.8698 | 177.9251 | 198.7507 | 211.7898 | 236.3859 | (62) |
| WWHRS | -27.2322 | -24.0844 | -25.2197 | -20.8829 | -19.4622 | -16.6539 | -15.6104 | -16.6001 | -17.2308 | -20.3132 | -23.0124 | -26.7279 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | | | | | | | | | | | | | |
| | 211.8345 | 187.3620 | 199.3158 | 176.1195 | 171.2648 | 154.9300 | 153.4479 | 159.2697 | 160.6943 | 178.4376 | 188.7774 | 209.6580 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2151.1116 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2151 | (64) |
| Electric shower(s) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | | | | | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | | | | | | | | | | | | | |
| | 101.2728 | 89.9810 | 96.4412 | 86.5837 | 85.1998 | 78.1321 | 77.9950 | 80.2598 | 80.2405 | 87.8677 | 91.5005 | 100.3814 | (65) |

## 5. Internal gains (see Table 5 and 5a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Metabolic gains (Table 5), Watts | | | | | | | | | | | | | |
| (66)m | 105.4135 | 105.4135 | 105.4135 | 105.4135 | 105.4135 | 105.4135 | 105.4135 | 105.4135 | 105.4135 | 105.4135 | 105.4135 | 105.4135 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 94.2253 | 104.3209 | 94.2253 | 97.3662 | 94.2253 | 97.3662 | 94.2253 | 94.2253 | 97.3662 | 94.2253 | 97.3662 | 94.2253 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 184.3817 | 186.2950 | 181.4736 | 171.2092 | 158.2524 | 146.0747 | 137.9393 | 136.0260 | 140.8475 | 151.1118 | 164.0687 | 176.2463 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 33.5413 | 33.5413 | 33.5413 | 33.5413 | 33.5413 | 33.5413 | 33.5413 | 33.5413 | 33.5413 | 33.5413 | 33.5413 | 33.5413 | (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.0000 | 3.0000 | 3.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | | | | | | | | | | | | | |
| | -84.3308 | -84.3308 | -84.3308 | -84.3308 | -84.3308 | -84.3308 | -84.3308 | -84.3308 | -84.3308 | -84.3308 | -84.3308 | -84.3308 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 136.1193 | 133.9003 | 129.6253 | 120.2552 | 114.5159 | 108.5168 | 104.8320 | 107.8761 | 111.4452 | 118.1018 | 127.0841 | 134.9213 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 472.3505 | 482.1403 | 462.9482 | 446.4547 | 424.6176 | 406.5817 | 391.6207 | 392.7515 | 404.2829 | 421.0630 | 446.1430 | 463.0170 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Northwest | 12.2800 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 42.3441 | (81) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 42.3441 | 86.1926 | 155.2916 | 255.0334 | 342.8149 | 365.4770 | 341.8962 | 272.5636 | 189.2252 | 105.3341 | 53.2798 | 34.5803 | (83) |
| Total gains | 514.6945 | 568.3328 | 618.2398 | 701.4881 | 767.4326 | 772.0587 | 733.5169 | 665.3151 | 593.5081 | 526.3971 | 499.4228 | 497.5973 | (84) |

## 7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 85.4325 | 85.7116 | 85.9869 | 87.3043 | 87.5552 | 88.7428 | 88.7428 | 88.9662 | 88.2816 | 87.5552 | 87.0490 | 86.5260 | |
| alpha | 6.6955 | 6.7141 | 6.7325 | 6.8203 | 6.8370 | 6.9162 | 6.9162 | 6.9311 | 6.8854 | 6.8370 | 6.8033 | 6.7684 | |
| util living area | | | | | | | | | | | | | |
| | 0.9987 | 0.9971 | 0.9915 | 0.9566 | 0.8302 | 0.6086 | 0.4456 | 0.5110 | 0.8050 | 0.9775 | 0.9967 | 0.9990 | (86) |
| MIT | 20.0667 | 20.1901 | 20.3978 | 20.7053 | 20.9221 | 20.9920 | 20.9992 | 20.9980 | 20.9534 | 20.6744 | 20.3292 | 20.0549 | (87) |
| Th 2 | 19.9223 | 19.9255 | 19.9285 | 19.9429 | 19.9456 | 19.9582 | 19.9582 | 19.9606 | 19.9534 | 19.9456 | 19.9402 | 19.9345 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9981 | 0.9957 | 0.9870 | 0.9347 | 0.7654 | 0.5141 | 0.3407 | 0.3970 | 0.7118 | 0.9618 | 0.9948 | 0.9985 | (89) |
| MIT 2 | 18.8527 | 19.0126 | 19.2785 | 19.6648 | 19.8919 | 19.9551 | 19.9581 | 19.9602 | 19.9292 | 19.6381 | 19.2022 | 18.8470 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.3525 | (91) |
| MIT | 19.2806 | 19.4277 | 19.6730 | 20.0315 | 20.2550 | 20.3206 | 20.3250 | 20.3260 | 20.2902 | 20.0033 | 19.5994 | 19.2727 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.2806 | 19.4277 | 19.6730 | 20.0315 | 20.2550 | 20.3206 | 20.3250 | 20.3260 | 20.2902 | 20.0033 | 19.5994 | 19.2727 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9976 | 0.9948 | 0.9856 | 0.9369 | 0.7860 | 0.5475 | 0.3778 | 0.4374 | 0.7443 | 0.9629 | 0.9939 | 0.9981 | (94) |
| Useful gains | 513.4409 | 565.3696 | 609.3327 | 657.2385 | 603.1942 | 422.7348 | 277.1127 | 291.0057 | 441.7435 | 506.8721 | 496.3952 | 496.6270 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | | | | | | | | | | | | | |
| | 1158.4762 | 1119.7915 | 1012.1240 | 842.3667 | 645.5341 | 425.8825 | 277.3193 | 291.5444 | 463.2530 | 709.5476 | 948.6511 | 1150.8716 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 479.9062 | 372.5715 | 299.6768 | 133.2924 | 31.5009 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 150.7905 | 325.6243 | 486.7580 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 2280.1205 | |
| Solar heating kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | | | | | | | | | | | | | |
| | 479.9062 | 372.5715 | 299.6768 | 133.2924 | 31.5009 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 150.7905 | 325.6243 | 486.7580 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 2280.1205 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 35.2960 | (99) |

## 9a. Energy requirements - Individual heating systems, including micro-CHP

| | | |
|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | 0.0000 | (201) |
| Fraction of space heat from main system(s) | 1.0000 | (202) |
| Efficiency of main space heating system 1 (in %) | 92.3000 | (206) |
| Efficiency of main space heating system 2 (in %) | 0.0000 | (207) |
| Efficiency of secondary/supplementary heating system, % | 0.0000 | (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement | | | | | | | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 479.9062 | 372.5715 | 299.6768 | 133.2924 | 31.5009 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 150.7905 | 325.6243 | 486.7580 (98) |
| Space heating efficiency (main heating system 1) | | | | | | | | | | | | |
| | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.3000 | 92.3000 | 92.3000 (210) |
| Space heating fuel (main heating system) | | | | | | | | | | | | |
| | 519.9417 | 403.6528 | 324.6769 | 144.4121 | 34.1288 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 163.3700 | 352.7890 | 527.3651 (211) |
| Space heating efficiency (main heating system 2) | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (212) |
| Space heating fuel (main heating system 2) | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (213) |
| Space heating fuel (secondary) | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (215) |
| Water heating | | | | | | | | | | | | |
| Water heating requirement | | | | | | | | | | | | |
| | 211.8345 | 187.3620 | 199.3158 | 176.1195 | 171.2648 | 154.9300 | 153.4479 | 159.2697 | 160.6943 | 178.4376 | 188.7774 | 209.6580 (64) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 (216) |
| (217)m | 85.8354 | 85.5707 | 84.9721 | 83.4433 | 81.0766 | 79.8000 | 79.8000 | 79.8000 | 79.8000 | 83.6847 | 85.2707 | 85.8840 (217) |
| Fuel for water heating, kWh/month | | | | | | | | | | | | |
| | 246.7914 | 218.9558 | 234.5663 | 211.0650 | 211.2382 | 194.1479 | 192.2906 | 199.5861 | 201.3713 | 213.2261 | 221.3860 | 244.1178 (219) |
| Space cooling fuel requirement | | | | | | | | | | | | |
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (221) |
| Pumps and Fa | 7.3041 | 6.5973 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 (231) |
| Lighting | 19.5782 | 15.7063 | 14.1418 | 10.3609 | 8.0031 | 6.5386 | 7.3007 | 9.4897 | 12.3261 | 16.1726 | 18.2669 | 20.1223 (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (233a)m | -14.3609 | -21.5616 | -32.9837 | -39.5497 | -44.8429 | -42.6723 | -42.1594 | -38.7052 | -33.0095 | -25.7186 | -16.2503 | -12.2677 (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | |
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (233b)m | -4.5565 | -9.8475 | -20.0709 | -30.8905 | -41.5834 | -42.0485 | -41.5478 | -34.8326 | -25.0864 | -14.3163 | -6.1576 | -3.5835 (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | |
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235d) |

| | |
|---|---|
| Annual totals kWh/year | |
| Space heating fuel - main system 1 | 2470.3364 (211) |
| Space heating fuel - main system 2 | 0.0000 (213) |
| Space heating fuel - secondary | 0.0000 (215) |
| Efficiency of water heater | 79.8000 |
| Water heating fuel used | 2588.7426 (219) |
| Space cooling fuel | 0.0000 (221) |
| Electricity for pumps and fans: | |
| Total electricity for the above, kWh/year | 86.0000 (231) |
| Electricity for lighting (calculated in Appendix L) | 158.0070 (232) |
| Energy saving/generation technologies (Appendices M ,N and Q) | |
| PV generation | -638.6034 (233) |
| Wind generation | 0.0000 (234) |
| Hydro-electric generation (Appendix N) | 0.0000 (235a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 (235) |
| Appendix Q - special features | |
| Energy saved or generated | -0.0000 (236) |
| Energy used | 0.0000 (237) |
| Total delivered energy for all uses | 4664.4827 (238) |

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 2470.3364 | 0.2100 | 518.7706 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2588.7426 | 0.2100 | 543.6359 | (264) |
| Space and water heating | | | 1062.4066 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 158.0070 | 0.1443 | 22.8053 | (268) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -364.0819 | 0.1333 | -48.5257 | |
| PV Unit electricity exported | -274.5215 | 0.1252 | -34.3677 | |
| Total | | | -82.8935 | (269) |
| Total CO2, kg/year | | | 1014.2477 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 15.7000 | (273) |

13a. Primary energy - Individual heating systems including micro-CHP

| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 2470.3364 | 1.1300 | 2791.4802 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2588.7426 | 1.1300 | 2925.2791 | (278) |
| Space and water heating | | | 5716.7593 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 158.0070 | 1.5338 | 242.3564 | (282) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -364.0819 | 1.4925 | -543.3976 | |
| PV Unit electricity exported | -274.5215 | 0.4595 | -126.1439 | |
| Total | | | -669.5415 | (283) |
| Total Primary energy kWh/year | | | 5419.6750 | (286) |
| Target Primary Energy Rate (TPER) | | | 83.9000 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Property Reference** | Unit 27 | **Issued on Date** | 17/05/2025 |
| **Assessment Reference** | 00001 | **Prop Type Ref** | Unit 27 |
| **Property** | | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 80 C | **DER** | 4.83 | **TER** | 12.32 |
| **Environmental** | 96 A | **% DER < TER** | | | 60.80 |
| **$CO_2$ Emissions (t/year)** | 0.35 | **DFEE** | 27.88 | **TFEE** | 31.55 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 11.63 |
| **% DPER < TPER** | 21.52 | **DPER** | 51.58 | **TPER** | 65.72 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Robert Arnold | **Assessor ID** | BA04-0001 |
| **Client** | | | |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

## 1. Overall dwelling characteristics

| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 78.8300 | (1b) | x 3.0000 | (2b) = | 236.4900 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 78.8300 | | | | | (4) |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | 236.4900 | (5) |

## 2. Ventilation rate

| | m3 per hour | |
|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 (6a) |
| Number of open flues | 0 * 20 = | 0.0000 (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 (6f) |
| Number of intermittent extract fans | 0 * 10 = | 0.0000 (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 (7c) |
| | Air changes per hour | |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 0.0000 / (5) = | 0.0000 (8) |
| Pressure test | | Yes |
| Pressure Test Method | | Blower Door |
| Measured/design AP50 | | 3.0000 (17) |
| Infiltration rate | | 0.1500 (18) |
| Number of sides sheltered | | 0 (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.1500 (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.1912 | 0.1875 | 0.1837 | 0.1650 | 0.1612 | 0.1425 | 0.1425 | 0.1388 | 0.1500 | 0.1612 | 0.1687 | 0.1762 | (22b) |

Balanced mechanical ventilation with heat recovery

| | |
|---|---|
| If mechanical ventilation | 0.5000 (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | 0.5000 (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | 81.0000 (23c) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective ac | 0.2862 | 0.2825 | 0.2787 | 0.2600 | 0.2562 | 0.2375 | 0.2375 | 0.2337 | 0.2450 | 0.2562 | 0.2637 | 0.2712 | (25) |

## 3. Heat losses and heat loss parameter

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| Windows | | | 6.9300 | 1.0536 | 7.3017 | | | (27) |
| Door | | | 1.8900 | 1.4000 | 2.6460 | | | (26) |
| Glass Door | | | 2.2900 | 1.3258 | 3.0360 | | | (27) |
| External Walls | 36.9100 | 9.2200 | 27.6900 | 0.1500 | 4.1535 | 150.0000 | 4153.5000 | (29a) |
| Wall to Communal Corridor | 27.1300 | 1.8900 | 25.2400 | 0.1400 | 3.5336 | 150.0000 | 3786.0000 | (29a) |
| Wall to Communal Stairs | 24.4900 | | 24.4900 | 0.1100 | 2.6939 | 150.0000 | 3673.5000 | (29a) |
| Total net area of external elements Aum(A, m2) | | | 88.5300 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 23.3647 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 25 | | | 23.0300 | 0.0000 | 0.0000 | 110.0000 | 2533.3000 | (32) |
| Party Floor | | | 78.8300 | | | 80.0000 | 6306.4000 | (32d) |
| Party Ceiling | | | 72.8600 | | | 100.0000 | 7286.0000 | (32b) |
| Internal Walls | | | 184.7500 | | | 9.0000 | 1662.7500 | (32c) |
| Heat capacity Cm = Sum(A x k) | | | | | (28)...(30) + (32) + (32a)...(32e) = | | 29401.4500 | (34) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 372.9729 (35)
List of Thermal Bridges

| | K1 Element | Length | Psi-value | Total |
|---|---|---|---|---|
| E1 | Steel lintel with perforated steel base plate | 4.4200 | 0.0500 | 0.2210 |
| E3 | Sill | 1.0225 | 0.0500 | 0.0511 |
| E4 | Jamb | 12.0600 | 0.0500 | 0.6030 |
| E7 | Party floor between dwellings (in blocks of flats) | 10.6200 | 0.0700 | 0.7434 |
| E18 | Party wall between dwellings | 3.0000 | 0.0300 | 0.0900 |
| E16 | Corner (normal) | 9.0000 | 0.0900 | 0.8100 |
| E17 | Corner (inverted - internal area greater than external area) | 6.0000 | -0.0900 | -0.5400 |
| E23 | Balcony within or between dwellings, balcony support penetrates wall insulation | 5.1470 | 0.0200 | 0.1029 |
| E7 | Party floor between dwellings (in blocks of flats) | 18.0900 | 0.0350 | 0.6332 |
| E24 | Eaves (insulation at ceiling level - inverted) | 7.1110 | 0.1200 | 0.8533 |
| E15 | Flat roof with parapet | 3.5850 | 0.5600 | 2.0076 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 5.5755 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 28.9402 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 22.3394 | 22.0468 | 21.7541 | 20.2908 | 19.9982 | 18.5349 | 18.5349 | 18.2422 | 19.1202 | 19.9982 | 20.5835 | 21.1688 | (38) |
| Heat transfer coeff | 51.2797 | 50.9870 | 50.6944 | 49.2311 | 48.9384 | 47.4751 | 47.4751 | 47.1825 | 48.0605 | 48.9384 | 49.5237 | 50.1091 | (39) |

Average = Sum(39)m / 12 = 49.1579

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 0.6505 | 0.6468 | 0.6431 | 0.6245 | 0.6208 | 0.6022 | 0.6022 | 0.5985 | 0.6097 | 0.6208 | 0.6282 | 0.6357 | (40) |
| HLP (average) | | | | | | | | | | | | 0.6236 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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4. Water heating energy requirements (kWh/year)

---

Assumed occupancy 2.4403 (42)
Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 63.4896 | 62.5176 | 61.0851 | 58.8815 | 56.9070 | 54.1448 | 51.9601 | 54.5142 | 55.7988 | 58.5346 | 61.3838 | 63.4324 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 28.9541 | 28.5170 | 27.8952 | 26.9640 | 26.1248 | 24.9696 | 24.0931 | 25.1649 | 25.7273 | 26.8720 | 28.0621 | 28.9311 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 41.7063 | 40.1897 | 38.6731 | 37.1565 | 35.6399 | 34.1233 | 34.1233 | 35.6399 | 37.1565 | 38.6731 | 40.1897 | 41.7063 | (42c) |

Average daily hot water use (litres/day) 123.2946 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 134.1500 | 131.2243 | 127.6534 | 123.0020 | 118.6718 | 113.2377 | 110.1765 | 115.3190 | 118.6826 | 124.0797 | 129.6356 | 134.0698 | (44) |
| Energy conte | 197.4920 | 173.6363 | 182.4141 | 160.6713 | 152.9206 | 130.9556 | 121.7483 | 135.7325 | 137.6659 | 159.8893 | 175.2068 | 196.8913 | (45) |

Energy content (annual) Total = Sum(45)m = 1925.2241
Distribution loss (46)m = 0.15 x (45)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 29.6238 | 26.0454 | 27.3621 | 24.1007 | 22.9381 | 19.6433 | 18.2622 | 20.3599 | 20.6499 | 23.9834 | 26.2810 | 29.5337 | (46) |

Water storage loss:
Store volume 110.0000 (47)
b) If manufacturer declared loss factor is not known :
Hot water storage loss factor from Table 2 (kWh/litre/day) 0.0152 (51)
Volume factor from Table 2a 1.0294 (52)
Temperature factor from Table 2b 0.6000 (53)
Enter (49) or (54) in (55) 1.0327 (55)
Total storage loss

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (56) |

If cylinder contains dedicated solar storage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (57) |
| Primary loss 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |

Total heat required for water heating calculated for each month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 252.7688 | 223.5637 | 237.6909 | 214.1650 | 208.1974 | 184.4493 | 177.0251 | 191.0093 | 191.1596 | 215.1661 | 228.7005 | 252.1681 | (62) |
| WWHRS 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63a) |
| PV diverter -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |

Output from w/h

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 252.7688 | 223.5637 | 237.6909 | 214.1650 | 208.1974 | 184.4493 | 177.0251 | 191.0093 | 191.1596 | 215.1661 | 228.7005 | 252.1681 | (64) |

Total per year (kWh/year) = Sum(64)m = 2576.0639 (64)
12Total per year (kWh/year) 2576 (64)
Electric shower(s)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)
Heat gains from water heating, kWh/month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 109.8875 | 97.6760 | 104.8741 | 96.2182 | 95.0675 | 86.3377 | 84.7028 | 89.3525 | 88.5689 | 97.3846 | 101.0512 | 109.6878 | (65) |

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5. Internal gains (see Table 5 and 5a)

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Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 122.0143 | 122.0143 | 122.0143 | 122.0143 | 122.0143 | 122.0143 | 122.0143 | 122.0143 | 122.0143 | 122.0143 | 122.0143 | 122.0143 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 122.1657 | 135.2549 | 122.1657 | 126.2379 | 122.1657 | 126.2379 | 122.1657 | 122.1657 | 126.2379 | 122.1657 | 126.2379 | 122.1657 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 216.9779 | 219.2294 | 213.5556 | 201.4767 | 186.2292 | 171.8987 | 162.3251 | 160.0735 | 165.7474 | 177.8263 | 193.0738 | 207.4042 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 35.2014 | 35.2014 | 35.2014 | 35.2014 | 35.2014 | 35.2014 | 35.2014 | 35.2014 | 35.2014 | 35.2014 | 35.2014 | 35.2014 | (69) |
| Pumps, fans | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | -97.6115 | -97.6115 | -97.6115 | -97.6115 | -97.6115 | -97.6115 | -97.6115 | -97.6115 | -97.6115 | -97.6115 | -97.6115 | -97.6115 | (71) |
| Water heating gains (Table 5) | 147.6983 | 145.3512 | 140.9599 | 133.6363 | 127.7790 | 119.9135 | 113.8478 | 120.0975 | 123.0123 | 130.8933 | 140.3489 | 147.4298 | (72) |
| Total internal gains | 546.4462 | 559.4398 | 536.2855 | 520.9552 | 495.7781 | 477.6544 | 457.9429 | 461.9410 | 474.6019 | 490.4896 | 519.2649 | 536.6041 | (73) |

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6. Solar gains

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| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W |
|---|---|---|---|---|---|---|

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southeast | | | | 6.9300 | | 36.7938 | | 0.4500 | | 0.7000 | | 0.7700 | | | 55.6611 | (77) |
| Southeast | | | | 2.2900 | | 36.7938 | | 0.4500 | | 0.7000 | | 0.7700 | | | 18.3931 | (77) |
| Solar gains | 74.0542 | 126.1417 | 172.5926 | 213.8506 | 239.5305 | 237.7983 | 229.2630 | 210.1046 | 186.8813 | 139.4135 | 88.6999 | 63.3750 | (83) |
| Total gains | 620.5004 | 685.5816 | 708.8781 | 734.8058 | 735.3086 | 715.4527 | 687.2058 | 672.0456 | 661.4831 | 629.9031 | 607.9647 | 599.9791 | (84) |

7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, ni1,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 159.2652 | 160.1794 | 161.1041 | 165.8925 | 166.8846 | 172.0283 | 172.0283 | 173.0953 | 169.9332 | 166.8846 | 164.9122 | 162.9859 | |
| alpha | 11.6177 | 11.6786 | 11.7403 | 12.0595 | 12.1256 | 12.4686 | 12.4686 | 12.5397 | 12.3289 | 12.1256 | 11.9941 | 11.8657 | |
| util living area | 0.9934 | 0.9776 | 0.9371 | 0.7976 | 0.6183 | 0.4247 | 0.3040 | 0.3230 | 0.5013 | 0.7955 | 0.9671 | 0.9948 | (86) |
| MIT | 20.7486 | 20.8421 | 20.9258 | 20.9899 | 20.9995 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 20.9917 | 20.8945 | 20.7428 | (87) |
| Th 2 | 20.3848 | 20.3881 | 20.3914 | 20.4080 | 20.4113 | 20.4280 | 20.4280 | 20.4313 | 20.4213 | 20.4113 | 20.4047 | 20.3980 | (88) |
| util rest of house | 0.9907 | 0.9697 | 0.9184 | 0.7631 | 0.5795 | 0.3867 | 0.2645 | 0.2830 | 0.4593 | 0.7553 | 0.9546 | 0.9926 | (89) |
| MIT 2 | 20.1023 | 20.2200 | 20.3198 | 20.4001 | 20.4110 | 20.4280 | 20.4280 | 20.4313 | 20.4213 | 20.4054 | 20.2987 | 20.1068 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.3344 | (91) |
| MIT | 20.3184 | 20.4280 | 20.5225 | 20.5973 | 20.6078 | 20.6193 | 20.6193 | 20.6215 | 20.6148 | 20.6015 | 20.4979 | 20.3195 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 20.3184 | 20.4280 | 20.5225 | 20.5973 | 20.6078 | 20.6193 | 20.6193 | 20.6215 | 20.6148 | 20.6015 | 20.4979 | 20.3195 | (93) |

8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9903 | 0.9702 | 0.9228 | 0.7743 | 0.5924 | 0.3994 | 0.2777 | 0.2964 | 0.4733 | 0.7686 | 0.9568 | 0.9923 | (94) |
| Useful gains | 614.4928 | 665.1821 | 654.1445 | 568.9969 | 435.6182 | 285.7631 | 190.8148 | 199.1799 | 313.0876 | 484.1402 | 581.6966 | 595.3472 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | 821.4174 | 791.7283 | 710.8596 | 575.8724 | 435.9319 | 285.7650 | 190.8148 | 199.1800 | 313.1039 | 489.4565 | 663.5160 | 807.7327 | (97) |
| Space heating kWh | 153.9520 | 85.0391 | 42.1960 | 4.9504 | 0.2334 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.9553 | 58.9100 | 158.0148 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 507.2510 | |
| Solar heating kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | 153.9520 | 85.0391 | 42.1960 | 4.9504 | 0.2334 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.9553 | 58.9100 | 158.0148 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 507.2510 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 6.4347 | (99) |

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ext. temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | |
| Heat loss rate W | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 446.2664 | 351.3161 | 358.5869 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (100) |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.9995 | 0.9999 | 0.9999 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (101) |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 446.0450 | 351.2981 | 358.5584 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (102) |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 765.9663 | 736.4932 | 720.4412 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 230.3433 | 286.5852 | 269.2408 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (104) |
| Cooled fraction | | | | | | | | | | fC = cooled area / (4) = | | 0.9895 | (105) |
| Intermittency factor (Table 10b) | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | (106) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 56.9795 | 70.8919 | 66.6015 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) |
| Space cooling requirement | | | | | | | | | | | | 194.4729 | (107) |

9b. Energy requirements

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | 0.0000 | (301) |
| Fraction of space heat from community system | | | | | | | | | | | | 1.0000 | (302) |
| Fraction of heat from community Heat pump-Space and Water | | | | | | | | | | | | 1.0000 | (303a) |
| Factor for control and charging method (Table 4c(3)) for space heating | | | | | | | | | | | | 1.0000 | (305) |
| Factor for charging method (Table 4c(3)) for water heating | | | | | | | | | | | | 1.0000 | (305a) |
| Distribution loss factor (Table 12c) for community heating system | | | | | | | | | | | | 2.0000 | (306) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 | (208) |
| Space heating: | | | | | | | | | | | | | |
| Space heating requirement | | | | | | | | | | | | | |
| | 153.9520 | 85.0391 | 42.1960 | 4.9504 | 0.2334 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.9553 | 58.9100 | 158.0148 | (98) |
| Space heat from Heat pump = (98) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 307a | 307.9039 | 170.0782 | 84.3921 | 9.9008 | 0.4668 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 7.9106 | 117.8200 | 316.0296 | |
| Space heating requirement | | | | | | | | | | | | | |
| | 307.9039 | 170.0782 | 84.3921 | 9.9008 | 0.4668 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 7.9106 | 117.8200 | 316.0296 | (307) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | | | | | | | | | | | 0.0000 | (308) |
| Space heating fuel for secondary/supplementary system | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (309) |
| Water heating | | | | | | | | | | | | | |
| Annual water heating requirement | | | | | | | | | | | | | |
| | 252.7688 | 223.5637 | 237.6909 | 214.1650 | 208.1974 | 184.4493 | 177.0251 | 191.0093 | 191.1596 | 215.1661 | 228.7005 | 252.1681 | (64) |
| Water heat from Heat pump = (64) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 310a | 505.5376 | 447.1275 | 475.3819 | 428.3301 | 416.3948 | 368.8987 | 354.0503 | 382.0187 | 382.3192 | 430.3322 | 457.4010 | 504.3362 | |
| Water heating fuel | | | | | | | | | | | | | |
| | 505.5376 | 447.1275 | 475.3819 | 428.3301 | 416.3948 | 368.8987 | 354.0503 | 382.0187 | 382.3192 | 430.3322 | 457.4010 | 504.3362 | (310) |
| Cooling System Energy Efficiency Ratio | | | | | | | | | | | | 2.6000 | (314) |
| Space coolin | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 21.9152 | 27.2661 | 25.6160 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (315) |
| Pumps and Fa | 21.6127 | 19.5212 | 21.6127 | 20.9156 | 21.6127 | 20.9156 | 21.6127 | 21.6127 | 20.9156 | 21.6127 | 20.9156 | 21.6127 | (331) |
| Lighting | 27.0213 | 21.6775 | 19.5182 | 14.2999 | 11.0456 | 9.0244 | 10.0762 | 13.0974 | 17.0123 | 22.3210 | 25.2115 | 27.7723 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333a)m | -4.8305 | -7.8680 | -13.1459 | -17.1305 | -20.5656 | -19.9940 | -19.7111 | -17.4826 | -13.9791 | -9.8612 | -5.6485 | -4.0503 | (333a) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335a) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (333b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335b) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - community heating | 1014.5019 | (307) |
| Space heating fuel - secondary | 0.0000 | (309) |
| Water heating fuel - community heating | 5152.1278 | (310) |
| Efficiency of water heater | 0.0000 | (311) |
| Electricity used for heat distribution | 10.1450 | (313) |
| Space cooling fuel | 74.7973 | (321) |
| | | |
| Electricity for pumps and fans: | | |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8820) | | |
| mechanical ventilation fans (SFP = 0.8820) | 254.4727 | (330a) |
| Total electricity for the above, kWh/year | 254.4727 | (331) |
| Electricity for lighting (calculated in Appendix L) | 218.0777 | (332) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -154.2673 | (333) |
| Wind generation | 0.0000 | (334) |
| Hydro-electric generation (Appendix N) | 0.0000 | (335a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (335) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (336) |
| Energy used | 0.0000 | (337) |
| Total delivered energy for all uses | 6559.7101 | (338) |

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12b. Carbon dioxide emissions - Community heating scheme

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (367) |
| Space and Water heating from Heat pump | 2202.3678 | 0.1599 | 57.9178 | (367) |
| Electrical energy for heat distribution (space & water) | 10.1450 | 0.0000 | 8.8786 | (372) |
| Overall CO2 factor for heat network | | | 0.0529 | (386) |
| Total CO2 associated with community systems | | | 325.9705 | (373) |
| Space and water heating | | | 325.9705 | (376) |
| Space cooling | 74.7973 | 0.1140 | 8.5254 | (377) |
| Pumps, fans and electric keep-hot | 254.4727 | 0.1387 | 35.2985 | (378) |
| Energy for lighting | 218.0777 | 0.1443 | 31.4753 | (379) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -154.2673 | 0.1318 | -20.3269 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -20.3269 | (380) |
| Total CO2, kg/year | | | 380.9429 | (383) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 4.8300 | (384) |

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13b. Primary energy - Community heating scheme

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| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (467a) |
| Space and Water heating from Heat pump | 2202.3678 | 1.5917 | 576.6922 | (467) |
| Electrical energy for heat distribution (space & water) | 10.1450 | 0.0000 | 94.5018 | (472) |
| Overall CO2 factor for heat network | | | 0.5626 | (486) |
| Total CO2 associated with community systems | | | 3469.5656 | (473) |
| Space and water heating | | | 3469.5656 | (476) |
| Space cooling | 74.7973 | 1.4201 | 106.2204 | (477) |
| Pumps, fans and electric keep-hot | 254.4727 | 1.5128 | 384.9663 | (478) |
| Energy for lighting | 218.0777 | 1.5338 | 334.4948 | (479) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -154.2673 | 1.4868 | -229.3667 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -229.3667 | (480) |
| Total Primary energy kWh/year | | | 4065.8804 | (483) |
| Dwelling Primary energy Rate (DPER) | | | 51.5800 | (484) |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 78.8300 | (1b) | x 3.0000 | (2b) = | 236.4900 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 78.8300 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | | 236.4900 | (5) |

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2. Ventilation rate

---

m3 per hour

| | | | |
|---|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 | (6a) |
| Number of open flues | 0 * 20 = | 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | 3 * 10 = | 30.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |

| | | Air changes per hour | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 30.0000 / (5) = | 0.1269 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3769 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.3769 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.4805 | 0.4711 | 0.4616 | 0.4145 | 0.4051 | 0.3580 | 0.3580 | 0.3486 | 0.3769 | 0.4051 | 0.4240 | 0.4428 | (22b) |
| Effective ac | 0.6154 | 0.6110 | 0.6066 | 0.5859 | 0.5821 | 0.5641 | 0.5641 | 0.5608 | 0.5710 | 0.5821 | 0.5899 | 0.5980 | (25) |

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## 3. Heat losses and heat loss parameter

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| Element | Gross | Openings | NetArea | U-value | A x U | K-value | A x K | |
|---|---|---|---|---|---|---|---|---|
| | m2 | m2 | m2 | W/m2K | W/K | kJ/m2K | kJ/K | |
| Main dwelling | | | | | | | | |
| TER Opaque door | | | 1.8900 | 1.0000 | 1.8900 | | | (26) |
| TER Opening Type | | | 9.2200 | 1.1450 | 10.5573 | | | (27) |
| External Walls | 36.9100 | 9.2200 | 27.6900 | 0.1800 | 4.9842 | | | (29a) |
| Wall to Communal Corridor | 27.1300 | 1.8900 | 25.2400 | 0.1800 | 4.5432 | | | (29a) |
| Wall to Communal Stairs | 24.4900 | | 24.4900 | 0.1800 | 4.4082 | | | (29a) |
| Total net area of external elements Aum(A, m2) | | | 88.5300 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 26.3829 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 25 | | | 23.0300 | 0.0000 | 0.0000 | | | (32) |

| | | |
|---|---|---|
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | 354.4875 | (35) |
| List of Thermal Bridges | | |

| K1 Element | Length | Psi-value | Total |
|---|---|---|---|
| E1 Steel lintel with perforated steel base plate | 4.4200 | 0.0500 | 0.2210 |
| E3 Sill | 1.0225 | 0.0500 | 0.0511 |
| E4 Jamb | 12.0600 | 0.0500 | 0.6030 |
| E7 Party floor between dwellings (in blocks of flats) | 10.6200 | 0.0700 | 0.7434 |
| E18 Party wall between dwellings | 3.0000 | 0.0600 | 0.1800 |
| E16 Corner (normal) | 9.0000 | 0.0900 | 0.8100 |
| E17 Corner (inverted - internal area greater than external area) | 6.0000 | -0.0900 | -0.5400 |
| E23 Balcony within or between dwellings, balcony support penetrates wall insulation | 5.1470 | 0.0200 | 0.1029 |
| E7 Party floor between dwellings (in blocks of flats) | 18.0900 | 0.0700 | 1.2663 |
| E24 Eaves (insulation at ceiling level - inverted) | 7.1110 | 0.2400 | 1.7066 |
| E15 Flat roof with parapet | 3.5850 | 0.5600 | 2.0076 |

| | | | |
|---|---|---|---|
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | 7.1520 | (36) |
| Point Thermal bridges | (36a) = | 0.0000 | |
| Total fabric heat loss | (33) + (36) + (36a) = | 33.5349 | (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 48.0296 | 47.6798 | 47.3369 | 45.7264 | 45.4250 | 44.0223 | 44.0223 | 43.7625 | 44.5626 | 45.4250 | 46.0346 | 46.6719 | (38) |
| Heat transfer coeff | 81.5645 | 81.2147 | 80.8718 | 79.2612 | 78.9599 | 77.5571 | 77.5571 | 77.2974 | 78.0974 | 78.9599 | 79.5695 | 80.2068 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 79.2598 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.0347 | 1.0303 | 1.0259 | 1.0055 | 1.0016 | 0.9839 | 0.9839 | 0.9806 | 0.9907 | 1.0016 | 1.0094 | 1.0175 | (40) |
| HLP (average) | | | | | | | | | | | | 1.0055 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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## 4. Water heating energy requirements (kWh/year)

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| | | |
|---|---|---|
| Assumed occupancy | 2.4403 | (42) |

Hot water usage for mixer showers

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 65.1353 | 64.1564 | 62.7300 | 60.0009 | 57.9869 | 55.7408 | 54.4642 | 55.8798 | 57.4315 | 59.8431 | 62.6309 | 64.8857 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 28.1335 | 27.7157 | 27.1273 | 26.0425 | 25.2301 | 24.3294 | 23.8428 | 24.4271 | 25.0632 | 26.0271 | 27.1343 | 28.0384 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 39.6210 | 38.1802 | 36.7394 | 35.2987 | 33.8579 | 32.4172 | 32.4172 | 33.8579 | 35.2987 | 36.7394 | 38.1802 | 39.6210 | (42c) |

| | | |
|---|---|---|
| Average daily hot water use (litres/day) | 122.1558 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 132.8898 | 130.0523 | 126.5968 | 121.3420 | 117.0749 | 112.4874 | 110.7242 | 114.1648 | 117.7935 | 122.6096 | 127.9454 | 132.5451 | (44) |
| Energy conte | 210.4649 | 185.1928 | 194.5746 | 166.1112 | 157.6053 | 138.3163 | 133.9113 | 141.3599 | 145.2511 | 166.3801 | 182.2816 | 207.5336 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 2028.9828 | |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | | |
| | 31.5697 | 27.7789 | 29.1862 | 24.9167 | 23.6408 | 20.7475 | 20.0867 | 21.2040 | 21.7877 | 24.9570 | 27.3422 | 31.1300 | (46) |

| | | |
|---|---|---|
| Water storage loss: | | |
| Store volume | 150.0000 | (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | 1.3938 | (48) |
| Temperature factor from Table 2b | 0.5400 | (49) |
| Enter (49) or (54) in (55) | 0.7527 | (55) |

Total storage loss

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (56) |

If cylinder contains dedicated solar storage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (57) |
| Primary loss 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |

Total heat required for water heating calculated for each month

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 257.0598 | 227.2785 | 241.1695 | 211.2030 | 204.2002 | 183.4082 | 180.5062 | 187.9548 | 190.3430 | 212.9750 | 227.3735 | 254.1285 | (62) |
| WWHRS | -29.7771 | -26.3351 | -27.5766 | -22.8345 | -21.2810 | -18.2103 | -17.0692 | -18.1514 | -18.8411 | -22.2115 | -25.1630 | -29.2257 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | | | | | | | | | | | | | |
| | 227.2827 | 200.9434 | 213.5928 | 188.3685 | 182.9193 | 165.1979 | 163.4370 | 169.8034 | 171.5019 | 190.7635 | 202.2105 | 224.9028 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2300.9236 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2301 | (64) |
| Electric shower(s) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | | | | | |
| Heat gains from water heating, kWh/month | | | | | | | | | | | | | |
| | 107.2555 | 95.2452 | 101.9720 | 91.3054 | 89.6797 | 82.0637 | 81.8014 | 84.2781 | 84.3695 | 92.5973 | 96.6821 | 106.2808 | (65) |

## 5. Internal gains (see Table 5 and 5a)

| Metabolic gains (Table 5), Watts | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 122.0143 | 122.0143 | 122.0143 | 122.0143 | 122.0143 | 122.0143 | 122.0143 | 122.0143 | 122.0143 | 122.0143 | 122.0143 | 122.0143 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 122.1657 | 135.2549 | 122.1657 | 126.2379 | 122.1657 | 126.2379 | 122.1657 | 122.1657 | 126.2379 | 122.1657 | 126.2379 | 122.1657 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 216.9779 | 219.2294 | 213.5556 | 201.4767 | 186.2292 | 171.8987 | 162.3251 | 160.0735 | 165.7474 | 177.8263 | 193.0738 | 207.4042 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 35.2014 | 35.2014 | 35.2014 | 35.2014 | 35.2014 | 35.2014 | 35.2014 | 35.2014 | 35.2014 | 35.2014 | 35.2014 | 35.2014 | (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.0000 | 3.0000 | 3.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | | | | | | | | | | | | | |
| | -97.6115 | -97.6115 | -97.6115 | -97.6115 | -97.6115 | -97.6115 | -97.6115 | -97.6115 | -97.6115 | -97.6115 | -97.6115 | -97.6115 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 144.1606 | 141.7339 | 137.0591 | 126.8131 | 120.5372 | 113.9773 | 109.9482 | 113.2770 | 117.1798 | 124.4587 | 134.2807 | 142.8506 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 545.9085 | 558.8225 | 535.3847 | 517.1320 | 491.5364 | 471.7182 | 454.0432 | 455.1205 | 468.7694 | 487.0550 | 516.1967 | 535.0249 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Southeast | 9.2200 | 36.7938 | 0.6300 | 0.7000 | 0.7700 | 103.6759 | (77) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 103.6759 | 176.5984 | 241.6296 | 299.3908 | 335.3427 | 332.9177 | 320.9681 | 294.1465 | 261.6338 | 195.1789 | 124.1798 | 88.7250 | (83) |
| Total gains | 649.5844 | 735.4209 | 777.0143 | 816.5228 | 826.8791 | 804.6359 | 775.0114 | 749.2670 | 730.4032 | 682.2339 | 640.3765 | 623.7498 | (84) |

## 7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 95.1675 | 95.5775 | 95.9827 | 97.9330 | 98.3068 | 100.0848 | 100.0848 | 100.4212 | 99.3924 | 98.3068 | 97.5536 | 96.7785 | |
| alpha | 7.3445 | 7.3718 | 7.3988 | 7.5289 | 7.5538 | 7.6723 | 7.6723 | 7.6947 | 7.6262 | 7.5538 | 7.5036 | 7.4519 | |
| util living area | | | | | | | | | | | | | |
| | 0.9977 | 0.9937 | 0.9834 | 0.9407 | 0.8245 | 0.6110 | 0.4399 | 0.4737 | 0.7173 | 0.9475 | 0.9930 | 0.9983 | (86) |
| MIT | 20.2585 | 20.4006 | 20.5752 | 20.8009 | 20.9451 | 20.9950 | 20.9996 | 20.9994 | 20.9843 | 20.8177 | 20.5100 | 20.2455 | (87) |
| Th 2 | 20.0545 | 20.0582 | 20.0618 | 20.0788 | 20.0820 | 20.0968 | 20.0968 | 20.0996 | 20.0911 | 20.0820 | 20.0755 | 20.0688 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9967 | 0.9909 | 0.9759 | 0.9155 | 0.7655 | 0.5279 | 0.3499 | 0.3815 | 0.6327 | 0.9198 | 0.9893 | 0.9975 | (89) |
| MIT 2 | 19.2049 | 19.3883 | 19.6102 | 19.8934 | 20.0433 | 20.0947 | 20.0967 | 20.0994 | 20.0834 | 19.9197 | 19.5420 | 19.1997 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.3344 | (91) |
| MIT | 19.5572 | 19.7268 | 19.9329 | 20.1969 | 20.3449 | 20.3958 | 20.3987 | 20.4004 | 20.3846 | 20.2200 | 19.8657 | 19.5494 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.5572 | 19.7268 | 19.9329 | 20.1969 | 20.3449 | 20.3958 | 20.3987 | 20.4004 | 20.3846 | 20.2200 | 19.8657 | 19.5494 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9959 | 0.9896 | 0.9746 | 0.9192 | 0.7835 | 0.5558 | 0.3800 | 0.4124 | 0.6610 | 0.9247 | 0.9882 | 0.9969 | (94) |
| Useful gains | 646.9520 | 727.7440 | 757.2941 | 750.5560 | 647.8836 | 447.2130 | 294.5034 | 309.0167 | 482.7884 | 630.8736 | 632.8009 | 621.8041 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | | | | | | | | | | | | | |
| | 1244.4449 | 1204.1547 | 1086.3419 | 895.4037 | 682.5978 | 449.5052 | 294.6128 | 309.2170 | 490.8147 | 759.5945 | 1015.7593 | 1231.1259 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 444.5347 | 320.1480 | 244.8116 | 104.2904 | 25.8274 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 95.7684 | 275.7300 | 453.3354 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 1964.4458 | |
| Solar heating kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | | | | | | | | | | | | | |
| | 444.5347 | 320.1480 | 244.8116 | 104.2904 | 25.8274 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 95.7684 | 275.7300 | 453.3354 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 1964.4458 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 24.9200 | (99) |

## 9a. Energy requirements - Individual heating systems, including micro-CHP

| | | |
|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | 0.0000 | (201) |
| Fraction of space heat from main system(s) | 1.0000 | (202) |
| Efficiency of main space heating system 1 (in %) | 92.3000 | (206) |
| Efficiency of main space heating system 2 (in %) | 0.0000 | (207) |
| Efficiency of secondary/supplementary heating system, % | 0.0000 | (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement | | | | | | | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 444.5347 | 320.1480 | 244.8116 | 104.2904 | 25.8274 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 95.7684 | 275.7300 | 453.3354 (98) |
| Space heating efficiency (main heating system 1) | | | | | | | | | | | | |
| | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.3000 | 92.3000 | 92.3000 (210) |
| Space heating fuel (main heating system) | | | | | | | | | | | | |
| | 481.6194 | 346.8559 | 265.2347 | 112.9907 | 27.9820 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 103.7577 | 298.7324 | 491.1543 (211) |
| Space heating efficiency (main heating system 2) | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (212) |
| Space heating fuel (main heating system 2) | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (213) |
| Space heating fuel (secondary) | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (215) |
| Water heating | | | | | | | | | | | | |
| Water heating requirement | | | | | | | | | | | | |
| | 227.2827 | 200.9434 | 213.5928 | 188.3685 | 182.9193 | 165.1979 | 163.4370 | 169.8034 | 171.5019 | 190.7635 | 202.2105 | 224.9028 (64) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 (216) |
| (217)m | 85.5363 | 85.0990 | 84.3665 | 82.7901 | 80.8134 | 79.8000 | 79.8000 | 79.8000 | 79.8000 | 82.5980 | 84.7557 | 85.5987 (217) |
| Fuel for water heating, kWh/month | | | | | | | | | | | | |
| | 265.7148 | 236.1291 | 253.1726 | 227.5253 | 226.3477 | 207.0149 | 204.8082 | 212.7862 | 214.9147 | 230.9541 | 238.5803 | 262.7408 (219) |
| Space cooling fuel requirement | | | | | | | | | | | | |
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (221) |
| Pumps and Fa | 7.3041 | 6.5973 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 (231) |
| Lighting | 25.3836 | 20.3637 | 18.3352 | 13.4332 | 10.3762 | 8.4774 | 9.4655 | 12.3036 | 15.9812 | 20.9682 | 23.6835 | 26.0891 (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (233a)m | -17.4246 | -26.1023 | -39.8307 | -47.6244 | -53.8629 | -51.1922 | -50.5725 | -46.4992 | -39.7565 | -31.0801 | -19.6960 | -14.8910 (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | |
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (233b)m | -5.6599 | -12.2255 | -24.9106 | -38.3323 | -51.6013 | -52.1907 | -51.5736 | -43.2374 | -31.1367 | -17.7736 | -7.6478 | -4.4520 (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | |
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235d) |

Annual totals kWh/year

| | |
|---|---|
| Space heating fuel - main system 1 | 2128.3269 (211) |
| Space heating fuel - main system 2 | 0.0000 (213) |
| Space heating fuel - secondary | 0.0000 (215) |
| Efficiency of water heater | 79.8000 |
| Water heating fuel used | 2780.6886 (219) |
| Space cooling fuel | 0.0000 (221) |
| Electricity for pumps and fans: | |
| Total electricity for the above, kWh/year | 86.0000 (231) |
| Electricity for lighting (calculated in Appendix L) | 204.8604 (232) |
| Energy saving/generation technologies (Appendices M ,N and Q) | |
| PV generation | -779.2741 (233) |
| Wind generation | 0.0000 (234) |
| Hydro-electric generation (Appendix N) | 0.0000 (235a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 (235) |
| Appendix Q - special features | |
| Energy saved or generated | -0.0000 (236) |
| Energy used | 0.0000 (237) |
| Total delivered energy for all uses | 4420.6019 (238) |

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 2128.3269 | 0.2100 | 446.9487 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2780.6886 | 0.2100 | 583.9446 | (264) |
| Space and water heating | | | 1030.8933 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 204.8604 | 0.1443 | 29.5677 | (268) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -438.5324 | 0.1333 | -58.4739 | |
| PV Unit electricity exported | -340.7416 | 0.1252 | -42.6584 | |
| Total | | | -101.1323 | (269) |
| Total CO2, kg/year | | | 971.2579 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 12.3200 | (273) |

13a. Primary energy - Individual heating systems including micro-CHP

| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 2128.3269 | 1.1300 | 2405.0094 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2780.6886 | 1.1300 | 3142.1781 | (278) |
| Space and water heating | | | 5547.1876 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 204.8604 | 1.5338 | 314.2217 | (282) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -438.5324 | 1.4927 | -654.6109 | |
| PV Unit electricity exported | -340.7416 | 0.4595 | -156.5739 | |
| Total | | | -811.1848 | (283) |
| Total Primary energy kWh/year | | | 5180.3252 | (286) |
| Target Primary Energy Rate (TPER) | | | 65.7200 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Property Reference** | Unit 28 | **Issued on Date** | 17/05/2025 |
| **Assessment Reference** | 00001 | **Prop Type Ref** | Unit 28 |
| **Property** | | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 76 C | **DER** | 6.66 | **TER** | 17.18 |
| **Environmental** | 95 A | **% DER < TER** | | | 61.23 |
| **$CO_2$ Emissions (t/year)** | 0.37 | **DFEE** | 42.28 | **TFEE** | 49.81 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 15.12 |
| **% DPER < TPER** | 23.37 | **DPER** | 70.40 | **TPER** | 91.87 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Robert Arnold | **Assessor ID** | BA04-0001 |
| **Client** | | | |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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## 1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 62.6700 | (1b) | x 3.0000 | (2b) = | 188.0100 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 62.6700 | | | | | (4) |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | 188.0100 | (5) |

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## 2. Ventilation rate

---

| | | m3 per hour | |
|---|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 | (6a) |
| Number of open flues | 0 * 20 = | 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | 0 * 10 = | 0.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |

| | Air changes per hour | | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 0.0000 / (5) = | 0.0000 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 3.0000 | (17) |
| Infiltration rate | | 0.1500 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.1500 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.1912 | 0.1875 | 0.1837 | 0.1650 | 0.1612 | 0.1425 | 0.1425 | 0.1388 | 0.1500 | 0.1612 | 0.1687 | 0.1762 | (22b) |

Balanced mechanical ventilation with heat recovery

| | | |
|---|---|---|
| If mechanical ventilation | 0.5000 | (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | 0.5000 | (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | 81.0000 | (23c) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective ac | 0.2862 | 0.2825 | 0.2787 | 0.2600 | 0.2562 | 0.2375 | 0.2375 | 0.2337 | 0.2450 | 0.2562 | 0.2637 | 0.2712 | (25) |

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## 3. Heat losses and heat loss parameter

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| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| Windows | | | 12.5600 | 1.0536 | 13.2337 | | | (27) |
| Front Door | | | 1.8900 | 1.4000 | 2.6460 | | | (26) |
| Glass Door | | | 2.2900 | 1.3258 | 3.0360 | | | (27) |
| External Walls | 57.4600 | 14.8500 | 42.6100 | 0.1500 | 6.3915 | 150.0000 | 6391.5000 | (29a) |
| Wall to Communal Corridor | 34.6900 | 1.8900 | 32.8000 | 0.1300 | 4.2640 | 150.0000 | 4920.0000 | (29a) |
| External Roof | 20.6800 | | 20.6800 | 0.1000 | 2.0680 | 9.0000 | 186.1200 | (30) |
| Total net area of external elements Aum(A, m2) | | | 112.8300 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 31.6392 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 26 | | | 19.6100 | 0.0000 | 0.0000 | 110.0000 | 2157.1000 | (32) |
| Party Floor | | | 62.6700 | | | 80.0000 | 5013.6000 | (32d) |
| Party Ceiling | | | 36.4000 | | | 100.0000 | 3640.0000 | (32b) |
| Internal Walls | | | 163.5600 | | | 9.0000 | 1472.0400 | (32c) |

| | | |
|---|---|---|
| Heat capacity Cm = Sum(A x k) | (28)...(30) + (32) + (32a)...(32e) = 23780.3600 | (34) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 379.4536 (35)

List of Thermal Bridges

| K1 Element | Length | Psi-value | Total |
|---|---|---|---|
| E1 Steel lintel with perforated steel base plate | 6.3600 | 0.0500 | 0.3180 |
| E4 Jamb | 17.6400 | 0.0500 | 0.8820 |
| E7 Party floor between dwellings (in blocks of flats) | 8.6475 | 0.0350 | 0.3027 |
| E18 Party wall between dwellings | 3.0000 | 0.0600 | 0.1800 |
| E24 Eaves (insulation at ceiling level - inverted) | 5.3750 | 0.1200 | 0.6450 |
| E24 Eaves (insulation at ceiling level - inverted) | 11.9590 | 0.1200 | 1.4351 |
| E15 Flat roof with parapet | 8.5600 | 0.5600 | 4.7936 |
| E7 Party floor between dwellings (in blocks of flats) | 11.5630 | 0.0350 | 0.4047 |
| E16 Corner (normal) | 9.0000 | 0.0900 | 0.8100 |
| E17 Corner (inverted - internal area greater than external area) | 6.0000 | -0.0900 | -0.5400 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 9.2310 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 40.8702 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 17.7599 | 17.5272 | 17.2946 | 16.1313 | 15.8986 | 14.7353 | 14.7353 | 14.5026 | 15.2006 | 15.8986 | 16.3639 | 16.8292 | (38) |
| Heat transfer coeff | 58.6301 | 58.3975 | 58.1648 | 57.0015 | 56.7688 | 55.6055 | 55.6055 | 55.3729 | 56.0709 | 56.7688 | 57.2342 | 57.6995 | (39) |

Average = Sum(39)m / 12 = 56.9433

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 0.9355 | 0.9318 | 0.9281 | 0.9096 | 0.9058 | 0.8873 | 0.8873 | 0.8836 | 0.8947 | 0.9058 | 0.9133 | 0.9207 | (40) |
| HLP (average) | | | | | | | | | | | | 0.9086 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

## 4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.0560 (42)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hot water usage for mixer showers | 57.2096 | 56.3338 | 55.0430 | 53.0572 | 51.2781 | 48.7891 | 46.8205 | 49.1219 | 50.2795 | 52.7447 | 55.3120 | 57.1580 | (42a) |
| Hot water usage for baths | 24.7975 | 24.4232 | 23.8907 | 23.0932 | 22.3744 | 21.3850 | 20.6344 | 21.5523 | 22.0340 | 23.0144 | 24.0336 | 24.7778 | (42b) |
| Hot water usage for other uses | 35.6858 | 34.3882 | 33.0905 | 31.7928 | 30.4952 | 29.1975 | 29.1975 | 30.4952 | 31.7928 | 33.0905 | 34.3882 | 35.6858 | (42c) |

Average daily hot water use (litres/day) 108.1777 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 117.6930 | 115.1451 | 112.0241 | 107.9432 | 104.1477 | 99.3716 | 96.6524 | 101.1694 | 104.1063 | 108.8496 | 113.7338 | 117.6217 | (44) |
| Energy conte | 173.2644 | 152.3602 | 160.0801 | 141.0008 | 134.2049 | 114.9200 | 106.8037 | 119.0782 | 120.7581 | 140.2637 | 153.7150 | 172.7361 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1689.1853 | |
| Distribution loss (46)m = 0.15 x (45)m | 25.9897 | 22.8540 | 24.0120 | 21.1501 | 20.1307 | 17.2380 | 16.0206 | 17.8617 | 18.1137 | 21.0396 | 23.0573 | 25.9104 | (46) |

Water storage loss:

Store volume 110.0000 (47)

b) If manufacturer declared loss factor is not known :

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.0152 (51)

Volume factor from Table 2a 1.0294 (52)

Temperature factor from Table 2b 0.6000 (53)

Enter (49) or (54) in (55) 1.0327 (55)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total storage loss | 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (56) |
| If cylinder contains dedicated solar storage | 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (57) |
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | 228.5412 | 202.2877 | 215.3569 | 194.4945 | 189.4817 | 168.4137 | 162.0805 | 174.3550 | 174.2518 | 195.5405 | 207.2087 | 228.0129 | (62) |
| WWHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | 228.5412 | 202.2877 | 215.3569 | 194.4945 | 189.4817 | 168.4137 | 162.0805 | 174.3550 | 174.2518 | 195.5405 | 207.2087 | 228.0129 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2340.0251 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2340 | (64) |
| Electric shower(s) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | 101.8318 | 90.6017 | 97.4481 | 89.6777 | 88.8446 | 81.0058 | 79.7337 | 83.8150 | 82.9470 | 90.8591 | 93.9052 | 101.6562 | (65) |

## 5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 102.8016 | 102.8016 | 102.8016 | 102.8016 | 102.8016 | 102.8016 | 102.8016 | 102.8016 | 102.8016 | 102.8016 | 102.8016 | 102.8016 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 90.6012 | 100.3085 | 90.6012 | 93.6212 | 90.6012 | 93.6212 | 90.6012 | 90.6012 | 93.6212 | 90.6012 | 93.6212 | 90.6012 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 179.6270 | 181.4910 | 176.7939 | 166.7942 | 154.1715 | 142.3078 | 134.3822 | 132.5183 | 137.2154 | 147.2150 | 159.8378 | 171.7014 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 33.2802 | 33.2802 | 33.2802 | 33.2802 | 33.2802 | 33.2802 | 33.2802 | 33.2802 | 33.2802 | 33.2802 | 33.2802 | 33.2802 | (69) |
| Pumps, fans | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | -82.2413 | -82.2413 | -82.2413 | -82.2413 | -82.2413 | -82.2413 | -82.2413 | -82.2413 | -82.2413 | -82.2413 | -82.2413 | -82.2413 | (71) |
| Water heating gains (Table 5) | 136.8708 | 134.8240 | 130.9786 | 124.5524 | 119.4147 | 112.5081 | 107.1689 | 112.6545 | 115.2042 | 122.1225 | 130.4239 | 136.6347 | (72) |
| Total internal gains | 460.9395 | 470.4639 | 452.2141 | 438.8083 | 418.0279 | 402.2777 | 385.9928 | 389.6144 | 399.8813 | 413.7792 | 437.7234 | 452.7778 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W |
|---|---|---|---|---|---|---|

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northeast | | | 2.5700 | | 11.2829 | | 0.7200 | | 0.7000 | | 0.7700 | | 10.1279 (75) |
| Northwest | | | 9.9900 | | 11.2829 | | 0.7200 | | 0.7000 | | 0.7700 | | 39.3687 (81) |
| Northwest | | | 2.2900 | | 11.2829 | | 0.4500 | | 0.7000 | | 0.7700 | | 5.6403 (81) |
| Solar gains | 55.1369 | 112.2328 | 202.2079 | 332.0834 | 446.3852 | 475.8939 | 445.1890 | 354.9098 | 246.3934 | 137.1574 | 69.3765 | 45.0276 | (83) |
| Total gains | 516.0764 | 582.6968 | 654.4220 | 770.8917 | 864.4131 | 878.1716 | 831.1818 | 744.5243 | 646.2747 | 550.9366 | 507.0999 | 497.8053 | (84) |

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| tau | 112.6665 | 113.1154 | 113.5679 | 115.8856 | 116.3606 | 118.7949 | 118.7949 | 119.2941 | 117.8091 | 116.3606 | 115.4145 | 114.4838 | |
| alpha | 8.5111 | 8.5410 | 8.5712 | 8.7257 | 8.7574 | 8.9197 | 8.9197 | 8.9529 | 8.8539 | 8.7574 | 8.6943 | 8.6323 | |
| util living area | 0.9980 | 0.9935 | 0.9721 | 0.8407 | 0.6076 | 0.4052 | 0.2944 | 0.3421 | 0.5961 | 0.9257 | 0.9927 | 0.9985 | (86) |
| MIT | 20.4207 | 20.5488 | 20.7410 | 20.9479 | 20.9965 | 20.9999 | 21.0000 | 21.0000 | 20.9979 | 20.8992 | 20.6342 | 20.4093 | (87) |
| Th 2 | 20.1374 | 20.1405 | 20.1437 | 20.1594 | 20.1625 | 20.1783 | 20.1783 | 20.1815 | 20.1720 | 20.1625 | 20.1562 | 20.1500 | (88) |
| util rest of house | 0.9970 | 0.9906 | 0.9601 | 0.7987 | 0.5543 | 0.3532 | 0.2394 | 0.2812 | 0.5260 | 0.8908 | 0.9887 | 0.9977 | (89) |
| MIT 2 | 19.4742 | 19.6392 | 19.8787 | 20.1174 | 20.1605 | 20.1783 | 20.1783 | 20.1815 | 20.1711 | 20.0788 | 19.7612 | 19.4700 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.3356 | (91) |
| MIT | 19.7918 | 19.9445 | 20.1681 | 20.3961 | 20.4411 | 20.4540 | 20.4541 | 20.4562 | 20.4486 | 20.3541 | 20.0542 | 19.7852 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.7918 | 19.9445 | 20.1681 | 20.3961 | 20.4411 | 20.4540 | 20.4541 | 20.4562 | 20.4486 | 20.3541 | 20.0542 | 19.7852 | (93) |

8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9965 | 0.9897 | 0.9605 | 0.8112 | 0.5722 | 0.3706 | 0.2578 | 0.3017 | 0.5495 | 0.8998 | 0.9881 | 0.9973 | (94) |
| Useful gains | 514.2547 | 576.6936 | 628.5783 | 625.3108 | 494.5759 | 325.4859 | 214.3058 | 224.5973 | 355.1530 | 495.7143 | 501.0521 | 496.4524 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | 908.2879 | 878.5587 | 795.0006 | 655.2949 | 496.2204 | 325.5152 | 214.3067 | 224.6007 | 355.9693 | 553.7280 | 741.4203 | 899.2587 | (97) |
| Space heating kWh | 293.1607 | 202.8533 | 123.8182 | 21.5886 | 1.2235 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 43.1622 | 173.0651 | 299.6879 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 1158.5595 | |
| Solar heating kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | 293.1607 | 202.8533 | 123.8182 | 21.5886 | 1.2235 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 43.1622 | 173.0651 | 299.6879 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 1158.5595 | |
| Space heating per m2 | | | | | | | | | | (98c) / (4) = | | 18.4867 | (99) |

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ext. temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | |
| Heat loss rate W | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 522.6920 | 411.4809 | 420.8338 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (100) |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.9983 | 0.9996 | 0.9988 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (101) |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 521.7869 | 411.3168 | 420.3407 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (102) |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 978.9854 | 926.5180 | 826.0736 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 329.1829 | 383.3097 | 301.8653 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (104) |
| Cooled fraction | | | | | | | | | | fC = cooled area / (4) = | | 0.9893 | (105) |
| Intermittency factor (Table 10b) | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | (106) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 81.4159 | 94.8029 | 74.6595 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) |
| Space cooling requirement | | | | | | | | | | | | 250.8784 | (107) |

9b. Energy requirements

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | 0.0000 | (301) |
| Fraction of space heat from community system | | | | | | | | | | | | 1.0000 | (302) |
| Fraction of heat from community Heat pump-Space and Water | | | | | | | | | | | | 1.0000 | (303a) |
| Factor for control and charging method (Table 4c(3)) for space heating | | | | | | | | | | | | 1.0000 | (305) |
| Factor for charging method (Table 4c(3)) for water heating | | | | | | | | | | | | 1.0000 | (305a) |
| Distribution loss factor (Table 12c) for community heating system | | | | | | | | | | | | 2.0000 | (306) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 | (208) |
| Space heating: | | | | | | | | | | | | | |
| Space heating requirement | | | | | | | | | | | | | |
| | 293.1607 | 202.8533 | 123.8182 | 21.5886 | 1.2235 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 43.1622 | 173.0651 | 299.6879 | (98) |
| Space heat from Heat pump = (98) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 307a | 586.3214 | 405.7067 | 247.6363 | 43.1772 | 2.4470 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 86.3244 | 346.1302 | 599.3758 | |
| Space heating requirement | | | | | | | | | | | | | |
| | 586.3214 | 405.7067 | 247.6363 | 43.1772 | 2.4470 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 86.3244 | 346.1302 | 599.3758 | (307) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | | | | | | | | | | | 0.0000 | (308) |
| Space heating fuel for secondary/supplementary system | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (309) |
| Water heating | | | | | | | | | | | | | |
| Annual water heating requirement | | | | | | | | | | | | | |
| | 228.5412 | 202.2877 | 215.3569 | 194.4945 | 189.4817 | 168.4137 | 162.0805 | 174.3550 | 174.2518 | 195.5405 | 207.2087 | 228.0129 | (64) |
| Water heat from Heat pump = (64) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 310a | 457.0823 | 404.5753 | 430.7139 | 388.9890 | 378.9633 | 336.8274 | 324.1611 | 348.7101 | 348.5036 | 391.0809 | 414.4174 | 456.0258 | |
| Water heating fuel | | | | | | | | | | | | | |
| | 457.0823 | 404.5753 | 430.7139 | 388.9890 | 378.9633 | 336.8274 | 324.1611 | 348.7101 | 348.5036 | 391.0809 | 414.4174 | 456.0258 | (310) |
| Cooling System Energy Efficiency Ratio | | | | | | | | | | | | 2.6000 | (314) |
| Space coolin | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 31.3138 | 36.4627 | 28.7152 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (315) |
| Pumps and Fa | 17.1822 | 15.5194 | 17.1822 | 16.6279 | 17.1822 | 16.6279 | 17.1822 | 17.1822 | 16.6279 | 17.1822 | 16.6279 | 17.1822 | (331) |
| Lighting | 18.5786 | 14.9044 | 13.4198 | 9.8319 | 7.5944 | 6.2047 | 6.9279 | 9.0052 | 11.6968 | 15.3468 | 17.3342 | 19.0949 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333a)m | -4.7632 | -7.7174 | -12.8257 | -16.6227 | -19.8753 | -19.2957 | -19.0228 | -16.9089 | -13.5740 | -9.6382 | -5.5563 | -3.9978 | (333a) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335a) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (333b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335b) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - community heating | 2317.1189 | (307) |
| Space heating fuel - secondary | 0.0000 | (309) |
| Water heating fuel - community heating | 4680.0502 | (310) |
| Efficiency of water heater | 0.0000 | (311) |
| Electricity used for heat distribution | 23.1712 | (313) |
| Space cooling fuel | 96.4917 | (321) |
| | | |
| Electricity for pumps and fans: | | |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8820) | | |
| mechanical ventilation fans (SFP = 0.8820) | 202.3063 | (330a) |
| Total electricity for the above, kWh/year | 202.3063 | (331) |
| Electricity for lighting (calculated in Appendix L) | 149.9396 | (332) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -149.7979 | (333) |
| Wind generation | 0.0000 | (334) |
| Hydro-electric generation (Appendix N) | 0.0000 | (335a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (335) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (336) |
| Energy used | 0.0000 | (337) |
| Total delivered energy for all uses | 7296.1088 | (338) |

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12b. Carbon dioxide emissions - Community heating scheme

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (367) |
| Space and Water heating from Heat pump | 2498.9890 | 0.1582 | 130.9190 | (367) |
| Electrical energy for heat distribution (space & water) | 23.1712 | 0.0000 | 10.2543 | (372) |
| Overall CO2 factor for heat network | | | 0.0538 | (386) |
| Total CO2 associated with community systems | | | 376.4785 | (373) |
| Space and water heating | | | 376.4785 | (376) |
| Space cooling | 96.4917 | 0.1142 | 11.0211 | (377) |
| Pumps, fans and electric keep-hot | 202.3063 | 0.1387 | 28.0624 | (378) |
| Energy for lighting | 149.9396 | 0.1443 | 21.6409 | (379) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -149.7979 | 0.1319 | -19.7524 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -19.7524 | (380) |
| Total CO2, kg/year | | | 417.4506 | (383) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 6.6600 | (384) |

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13b. Primary energy - Community heating scheme

---

| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (467a) |
| Space and Water heating from Heat pump | 2498.9890 | 1.5856 | 1312.1688 | (467) |
| Electrical energy for heat distribution (space & water) | 23.1712 | 0.0000 | 107.9030 | (472) |
| Overall CO2 factor for heat network | | | 0.5662 | (486) |
| Total CO2 associated with community systems | | | 3961.5801 | (473) |
| Space and water heating | | | 3961.5801 | (476) |
| Space cooling | 96.4917 | 1.4210 | 137.1101 | (477) |
| Pumps, fans and electric keep-hot | 202.3063 | 1.5128 | 306.0489 | (478) |
| Energy for lighting | 149.9396 | 1.5338 | 229.9824 | (479) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -149.7979 | 1.4872 | -222.7756 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -222.7756 | (480) |
| Total Primary energy kWh/year | | | 4411.9459 | (483) |
| Dwelling Primary energy Rate (DPER) | | | 70.4000 | (484) |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 62.6700 | (1b) | x 3.0000 | (2b) = | 188.0100 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 62.6700 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = | 188.0100 | (5) |

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2. Ventilation rate

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m3 per hour

| | | | |
|---|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 | (6a) |
| Number of open flues | 0 * 20 = | 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | 2 * 10 = | 20.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |

| | | Air changes per hour | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 20.0000 / (5) = | 0.1064 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3564 | (18) |
| Number of sides sheltered | | 0 | (19) |

| | | | |
|---|---|---|---|
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.3564 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.4544 | 0.4455 | 0.4366 | 0.3920 | 0.3831 | 0.3386 | 0.3386 | 0.3296 | 0.3564 | 0.3831 | 0.4009 | 0.4187 | (22b) |
| Effective ac | 0.6032 | 0.5992 | 0.5953 | 0.5768 | 0.5734 | 0.5573 | 0.5573 | 0.5543 | 0.5635 | 0.5734 | 0.5804 | 0.5877 | (25) |

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## 3. Heat losses and heat loss parameter

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| Element | Gross | Openings | NetArea | U-value | A x U | K-value | A x K | |
|---|---|---|---|---|---|---|---|---|
| | m2 | m2 | m2 | W/m2K | W/K | kJ/m2K | kJ/K | |
| Main dwelling | | | | | | | | |
| TER Opaque door | | | 1.8900 | 1.0000 | 1.8900 | | | (26) |
| TER Opening Type | | | 13.7700 | 1.1450 | 15.7672 | | | (27) |
| External Walls | 57.4600 | 13.7700 | 43.6900 | 0.1800 | 7.8642 | | | (29a) |
| Wall to Communal Corridor | 34.6900 | 1.8900 | 32.8000 | 0.1800 | 5.9040 | | | (29a) |
| External Roof | 20.6800 | | 20.6800 | 0.1100 | 2.2748 | | | (30) |
| Total net area of external elements Aum(A, m2) | | | 112.8300 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 33.7002 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 26 | | | 19.6100 | 0.0000 | 0.0000 | | | (32) |

| | |
|---|---|
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | 367.8372 (35) |

List of Thermal Bridges

| K1 Element | Length | Psi-value | Total |
|---|---|---|---|
| E1 Steel lintel with perforated steel base plate | 6.3600 | 0.0500 | 0.3180 |
| E4 Jamb | 17.6400 | 0.0500 | 0.8820 |
| E7 Party floor between dwellings (in blocks of flats) | 8.6475 | 0.0700 | 0.6053 |
| E18 Party wall between dwellings | 3.0000 | 0.0600 | 0.1800 |
| E24 Eaves (insulation at ceiling level - inverted) | 5.3750 | 0.2400 | 1.2900 |
| E24 Eaves (insulation at ceiling level - inverted) | 11.9590 | 0.2400 | 2.8702 |
| E15 Flat roof with parapet | 8.5600 | 0.5600 | 4.7936 |
| E7 Party floor between dwellings (in blocks of flats) | 11.5630 | 0.0700 | 0.8094 |
| E16 Corner (normal) | 9.0000 | 0.0900 | 0.8100 |
| E17 Corner (inverted - internal area greater than external area) | 6.0000 | -0.0900 | -0.5400 |

| | | |
|---|---|---|
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | 12.0185 (36) |
| Point Thermal bridges | (36a) = | 0.0000 |
| Total fabric heat loss | (33) + (36) + (36a) = | 45.7187 (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 37.4264 | 37.1777 | 36.9340 | 35.7889 | 35.5747 | 34.5774 | 34.5774 | 34.3927 | 34.9615 | 35.5747 | 36.0081 | 36.4612 | (38) |
| Heat transfer coeff | 83.1451 | 82.8964 | 82.6526 | 81.5076 | 81.2934 | 80.2961 | 80.2961 | 80.1114 | 80.6802 | 81.2934 | 81.7268 | 82.1798 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 81.5066 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.3267 | 1.3227 | 1.3189 | 1.3006 | 1.2972 | 1.2813 | 1.2813 | 1.2783 | 1.2874 | 1.2972 | 1.3041 | 1.3113 | (40) |
| HLP (average) | | | | | | | | | | | | 1.3006 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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## 4. Water heating energy requirements (kWh/year)

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| | | |
|---|---|---|
| Assumed occupancy | 2.0560 | (42) |

Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 58.6925 | 57.8105 | 56.5252 | 54.0660 | 52.2512 | 50.2273 | 49.0769 | 50.3525 | 51.7508 | 53.9238 | 56.4358 | 58.4676 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 25.3629 | 24.9862 | 24.4558 | 23.4778 | 22.7454 | 21.9334 | 21.4948 | 22.0215 | 22.5950 | 23.4639 | 24.4621 | 25.2772 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 35.6858 | 34.3882 | 33.0905 | 31.7928 | 30.4952 | 29.1975 | 29.1975 | 30.4952 | 31.7928 | 33.0905 | 34.3882 | 35.6858 | (42c) |

| | |
|---|---|
| Average daily hot water use (litres/day) | 110.0696 (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 119.7412 | 117.1848 | 114.0714 | 109.3366 | 105.4917 | 101.3582 | 99.7692 | 102.8691 | 106.1386 | 110.4782 | 115.2860 | 119.4306 | (44) |
| Energy conte | 189.6408 | 166.8697 | 175.3236 | 149.6763 | 142.0122 | 124.6317 | 120.6622 | 127.3735 | 130.8795 | 149.9178 | 164.2461 | 186.9995 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1828.2327 | |
| Distribution loss (46)m = 0.15 x (45)m | 28.4461 | 25.0304 | 26.2985 | 22.4514 | 21.3018 | 18.6948 | 18.0993 | 19.1060 | 19.6319 | 22.4877 | 24.6369 | 28.0499 | (46) |

| | | |
|---|---|---|
| Water storage loss: | | |
| Store volume | 150.0000 | (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | 1.3938 | (48) |
| Temperature factor from Table 2b | 0.5400 | (49) |
| Enter (49) or (54) in (55) | 0.7527 | (55) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total storage loss | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (56) |
| If cylinder contains dedicated solar storage | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (57) |
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |

Total heat required for water heating calculated for each month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 236.2357 | 208.9554 | 221.9185 | 194.7681 | 188.6071 | 169.7235 | 167.2571 | 173.9684 | 175.9713 | 196.5127 | 209.3379 | 233.5944 | (62) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WWHRS | -26.8318 | -23.7302 | -24.8489 | -20.5759 | -19.1760 | -16.4090 | -15.3808 | -16.3560 | -16.9774 | -20.0145 | -22.6740 | -26.3349 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | | | | | | | | | | | | | |
| | 209.4040 | 185.2252 | 197.0695 | 174.1922 | 169.4311 | 153.3145 | 151.8762 | 157.6124 | 158.9939 | 176.4982 | 186.6639 | 207.2595 | (64) |
| | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | | 2127.5407 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2128 | (64) |
| Electric shower(s) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | | | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | | | | | | | | | | | | | |
| | 100.3315 | 89.1527 | 95.5710 | 85.8408 | 84.4950 | 77.5135 | 77.3961 | 79.6276 | 79.5909 | 87.1236 | 90.6853 | 99.4532 | (65) |

## 5. Internal gains (see Table 5 and 5a)

| Metabolic gains (Table 5), Watts | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 102.8016 | 102.8016 | 102.8016 | 102.8016 | 102.8016 | 102.8016 | 102.8016 | 102.8016 | 102.8016 | 102.8016 | 102.8016 | 102.8016 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 90.6361 | 100.3471 | 90.6361 | 93.6573 | 90.6361 | 93.6573 | 90.6361 | 90.6361 | 93.6573 | 90.6361 | 93.6573 | 90.6361 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 179.6270 | 181.4910 | 176.7939 | 166.7942 | 154.1715 | 142.3078 | 134.3822 | 132.5183 | 137.2154 | 147.2150 | 159.8378 | 171.7014 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 33.2802 | 33.2802 | 33.2802 | 33.2802 | 33.2802 | 33.2802 | 33.2802 | 33.2802 | 33.2802 | 33.2802 | 33.2802 | 33.2802 | (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.0000 | 3.0000 | 3.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | | | | | | | | | | | | | |
| | -82.2413 | -82.2413 | -82.2413 | -82.2413 | -82.2413 | -82.2413 | -82.2413 | -82.2413 | -82.2413 | -82.2413 | -82.2413 | -82.2413 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 134.8542 | 132.6678 | 128.4557 | 119.2234 | 113.5685 | 107.6577 | 104.0270 | 107.0264 | 110.5429 | 117.1016 | 125.9518 | 133.6737 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 461.9578 | 471.3464 | 452.7261 | 436.5154 | 415.2166 | 397.4633 | 382.8858 | 384.0212 | 395.2561 | 411.7932 | 436.2874 | 452.8517 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Northeast | 2.3800 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 8.2067 | (75) |
| Northwest | 11.3900 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 39.2752 | (81) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 47.4819 | 96.6508 | 174.1340 | 285.9780 | 384.4105 | 409.8223 | 383.3804 | 305.6353 | 212.1850 | 118.1149 | 59.7445 | 38.7761 | (83) |
| Total gains | 509.4397 | 567.9971 | 626.8601 | 722.4934 | 799.6271 | 807.2856 | 766.2662 | 689.6565 | 607.4411 | 529.9082 | 496.0319 | 491.6278 | (84) |

## 7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 77.0151 | 77.2462 | 77.4740 | 78.5624 | 78.7694 | 79.7478 | 79.7478 | 79.9316 | 79.3681 | 78.7694 | 78.3517 | 77.9198 | |
| alpha | 6.1343 | 6.1497 | 6.1649 | 6.2375 | 6.2513 | 6.3165 | 6.3165 | 6.3288 | 6.2912 | 6.2513 | 6.2234 | 6.1947 | |
| util living area | | | | | | | | | | | | | |
| | 0.9986 | 0.9970 | 0.9911 | 0.9571 | 0.8368 | 0.6227 | 0.4592 | 0.5296 | 0.8225 | 0.9792 | 0.9967 | 0.9989 | (86) |
| MIT | 19.9288 | 20.0640 | 20.2965 | 20.6399 | 20.8938 | 20.9863 | 20.9982 | 20.9960 | 20.9301 | 20.6008 | 20.2165 | 19.9147 | (87) |
| Th 2 | 19.8200 | 19.8231 | 19.8261 | 19.8404 | 19.8431 | 19.8555 | 19.8555 | 19.8579 | 19.8507 | 19.8431 | 19.8376 | 19.8320 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9980 | 0.9955 | 0.9864 | 0.9347 | 0.7692 | 0.5186 | 0.3409 | 0.4009 | 0.7253 | 0.9639 | 0.9948 | 0.9984 | (89) |
| MIT 2 | 18.5982 | 18.7731 | 19.0705 | 19.5011 | 19.7695 | 19.8502 | 19.8552 | 19.8571 | 19.8140 | 19.4657 | 18.9796 | 18.5893 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.3356 | (91) |
| MIT | 19.0447 | 19.2063 | 19.4819 | 19.8832 | 20.1468 | 20.2315 | 20.2388 | 20.2392 | 20.1885 | 19.8466 | 19.3947 | 19.0341 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.0447 | 19.2063 | 19.4819 | 19.8832 | 20.1468 | 20.2315 | 20.2388 | 20.2392 | 20.1885 | 19.8466 | 19.3947 | 19.0341 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9973 | 0.9943 | 0.9845 | 0.9357 | 0.7887 | 0.5537 | 0.3808 | 0.4445 | 0.7570 | 0.9640 | 0.9937 | 0.9978 | (94) |
| Useful gains | 508.0746 | 564.7812 | 617.1703 | 676.0391 | 630.6690 | 446.9967 | 291.7713 | 306.5360 | 459.8443 | 510.8199 | 492.9081 | 490.5687 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | | | | | | | | | | | | | |
| | 1225.9475 | 1185.9409 | 1072.9915 | 895.2175 | 686.6658 | 452.1847 | 292.1811 | 307.5668 | 491.2240 | 751.6867 | 1004.8032 | 1219.0599 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 534.0974 | 417.4193 | 339.1310 | 157.8084 | 41.6616 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 179.2049 | 368.5644 | 541.9974 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 2579.8846 | |
| Solar heating kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | | | | | | | | | | | | | |
| | 534.0974 | 417.4193 | 339.1310 | 157.8084 | 41.6616 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 179.2049 | 368.5644 | 541.9974 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 2579.8846 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 41.1662 | (99) |

## 9a. Energy requirements - Individual heating systems, including micro-CHP

| | | |
|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | 0.0000 | (201) |
| Fraction of space heat from main system(s) | 1.0000 | (202) |
| Efficiency of main space heating system 1 (in %) | 92.3000 | (206) |
| Efficiency of main space heating system 2 (in %) | 0.0000 | (207) |
| Efficiency of secondary/supplementary heating system, % | 0.0000 | (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement | | | | | | | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 534.0974 | 417.4193 | 339.1310 | 157.8084 | 41.6616 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 179.2049 | 368.5644 | 541.9974 (98) |
| Space heating efficiency (main heating system 1) | | | | | | | | | | | | |
| | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.3000 | 92.3000 | 92.3000 (210) |
| Space heating fuel (main heating system) | | | | | | | | | | | | |
| | 578.6538 | 452.2420 | 367.4225 | 170.9734 | 45.1372 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 194.1549 | 399.3114 | 587.2128 (211) |
| Space heating efficiency (main heating system 2) | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (212) |
| Space heating fuel (main heating system 2) | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (213) |
| Space heating fuel (secondary) | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (215) |
| Water heating | | | | | | | | | | | | |
| Water heating requirement | | | | | | | | | | | | |
| | 209.4040 | 185.2252 | 197.0695 | 174.1922 | 169.4311 | 153.3145 | 151.8762 | 157.6124 | 158.9939 | 176.4982 | 186.6639 | 207.2595 (64) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 (216) |
| (217)m | 86.0661 | 85.8250 | 85.2657 | 83.8389 | 81.4288 | 79.8000 | 79.8000 | 79.8000 | 79.8000 | 84.0939 | 85.5560 | 86.1135 (217) |
| Fuel for water heating, kWh/month | | | | | | | | | | | | |
| | 243.3059 | 215.8173 | 231.1241 | 207.7701 | 208.0726 | 192.1234 | 190.3211 | 197.5093 | 199.2405 | 209.8822 | 218.1774 | 240.6819 (219) |
| Space cooling fuel requirement | | | | | | | | | | | | |
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (221) |
| Pumps and Fa | 7.3041 | 6.5973 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 (231) |
| Lighting | 18.8324 | 15.1080 | 13.6031 | 9.9662 | 7.6982 | 6.2895 | 7.0226 | 9.1282 | 11.8566 | 15.5565 | 17.5710 | 19.3558 (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (233a)m | -13.9422 | -20.9390 | -32.0416 | -38.4344 | -43.5931 | -41.4901 | -40.9924 | -37.6265 | -32.0788 | -24.9822 | -15.7788 | -11.9094 (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | |
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (233b)m | -4.4101 | -9.5317 | -19.4279 | -29.9013 | -40.2511 | -40.6995 | -40.2140 | -33.7143 | -24.2814 | -13.8567 | -5.9596 | -3.4683 (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | |
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235d) |

| | |
|---|---|
| Annual totals kWh/year | |
| Space heating fuel - main system 1 | 2795.1079 (211) |
| Space heating fuel - main system 2 | 0.0000 (213) |
| Space heating fuel - secondary | 0.0000 (215) |
| Efficiency of water heater | 79.8000 |
| Water heating fuel used | 2554.0259 (219) |
| Space cooling fuel | 0.0000 (221) |
| Electricity for pumps and fans: | |
| Total electricity for the above, kWh/year | 86.0000 (231) |
| Electricity for lighting (calculated in Appendix L) | 151.9882 (232) |
| Energy saving/generation technologies (Appendices M ,N and Q) | |
| PV generation | -619.5244 (233) |
| Wind generation | 0.0000 (234) |
| Hydro-electric generation (Appendix N) | 0.0000 (235a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 (235) |
| Appendix Q - special features | |
| Energy saved or generated | -0.0000 (236) |
| Energy used | 0.0000 (237) |
| Total delivered energy for all uses | 4967.5976 (238) |

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 2795.1079 | 0.2100 | 586.9726 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2554.0259 | 0.2100 | 536.3454 | (264) |
| Space and water heating | | | 1123.3181 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 151.9882 | 0.1443 | 21.9366 | (268) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -353.8086 | 0.1333 | -47.1538 | |
| PV Unit electricity exported | -265.7158 | 0.1252 | -33.2654 | |
| Total | | | -80.4192 | (269) |
| Total CO2, kg/year | | | 1076.7648 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 17.1800 | (273) |

13a. Primary energy - Individual heating systems including micro-CHP

| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 2795.1079 | 1.1300 | 3158.4719 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2554.0259 | 1.1300 | 2886.0493 | (278) |
| Space and water heating | | | 6044.5212 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 151.9882 | 1.5338 | 233.1246 | (282) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -353.8086 | 1.4925 | -528.0544 | |
| PV Unit electricity exported | -265.7158 | 0.4595 | -122.0981 | |
| Total | | | -650.1525 | (283) |
| Total Primary energy kWh/year | | | 5757.5941 | (286) |
| Target Primary Energy Rate (TPER) | | | 91.8700 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Property Reference** | Unit 29 | **Issued on Date** | 17/05/2025 |
| **Assessment Reference** | 00001 | **Prop Type Ref** | Unit 29 |
| **Property** | | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 77 C | **DER** | 6.44 | **TER** | 15.28 |
| **Environmental** | 96 A | **% DER < TER** | | | 57.85 |
| **$CO_2$ Emissions (t/year)** | 0.3 | **DFEE** | 36.80 | **TFEE** | 38.14 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 3.51 |
| **% DPER < TPER** | 15.90 | **DPER** | 68.48 | **TPER** | 81.42 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Robert Arnold | **Assessor ID** | BA04-0001 |
| **Client** | | | |

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SAP 10 WORKSHEET FOR New Build (As Designed)  (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 52.1200 | (1b) | x 3.0000 | (2b) = | 156.3600 | (1b) - (3b) (4) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 52.1200 | | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | 156.3600 | (5) |

---

2. Ventilation rate

---

| | m3 per hour | |
|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 (6a) |
| Number of open flues | 0 * 20 = | 0.0000 (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 (6f) |
| Number of intermittent extract fans | 0 * 10 = | 0.0000 (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 (7c) |

| | Air changes per hour | |
|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 0.0000 / (5) = | 0.0000 (8) |
| Pressure test | | Yes |
| Pressure Test Method | | Blower Door |
| Measured/design AP50 | | 3.0000 (17) |
| Infiltration rate | | 0.1500 (18) |
| Number of sides sheltered | | 0 (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.1500 (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.1912 | 0.1875 | 0.1837 | 0.1650 | 0.1612 | 0.1425 | 0.1425 | 0.1388 | 0.1500 | 0.1612 | 0.1687 | 0.1762 | (22b) |
| Balanced mechanical ventilation with heat recovery | | | | | | | | | | | | | |
| If mechanical ventilation | | | | | | | | | | | | 0.5000 | (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | | | | | | | | | | | | 0.5000 | (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | | | | | | | | | | | | 81.0000 | (23c) |
| Effective ac | 0.2862 | 0.2825 | 0.2787 | 0.2600 | 0.2562 | 0.2375 | 0.2375 | 0.2337 | 0.2450 | 0.2562 | 0.2637 | 0.2712 | (25) |

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3. Heat losses and heat loss parameter

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| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| Window | | | 11.9300 | 1.0536 | 12.5699 | | | (27) |
| Front Door | | | 1.8900 | 1.4000 | 2.6460 | | | (26) |
| Glass Door | | | 2.4000 | 1.3258 | 3.1818 | | | (27) |
| External Walls | 50.4000 | 14.3300 | 36.0700 | 0.1500 | 5.4105 | 150.0000 | 5410.5000 | (29a) |
| Wall to Communal Corridor | 22.2300 | 1.8900 | 20.3400 | 0.1300 | 2.6442 | 150.0000 | 3051.0000 | (29a) |
| External Roof | 3.5200 | | 3.5200 | 0.1000 | 0.3520 | 9.0000 | 31.6800 | (30) |
| Total net area of external elements Aum(A, m2) | | | 76.1500 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 26.8044 | | | (33) |
| Main dwelling | | | | | | | | |
| Wall to Unit 31 | | | 20.1600 | 0.0000 | 0.0000 | 70.0000 | 1411.2000 | (32) |
| Party Floor | | | 52.2000 | | | 80.0000 | 4176.0000 | (32d) |
| Party Ceiling | | | 46.6000 | | | 100.0000 | 4660.0000 | (32b) |
| Partitions | | | 71.7000 | | | 9.0000 | 645.3000 | (32c) |
| Heat capacity Cm = Sum(A x k) | | | | | (28)...(30) + (32) + (32a)...(32e) = | | 19385.6800 | (34) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 371.9432 (35)

List of Thermal Bridges

| | K1 Element | Length | Psi-value | Total |
|---|---|---|---|---|
| E1 | Steel lintel with perforated steel base plate | 6.3400 | 0.0500 | 0.3170 |
| E3 | Sill | 6.3400 | 0.0500 | 0.3170 |
| E4 | Jamb | 18.0800 | 0.0500 | 0.9040 |
| E7 | Party floor between dwellings (in blocks of flats) | 11.6700 | 0.0700 | 0.8169 |
| E16 | Corner (normal) | 12.0000 | 0.0900 | 1.0800 |
| E18 | Party wall between dwellings | 3.0000 | 0.0600 | 0.1800 |
| E17 | Corner (inverted - internal area greater than external area) | 3.0000 | -0.0900 | -0.2700 |
| E23 | Balcony within or between dwellings, balcony support penetrates wall insulation | 5.1260 | 0.0200 | 0.1025 |
| E25 | Staggered party wall between dwellings | 3.0000 | 0.0600 | 0.1800 |
| E15 | Flat roof with parapet | 4.2400 | 0.5600 | 2.3744 |
| E24 | Eaves (insulation at ceiling level - inverted) | 7.0750 | 0.1200 | 0.8490 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 6.8508 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 33.6553 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 14.7702 | 14.5767 | 14.3832 | 13.4157 | 13.2222 | 12.2547 | 12.2547 | 12.0612 | 12.6417 | 13.2222 | 13.6092 | 13.9962 | (38) |
| Heat transfer coeff | 48.4254 | 48.2319 | 48.0384 | 47.0709 | 46.8775 | 45.9100 | 45.9100 | 45.7165 | 46.2970 | 46.8775 | 47.2644 | 47.6514 | (39) |

Average = Sum(39)m / 12 = 47.0226

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 0.9291 | 0.9254 | 0.9217 | 0.9031 | 0.8994 | 0.8809 | 0.8809 | 0.8771 | 0.8883 | 0.8994 | 0.9068 | 0.9143 | (40) |
| HLP (average) | | | | | | | | | | | | 0.9022 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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4. Water heating energy requirements (kWh/year)

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Assumed occupancy 1.7526 (42)

Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 52.2507 | 51.4507 | 50.2718 | 48.4583 | 46.8334 | 44.5601 | 42.7621 | 44.8641 | 45.9213 | 48.1728 | 50.5176 | 52.2036 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 22.6585 | 22.3165 | 21.8299 | 21.1012 | 20.4444 | 19.5404 | 18.8545 | 19.6932 | 20.1334 | 21.0292 | 21.9605 | 22.6405 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.5785 | 31.3938 | 30.2091 | 29.0245 | 27.8398 | 26.6551 | 26.6551 | 27.8398 | 29.0245 | 30.2091 | 31.3938 | 32.5785 | (42c) |

Average daily hot water use (litres/day) 98.7977 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 107.4877 | 105.1610 | 102.3109 | 98.5839 | 95.1176 | 90.7556 | 88.2717 | 92.3971 | 95.0791 | 99.4111 | 103.8719 | 107.4226 | (44) |
| Energy conte | 158.2405 | 139.1493 | 146.2001 | 128.7752 | 122.5686 | 104.9558 | 97.5429 | 108.7531 | 110.2870 | 128.1013 | 140.3864 | 157.7580 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1542.7182 | |
| Distribution loss (46)m = 0.15 x (45)m | 23.7361 | 20.8724 | 21.9300 | 19.3163 | 18.3853 | 15.7434 | 14.6314 | 16.3130 | 16.5431 | 19.2152 | 21.0580 | 23.6637 | (46) |

Water storage loss:

Store volume 110.0000 (47)

b) If manufacturer declared loss factor is not known :

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.0152 (51)

Volume factor from Table 2a 1.0294 (52)

Temperature factor from Table 2b 0.6000 (53)

Enter (49) or (54) in (55) 1.0327 (55)

Total storage loss

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (56) |

If cylinder contains dedicated solar storage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (57) |
| Primary loss 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |

Total heat required for water heating calculated for each month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 213.5173 | 189.0768 | 201.4769 | 182.2689 | 177.8454 | 158.4495 | 152.8197 | 164.0299 | 163.7807 | 183.3781 | 193.8801 | 213.0348 | (62) |
| WWHRS 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63a) |
| PV diverter -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | 213.5173 | 189.0768 | 201.4769 | 182.2689 | 177.8454 | 158.4495 | 152.8197 | 164.0299 | 163.7807 | 183.3781 | 193.8801 | 213.0348 | (64) |
| | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | | 2193.5580 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2194 | (64) |

Electric shower(s)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)

Heat gains from water heating, kWh/month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 96.8364 | 86.2091 | 92.8330 | 85.6127 | 84.9755 | 77.6928 | 76.6544 | 80.3818 | 79.4654 | 86.8151 | 89.4734 | 96.6760 | (65) |

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5. Internal gains (see Table 5 and 5a)

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Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 87.6306 | 87.6306 | 87.6306 | 87.6306 | 87.6306 | 87.6306 | 87.6306 | 87.6306 | 87.6306 | 87.6306 | 87.6306 | 87.6306 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 77.0384 | 85.2925 | 77.0384 | 79.6063 | 77.0384 | 79.6063 | 77.0384 | 77.0384 | 79.6063 | 77.0384 | 79.6063 | 77.0384 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 152.7372 | 154.3221 | 150.3281 | 141.8254 | 131.0922 | 121.0046 | 114.2654 | 112.6805 | 116.6745 | 125.1772 | 135.9103 | 145.9980 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 31.7631 | 31.7631 | 31.7631 | 31.7631 | 31.7631 | 31.7631 | 31.7631 | 31.7631 | 31.7631 | 31.7631 | 31.7631 | 31.7631 | (69) |
| Pumps, fans 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (70) | |
| Losses e.g. evaporation (negative values) (Table 5) | -70.1044 | -70.1044 | -70.1044 | -70.1044 | -70.1044 | -70.1044 | -70.1044 | -70.1044 | -70.1044 | -70.1044 | -70.1044 | -70.1044 | (71) |
| Water heating gains (Table 5) | 130.1565 | 128.2873 | 124.7755 | 118.9065 | 114.2144 | 107.9066 | 103.0302 | 108.0401 | 110.3686 | 116.6870 | 124.2686 | 129.9408 | (72) |
| Total internal gains | 409.2211 | 417.1911 | 401.4311 | 389.6274 | 371.6342 | 357.8067 | 343.6231 | 347.0481 | 355.9385 | 368.1917 | 389.0744 | 402.2663 | (73) |

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6. Solar gains

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| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W |
|---|---|---|---|---|---|---|

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southeast | | | 6.2900 | | 36.7938 | | 0.4500 | | 0.7000 | | 0.7700 | | 50.5207 (77) |
| Southwest | | | 5.6400 | | 36.7938 | | 0.4500 | | 0.7000 | | 0.7700 | | 45.3000 (79) |
| Southeast | | | 2.4000 | | 36.7938 | | 0.4500 | | 0.7000 | | 0.7700 | | 19.2766 (77) |
| Solar gains | 115.0973 | 196.0532 | 268.2486 | 332.3730 | 372.2854 | 369.5933 | 356.3274 | 326.5509 | 290.4565 | 216.6806 | 137.8600 | 98.4993 | (83) |
| Total gains | 524.3184 | 613.2443 | 669.6797 | 722.0004 | 743.9196 | 727.4000 | 699.9505 | 673.5990 | 646.3950 | 584.8723 | 526.9344 | 500.7656 | (84) |

## 7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, ni1,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 111.2001 | 111.6462 | 112.0959 | 114.3999 | 114.8721 | 117.2928 | 117.2928 | 117.7893 | 116.3124 | 114.8721 | 113.9315 | 113.0063 | |
| alpha | 8.4133 | 8.4431 | 8.4731 | 8.6267 | 8.6581 | 8.8195 | 8.8195 | 8.8526 | 8.7542 | 8.6581 | 8.5954 | 8.5338 | |
| util living area | 0.9907 | 0.9679 | 0.9112 | 0.7649 | 0.5836 | 0.4039 | 0.2886 | 0.3122 | 0.4937 | 0.7989 | 0.9662 | 0.9931 | (86) |
| MIT | 20.5578 | 20.7201 | 20.8678 | 20.9734 | 20.9973 | 20.9999 | 21.0000 | 21.0000 | 20.9995 | 20.9689 | 20.7733 | 20.5355 | (87) |
| Th 2 | 20.1428 | 20.1460 | 20.1491 | 20.1648 | 20.1680 | 20.1838 | 20.1838 | 20.1870 | 20.1775 | 20.1680 | 20.1617 | 20.1554 | (88) |
| util rest of house | 0.9868 | 0.9563 | 0.8847 | 0.7201 | 0.5325 | 0.3524 | 0.2351 | 0.2570 | 0.4351 | 0.7474 | 0.9519 | 0.9901 | (89) |
| MIT 2 | 19.6528 | 19.8537 | 20.0250 | 20.1445 | 20.1664 | 20.1838 | 20.1838 | 20.1870 | 20.1773 | 20.1456 | 19.9340 | 19.6355 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.6429 | (91) |
| MIT | 20.2346 | 20.4108 | 20.5669 | 20.6774 | 20.7006 | 20.7085 | 20.7086 | 20.7097 | 20.7059 | 20.6749 | 20.4736 | 20.2142 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 20.2346 | 20.4108 | 20.5669 | 20.6774 | 20.7006 | 20.7085 | 20.7086 | 20.7097 | 20.7059 | 20.6749 | 20.4736 | 20.2142 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9873 | 0.9603 | 0.8984 | 0.7480 | 0.5653 | 0.3855 | 0.2695 | 0.2925 | 0.4728 | 0.7795 | 0.9578 | 0.9904 | (94) |
| Useful gains | 517.6334 | 588.8787 | 601.6593 | 540.0736 | 420.5735 | 280.4025 | 188.6229 | 197.0215 | 305.6028 | 455.9346 | 504.7101 | 495.9507 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | 771.6407 | 748.1141 | 675.7515 | 554.3757 | 421.9254 | 280.4411 | 188.6242 | 197.0241 | 305.8330 | 472.2865 | 632.0956 | 763.0975 | (97) |
| Space heating kWh | 188.9814 | 107.0062 | 55.1246 | 10.2975 | 1.0059 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 12.1658 | 91.7176 | 198.7572 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 665.0561 | |
| Solar heating kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | 188.9814 | 107.0062 | 55.1246 | 10.2975 | 1.0059 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 12.1658 | 91.7176 | 198.7572 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 665.0561 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 12.7601 | (99) |

## 8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ext. temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | |
| Heat loss rate W | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 431.5538 | 339.7338 | 347.4453 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (100) |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.9982 | 0.9996 | 0.9994 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (101) |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 430.7610 | 339.6064 | 347.2365 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (102) |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 808.6957 | 778.7281 | 748.4714 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 272.1130 | 326.7065 | 298.5188 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (104) |
| Cooled fraction | | | | | | | | | | fC = cooled area / (4) = | | 0.9977 | (105) |
| Intermittency factor (Table 10b) | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | (106) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 67.8716 | 81.4886 | 74.4579 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) |
| Space cooling requirement | | | | | | | | | | | | 223.8181 | (107) |

## 9b. Energy requirements

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | 0.0000 | (301) |
| Fraction of space heat from community system | | | | | | | | | | | | 1.0000 | (302) |
| Fraction of heat from community Heat pump-Space and Water | | | | | | | | | | | | 1.0000 | (303a) |
| Factor for control and charging method (Table 4c(3)) for space heating | | | | | | | | | | | | 1.0000 | (305) |
| Factor for charging method (Table 4c(3)) for water heating | | | | | | | | | | | | 1.0000 | (305a) |
| Distribution loss factor (Table 12c) for community heating system | | | | | | | | | | | | 2.0000 | (306) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 | (208) |
| Space heating: | | | | | | | | | | | | | |
| Space heating requirement | | | | | | | | | | | | | |
| | 188.9814 | 107.0062 | 55.1246 | 10.2975 | 1.0059 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 12.1658 | 91.7176 | 198.7572 | (98) |
| Space heat from Heat pump = (98) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 307a | 377.9628 | 214.0124 | 110.2492 | 20.5950 | 2.0117 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 24.3316 | 183.4351 | 397.5145 | |
| Space heating requirement | | | | | | | | | | | | | |
| | 377.9628 | 214.0124 | 110.2492 | 20.5950 | 2.0117 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 24.3316 | 183.4351 | 397.5145 | (307) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | | | | | | | | | | | 0.0000 | (308) |
| Space heating fuel for secondary/supplementary system | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (309) |
| Water heating | | | | | | | | | | | | | |
| Annual water heating requirement | | | | | | | | | | | | | |
| | 213.5173 | 189.0768 | 201.4769 | 182.2689 | 177.8454 | 158.4495 | 152.8197 | 164.0299 | 163.7807 | 183.3781 | 193.8801 | 213.0348 | (64) |
| Water heat from Heat pump = (64) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 310a | 427.0346 | 378.1535 | 402.9538 | 364.5378 | 355.6909 | 316.8990 | 305.6394 | 328.0597 | 327.5614 | 366.7562 | 387.7601 | 426.0696 | |
| Water heating fuel | | | | | | | | | | | | | |
| | 427.0346 | 378.1535 | 402.9538 | 364.5378 | 355.6909 | 316.8990 | 305.6394 | 328.0597 | 327.5614 | 366.7562 | 387.7601 | 426.0696 | (310) |
| Cooling System Energy Efficiency Ratio | | | | | | | | | | | | 2.6000 | (314) |
| Space coolin | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 26.1045 | 31.3418 | 28.6376 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (315) |
| Pumps and Fa | 14.2897 | 12.9068 | 14.2897 | 13.8287 | 14.2897 | 13.8287 | 14.2897 | 14.2897 | 13.8287 | 14.2897 | 13.8287 | 14.2897 | (331) |
| Lighting | 14.8947 | 11.9490 | 10.7588 | 7.8823 | 6.0886 | 4.9744 | 5.5542 | 7.2195 | 9.3775 | 12.3037 | 13.8970 | 15.3086 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (333a)m | -4.7046 | -7.5863 | -12.5469 | -16.1803 | -19.2741 | -18.6879 | -18.4257 | -16.4136 | -13.2256 | -9.4462 | -5.4767 | -3.9523 | (333a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335a) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (333b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335b) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - community heating | 1330.1123 | (307) |
| Space heating fuel - secondary | 0.0000 | (309) |
| Water heating fuel - community heating | 4387.1160 | (310) |
| Efficiency of water heater | 0.0000 | (311) |
| Electricity used for heat distribution | 13.3011 | (313) |
| Space cooling fuel | 86.0839 | (321) |
| | | |
| Electricity for pumps and fans: | | |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8820) | | |
| mechanical ventilation fans (SFP = 0.8820) | 168.2496 | (330a) |
| Total electricity for the above, kWh/year | 168.2496 | (331) |
| Electricity for lighting (calculated in Appendix L) | 120.2084 | (332) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -145.9201 | (333) |
| Wind generation | 0.0000 | (334) |
| Hydro-electric generation (Appendix N) | 0.0000 | (335a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (335) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (336) |
| Energy used | 0.0000 | (337) |
| Total delivered energy for all uses | 5945.8500 | (338) |

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12b. Carbon dioxide emissions - Community heating scheme

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (367) |
| Space and Water heating from Heat pump | 2041.8672 | 0.1592 | 75.6183 | (367) |
| Electrical energy for heat distribution (space & water) | 13.3011 | 0.0000 | 8.2911 | (372) |
| Overall CO2 factor for heat network | | | 0.0532 | (386) |
| Total CO2 associated with community systems | | | 304.4031 | (373) |
| Space and water heating | | | 304.4031 | (376) |
| Space cooling | 86.0839 | 0.1141 | 9.8189 | (377) |
| Pumps, fans and electric keep-hot | 168.2496 | 0.1387 | 23.3383 | (378) |
| Energy for lighting | 120.2084 | 0.1443 | 17.3498 | (379) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -145.9201 | 0.1319 | -19.2538 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -19.2538 | (380) |
| Total CO2, kg/year | | | 335.6563 | (383) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 6.4400 | (384) |

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13b. Primary energy - Community heating scheme

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| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (467a) |
| Space and Water heating from Heat pump | 2041.8672 | 1.5892 | 754.9252 | (467) |
| Electrical energy for heat distribution (space & water) | 13.3011 | 0.0000 | 87.8372 | (472) |
| Overall CO2 factor for heat network | | | 0.5641 | (486) |
| Total CO2 associated with community systems | | | 3224.8801 | (473) |
| Space and water heating | | | 3224.8801 | (476) |
| Space cooling | 86.0839 | 1.4204 | 122.2734 | (477) |
| Pumps, fans and electric keep-hot | 168.2496 | 1.5128 | 254.5280 | (478) |
| Energy for lighting | 120.2084 | 1.5338 | 184.3796 | (479) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -145.9201 | 1.4875 | -217.0567 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -217.0567 | (480) |
| Total Primary energy kWh/year | | | 3569.0045 | (483) |
| Dwelling Primary energy Rate (DPER) | | | 68.4800 | (484) |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 52.1200 | (1b) | x 3.0000 | (2b) = | 156.3600 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 52.1200 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = | 156.3600 | (5) |

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2. Ventilation rate

---

| | | | |
|---|---|---|---|
| | | m3 per hour | |
| Number of open chimneys | 0 * 80 = | 0.0000 | (6a) |
| Number of open flues | 0 * 20 = | 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | 2 * 10 = | 20.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |
| | Air changes per hour | | |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 20.0000 / (5) = | 0.1279 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3779 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.3779 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.4818 | 0.4724 | 0.4629 | 0.4157 | 0.4063 | 0.3590 | 0.3590 | 0.3496 | 0.3779 | 0.4063 | 0.4251 | 0.4440 | (22b) |
| Effective ac | 0.6161 | 0.6116 | 0.6072 | 0.5864 | 0.5825 | 0.5644 | 0.5644 | 0.5611 | 0.5714 | 0.5825 | 0.5904 | 0.5986 | (25) |

## 3. Heat losses and heat loss parameter

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| TER Opaque door | | | 1.8900 | 1.0000 | 1.8900 | | | (26) |
| TER Opening Type | | | 11.1500 | 1.1450 | 12.7672 | | | (27) |
| External Walls | 50.4000 | 11.1500 | 39.2500 | 0.1800 | 7.0650 | | | (29a) |
| Wall to Communal Corridor | 22.2300 | 1.8900 | 20.3400 | 0.1800 | 3.6612 | | | (29a) |
| External Roof | 3.5200 | | 3.5200 | 0.1100 | 0.3872 | | | (30) |
| Total net area of external elements Aum(A, m2) | | | 76.1500 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 25.7706 | | | (33) |
| Main dwelling | | | | | | | | |
| Wall to Unit 31 | | | 20.1600 | 0.0000 | 0.0000 | | | (32) |

| | | |
|---|---|---|
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | 354.0614 | (35) |

List of Thermal Bridges

| | Length | Psi-value | Total | |
|---|---|---|---|---|
| K1 Element | | | | |
| E1 Steel lintel with perforated steel base plate | 6.3400 | 0.0500 | 0.3170 | |
| E3 Sill | 6.3400 | 0.0500 | 0.3170 | |
| E4 Jamb | 18.0800 | 0.0500 | 0.9040 | |
| E7 Party floor between dwellings (in blocks of flats) | 11.6700 | 0.0700 | 0.8169 | |
| E16 Corner (normal) | 12.0000 | 0.0900 | 1.0800 | |
| E18 Party wall between dwellings | 3.0000 | 0.0600 | 0.1800 | |
| E17 Corner (inverted - internal area greater than external area) | 3.0000 | -0.0900 | -0.2700 | |
| E23 Balcony within or between dwellings, balcony support penetrates wall insulation | 5.1260 | 0.0200 | 0.1025 | |
| E25 Staggered party wall between dwellings | 3.0000 | 0.0600 | 0.1800 | |
| E15 Flat roof with parapet | 4.2400 | 0.5600 | 2.3744 | |
| E24 Eaves (insulation at ceiling level - inverted) | 7.0750 | 0.2400 | 1.6980 | |

| | | | |
|---|---|---|---|
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | 7.6998 | (36) |
| Point Thermal bridges | (36a) = | 0.0000 | |
| Total fabric heat loss | (33) + (36) + (36a) = | 33.4704 | (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 31.7891 | 31.5565 | 31.3286 | 30.2577 | 30.0574 | 29.1247 | 29.1247 | 28.9520 | 29.4840 | 30.0574 | 30.4627 | 30.8864 | (38) |
| Heat transfer coeff | 65.2595 | 65.0269 | 64.7989 | 63.7281 | 63.5278 | 62.5951 | 62.5951 | 62.4224 | 62.9544 | 63.5278 | 63.9331 | 64.3568 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 63.7272 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.2521 | 1.2476 | 1.2433 | 1.2227 | 1.2189 | 1.2010 | 1.2010 | 1.1977 | 1.2079 | 1.2189 | 1.2267 | 1.2348 | (40) |
| HLP (average) | | | | | | | | | | | | 1.2227 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

## 4. Water heating energy requirements (kWh/year)

| | | |
|---|---|---|
| Assumed occupancy | 1.7526 | (42) |

Hot water usage for mixer showers

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 53.6050 | 52.7994 | 51.6256 | 49.3795 | 47.7220 | 45.8736 | 44.8229 | 45.9879 | 47.2650 | 49.2497 | 51.5439 | 53.3996 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.1751 | 22.8310 | 22.3463 | 21.4526 | 20.7834 | 20.0414 | 19.6407 | 20.1219 | 20.6460 | 21.4400 | 22.3520 | 23.0968 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.5785 | 31.3938 | 30.2091 | 29.0245 | 27.8398 | 26.6551 | 26.6551 | 27.8398 | 29.0245 | 30.2091 | 31.3938 | 32.5785 | (42c) |

| | | |
|---|---|---|
| Average daily hot water use (litres/day) | 100.5259 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 109.3587 | 107.0242 | 104.1810 | 99.8566 | 96.3453 | 92.5702 | 91.1187 | 93.9497 | 96.9355 | 100.8988 | 105.2898 | 109.0749 | (44) |
| Energy conte | 173.1974 | 152.4011 | 160.1223 | 136.6987 | 129.6993 | 113.8258 | 110.2002 | 116.3293 | 119.5311 | 136.9187 | 150.0046 | 170.7850 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1669.7135 | |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | | |
| | 25.9796 | 22.8602 | 24.0183 | 20.5048 | 19.4549 | 17.0739 | 16.5300 | 17.4494 | 17.9297 | 20.5378 | 22.5007 | 25.6177 | (46) |
| Water storage loss: | | | | | | | | | | | | | |
| Store volume | | | | | | | | | | | | 150.0000 | (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | | | | | | | | | | | | 1.3938 | (48) |
| Temperature factor from Table 2b | | | | | | | | | | | | 0.5400 | (49) |
| Enter (49) or (54) in (55) | | | | | | | | | | | | 0.7527 | (55) |
| Total storage loss | | | | | | | | | | | | | |
| | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (56) |
| If cylinder contains dedicated solar storage | | | | | | | | | | | | | |
| | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (57) |
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |

Total heat required for water heating calculated for each month

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 219.7923 | 194.4868 | 206.7172 | 181.7906 | 176.2942 | 158.9177 | 156.7951 | 162.9242 | 164.6230 | 183.5136 | 195.0964 | 217.3799 | (62) |
| WWHRS | -24.5060 | -21.6733 | -22.6950 | -18.7924 | -17.5138 | -14.9867 | -14.0476 | -14.9383 | -15.5058 | -18.2796 | -20.7086 | -24.0522 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | | | | | | | | | | | | | |
| | 195.2863 | 172.8135 | 184.0222 | 162.9982 | 158.7803 | 143.9310 | 142.7475 | 147.9860 | 149.1171 | 165.2339 | 174.3878 | 193.3277 | (64) |
| | | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | 1990.6316 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 1991 | (64) |
| Electric shower(s) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | | | | | | | | | | | | | |
| | 94.8641 | 84.3419 | 90.5166 | 81.5258 | 80.4009 | 73.9206 | 73.9175 | 75.9554 | 75.8176 | 82.8014 | 85.9500 | 94.0619 | (65) |

## 5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 87.6306 | 87.6306 | 87.6306 | 87.6306 | 87.6306 | 87.6306 | 87.6306 | 87.6306 | 87.6306 | 87.6306 | 87.6306 | 87.6306 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 77.1596 | 85.4267 | 77.1596 | 79.7316 | 77.1596 | 79.7316 | 77.1596 | 77.1596 | 79.7316 | 77.1596 | 79.7316 | 77.1596 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 152.7372 | 154.3221 | 150.3281 | 141.8254 | 131.0922 | 121.0046 | 114.2654 | 112.6805 | 116.6745 | 125.1772 | 135.9103 | 145.9980 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 31.7631 | 31.7631 | 31.7631 | 31.7631 | 31.7631 | 31.7631 | 31.7631 | 31.7631 | 31.7631 | 31.7631 | 31.7631 | 31.7631 | (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.0000 | 3.0000 | 3.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | | | | | | | | | | | | | |
| | -70.1044 | -70.1044 | -70.1044 | -70.1044 | -70.1044 | -70.1044 | -70.1044 | -70.1044 | -70.1044 | -70.1044 | -70.1044 | -70.1044 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 127.5055 | 125.5088 | 121.6621 | 113.2303 | 108.0658 | 102.6674 | 99.3515 | 102.0906 | 105.3022 | 111.2922 | 119.3750 | 126.4273 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 409.6913 | 417.5468 | 401.4389 | 387.0764 | 368.6067 | 352.6928 | 340.0656 | 341.2199 | 350.9974 | 365.9181 | 387.3061 | 401.8741 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Southeast | 6.7600 | 36.7938 | 0.6300 | 0.7000 | 0.7700 | 76.0140 | (77) |
| Southwest | 4.3900 | 36.7938 | 0.6300 | 0.7000 | 0.7700 | 49.3641 | (79) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 125.3781 | 213.5653 | 292.2094 | 362.0616 | 405.5391 | 402.6065 | 388.1556 | 355.7194 | 316.4009 | 236.0352 | 150.1741 | 107.2975 | (83) |
| Total gains | 535.0695 | 631.1121 | 693.6483 | 749.1380 | 774.1459 | 755.2993 | 728.2212 | 696.9393 | 667.3983 | 601.9533 | 537.4801 | 509.1716 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| tau | 78.5483 | 78.8292 | 79.1066 | 80.4358 | 80.6895 | 81.8917 | 81.8917 | 82.1183 | 81.4244 | 80.6895 | 80.1779 | 79.6500 | |
| alpha | 6.2366 | 6.2553 | 6.2738 | 6.3624 | 6.3793 | 6.4594 | 6.4594 | 6.4746 | 6.4283 | 6.3793 | 6.3452 | 6.3100 | |
| util living area | | | | | | | | | | | | | |
| | 0.9939 | 0.9828 | 0.9562 | 0.8763 | 0.7259 | 0.5262 | 0.3778 | 0.4112 | 0.6359 | 0.9012 | 0.9833 | 0.9954 | (86) |
| MIT | 20.1484 | 20.3484 | 20.5778 | 20.8244 | 20.9557 | 20.9951 | 20.9995 | 20.9992 | 20.9846 | 20.8188 | 20.4485 | 20.1214 | (87) |
| Th 2 | 19.8785 | 19.8821 | 19.8855 | 19.9019 | 19.9049 | 19.9192 | 19.9192 | 19.9219 | 19.9137 | 19.9049 | 19.8987 | 19.8923 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9913 | 0.9757 | 0.9386 | 0.8339 | 0.6547 | 0.4396 | 0.2852 | 0.3153 | 0.5431 | 0.8565 | 0.9750 | 0.9934 | (89) |
| MIT 2 | 18.9263 | 19.1796 | 19.4615 | 19.7517 | 19.8765 | 19.9174 | 19.9191 | 19.9217 | 19.9068 | 19.7563 | 19.3206 | 18.9027 | (90) |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.6429 | (91) |
| MIT | 19.7120 | 19.9311 | 20.1792 | 20.4414 | 20.5704 | 20.6103 | 20.6137 | 20.6144 | 20.5998 | 20.4394 | 20.0457 | 19.6863 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.7120 | 19.9311 | 20.1792 | 20.4414 | 20.5704 | 20.6103 | 20.6137 | 20.6144 | 20.5998 | 20.4394 | 20.0457 | 19.6863 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9908 | 0.9760 | 0.9439 | 0.8561 | 0.6990 | 0.4953 | 0.3448 | 0.3770 | 0.6026 | 0.8802 | 0.9764 | 0.9929 | (94) |
| Useful gains | 530.1286 | 615.9871 | 654.7156 | 641.3464 | 541.1480 | 374.1110 | 251.0706 | 262.7771 | 402.1849 | 529.8497 | 524.7704 | 505.5491 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | | | | | | | | | | | | | |
| | 1005.7816 | 977.4263 | 886.3972 | 735.5091 | 563.5159 | 376.2162 | 251.2409 | 263.0757 | 409.1894 | 625.0772 | 827.6607 | 996.6456 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 353.8858 | 242.8871 | 172.3711 | 67.7972 | 16.6417 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 70.8493 | 218.0810 | 365.3758 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 1507.8890 | |
| Solar heating kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | | | | | | | | | | | | | |
| | 353.8858 | 242.8871 | 172.3711 | 67.7972 | 16.6417 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 70.8493 | 218.0810 | 365.3758 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 1507.8890 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 28.9311 | (99) |

## 9a. Energy requirements - Individual heating systems, including micro-CHP

| | | |
|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | 0.0000 | (201) |
| Fraction of space heat from main system(s) | 1.0000 | (202) |
| Efficiency of main space heating system 1 (in %) | 92.3000 | (206) |
| Efficiency of main space heating system 2 (in %) | 0.0000 | (207) |
| Efficiency of secondary/supplementary heating system, % | 0.0000 | (208) |

# Full SAP Calculation Printout

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement | | | | | | | | | | | | | |
| | 353.8858 | 242.8871 | 172.3711 | 67.7972 | 16.6417 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 70.8493 | 218.0810 | 365.3758 | (98) |
| Space heating efficiency (main heating system 1) | | | | | | | | | | | | | |
| | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.3000 | 92.3000 | 92.3000 | (210) |
| Space heating fuel (main heating system) | | | | | | | | | | | | | |
| | 383.4083 | 263.1497 | 186.7510 | 73.4530 | 18.0300 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 76.7598 | 236.2741 | 395.8568 | (211) |
| Space heating efficiency (main heating system 2) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (212) |
| Space heating fuel (main heating system 2) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (213) |
| Space heating fuel (secondary) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (215) |
| | | | | | | | | | | | | | |
| Water heating | | | | | | | | | | | | | |
| Water heating requirement | | | | | | | | | | | | | |
| | 195.2863 | 172.8135 | 184.0222 | 162.9982 | 158.7803 | 143.9310 | 142.7475 | 147.9860 | 149.1171 | 165.2339 | 174.3878 | 193.3277 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 | (216) |
| (217)m | 85.3760 | 84.8230 | 83.9133 | 82.2487 | 80.5747 | 79.8000 | 79.8000 | 79.8000 | 79.8000 | 82.3033 | 84.5623 | 85.4647 | (217) |
| Fuel for water heating, kWh/month | | | | | | | | | | | | | |
| | 228.7369 | 203.7341 | 219.3002 | 198.1771 | 197.0598 | 180.3646 | 178.8815 | 185.4461 | 186.8636 | 200.7621 | 206.2240 | 226.2078 | (219) |
| Space cooling fuel requirement | | | | | | | | | | | | | |
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (221) |
| Pumps and Fa | 7.3041 | 6.5973 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | (231) |
| Lighting | 16.0322 | 12.8617 | 11.5805 | 8.4844 | 6.5536 | 5.3543 | 5.9784 | 7.7709 | 10.0937 | 13.2434 | 14.9584 | 16.4778 | (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233a)m | -14.0997 | -20.9635 | -31.7667 | -37.7307 | -42.4806 | -40.3327 | -39.8611 | -36.7452 | -31.5537 | -24.8624 | -15.8883 | -12.0681 | (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233b)m | -4.9788 | -10.7130 | -21.7395 | -33.3092 | -44.6816 | -45.1094 | -44.5588 | -37.4187 | -27.0368 | -15.5134 | -6.7103 | -3.9181 | (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235d) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - main system 1 | 1633.6825 | (211) |
| Space heating fuel - main system 2 | 0.0000 | (213) |
| Space heating fuel - secondary | 0.0000 | (215) |
| Efficiency of water heater | 79.8000 | |
| Water heating fuel used | 2411.7579 | (219) |
| Space cooling fuel | 0.0000 | (221) |
| | | |
| Electricity for pumps and fans: | | |
| Total electricity for the above, kWh/year | 86.0000 | (231) |
| Electricity for lighting (calculated in Appendix L) | 129.3893 | (232) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -644.0404 | (233) |
| Wind generation | 0.0000 | (234) |
| Hydro-electric generation (Appendix N) | 0.0000 | (235a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (235) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (236) |
| Energy used | 0.0000 | (237) |
| Total delivered energy for all uses | 3616.7894 | (238) |

---

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

---

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 1633.6825 | 0.2100 | 343.0733 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2411.7579 | 0.2100 | 506.4692 | (264) |
| Space and water heating | | | 849.5425 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 129.3893 | 0.1443 | 18.6749 | (268) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -348.3528 | 0.1335 | -46.4927 | |
| PV Unit electricity exported | -295.6876 | 0.1253 | -37.0577 | |
| Total | | | -83.5504 | (269) |
| Total CO2, kg/year | | | 796.5962 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 15.2800 | (273) |

---

13a. Primary energy - Individual heating systems including micro-CHP

---

| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 1633.6825 | 1.1300 | 1846.0613 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2411.7579 | 1.1300 | 2725.2865 | (278) |
| Space and water heating | | | 4571.3477 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 129.3893 | 1.5338 | 198.4617 | (282) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -348.3528 | 1.4932 | -520.1597 | |
| PV Unit electricity exported | -295.6876 | 0.4600 | -136.0195 | |
| Total | | | -656.1792 | (283) |
| Total Primary energy kWh/year | | | 4243.7310 | (286) |
| Target Primary Energy Rate (TPER) | | | 81.4200 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Property Reference** | Unit 30 | **Issued on Date** | 17/05/2025 |
| **Assessment Reference** | 00001 | **Prop Type Ref** | Unit 30 |
| **Property** | | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 79 C | **DER** | 5.41 | **TER** | 14.36 |
| **Environmental** | 96 A | **% DER < TER** | | | 62.33 |
| **$CO_2$ Emissions (t/year)** | 0.34 | **DFEE** | 34.42 | **TFEE** | 38.98 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 11.71 |
| **% DPER < TPER** | 25.00 | **DPER** | 57.51 | **TPER** | 76.68 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Robert Arnold | **Assessor ID** | BA04-0001 |
| **Client** | | | |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 70.8100 | (1b) | x 3.0000 | (2b) = | 212.4300 | (1b) - (3b) (4) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 70.8100 | | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | 212.4300 | (5) |

---

2. Ventilation rate

---

| | | m3 per hour | |
|---|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 | (6a) |
| Number of open flues | 0 * 20 = | 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | 0 * 10 = | 0.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |

| | Air changes per hour | | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 0.0000 / (5) = | 0.0000 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 3.0000 | (17) |
| Infiltration rate | | 0.1500 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.1500 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.1912 | 0.1875 | 0.1837 | 0.1650 | 0.1612 | 0.1425 | 0.1425 | 0.1388 | 0.1500 | 0.1612 | 0.1687 | 0.1762 | (22b) |

Balanced mechanical ventilation with heat recovery

| | | |
|---|---|---|
| If mechanical ventilation | | 0.5000 (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | | 0.5000 (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | | 81.0000 (23c) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective ac | 0.2862 | 0.2825 | 0.2787 | 0.2600 | 0.2562 | 0.2375 | 0.2375 | 0.2337 | 0.2450 | 0.2562 | 0.2637 | 0.2712 | (25) |

---

3. Heat losses and heat loss parameter

---

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| Windows | | | 8.3400 | 1.0536 | 8.7874 | | | (27) |
| Front Door | | | 1.8900 | 1.4000 | 2.6460 | | | (26) |
| Glass Door | | | 2.4000 | 1.3258 | 3.1818 | | | (27) |
| External Walls | 39.1400 | 10.7400 | 28.4000 | 0.1500 | 4.2600 | 150.0000 | 4260.0000 | (29a) |
| Wall to Communal Corridor | 54.9700 | 1.8900 | 53.0800 | 0.1400 | 7.4312 | 150.0000 | 7962.0000 | (29a) |
| External Roof | 3.9400 | | 3.9400 | 0.1000 | 0.3940 | 9.0000 | 35.4600 | (30) |
| Total net area of external elements Aum(A, m2) | | | 98.0500 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 26.7004 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 17 | | | 22.0600 | 0.0000 | 0.0000 | 110.0000 | 2426.6000 | (32) |
| Party Floor | | | 70.8100 | | | 80.0000 | 5664.8000 | (32d) |
| Party Ceiling | | | 65.7000 | | | 100.0000 | 6570.0000 | (32b) |
| Internal Walls | | | 146.5900 | | | 9.0000 | 1319.3100 | (32c) |

| | | |
|---|---|---|
| Heat capacity Cm = Sum(A x k) | (28)...(30) + (32) + (32a)...(32e) = | 28238.1700 (34) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 398.7879 (35)

List of Thermal Bridges

| K1 Element | Length | Psi-value | Total |
|---|---|---|---|
| E1 Steel lintel with perforated steel base plate | 6.0200 | 0.0500 | 0.3010 |
| E3 Sill | 1.0225 | 0.0500 | 0.0511 |
| E4 Jamb | 16.1400 | 0.0500 | 0.8070 |
| E7 Party floor between dwellings (in blocks of flats) | 12.7100 | 0.0350 | 0.4449 |
| E18 Party wall between dwellings | 3.0000 | 0.0600 | 0.1800 |
| E7 Party floor between dwellings (in blocks of flats) | 17.8540 | 0.0350 | 0.6249 |
| E16 Corner (normal) | 6.0000 | 0.0900 | 0.5400 |
| E17 Corner (inverted - internal area greater than external area) | 6.0000 | -0.0900 | -0.5400 |
| E23 Balcony within or between dwellings, balcony support penetrates wall insulation | 5.2620 | 0.0200 | 0.1052 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 2.5141 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 29.2145 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 20.0667 | 19.8038 | 19.5409 | 18.2265 | 17.9636 | 16.6492 | 16.6492 | 16.3863 | 17.1750 | 17.9636 | 18.4894 | 19.0151 | (38) |
| Heat transfer coeff | 49.2811 | 49.0183 | 48.7554 | 47.4410 | 47.1781 | 45.8637 | 45.8637 | 45.6008 | 46.3894 | 47.1781 | 47.7039 | 48.2296 | (39) |

Average = Sum(39)m / 12 = 47.3753

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 0.6960 | 0.6923 | 0.6885 | 0.6700 | 0.6663 | 0.6477 | 0.6477 | 0.6440 | 0.6551 | 0.6663 | 0.6737 | 0.6811 | (40) |
| HLP (average) | | | | | | | | | | | | 0.6690 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

---

## 4. Water heating energy requirements (kWh/year)

---

Assumed occupancy 2.2656 (42)

Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 60.6351 | 59.7068 | 58.3387 | 56.2341 | 54.3485 | 51.7105 | 49.6239 | 52.0632 | 53.2900 | 55.9029 | 58.6239 | 60.5805 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 26.2751 | 25.8785 | 25.3142 | 24.4692 | 23.7076 | 22.6593 | 21.8639 | 22.8365 | 23.3469 | 24.3857 | 25.4657 | 26.2542 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 37.8323 | 36.4566 | 35.0809 | 33.7051 | 32.3294 | 30.9537 | 30.9537 | 32.3294 | 33.7051 | 35.0809 | 36.4566 | 37.8323 | (42c) |

Average daily hot water use (litres/day) 114.6571 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 124.7425 | 122.0419 | 118.7338 | 114.4084 | 110.3855 | 105.3234 | 102.4416 | 107.2291 | 110.3421 | 115.3694 | 120.5462 | 124.6670 | (44) |
| Energy conte | 183.6425 | 161.4860 | 169.6681 | 149.4460 | 142.2429 | 121.8030 | 113.2009 | 126.2106 | 127.9913 | 148.6652 | 162.9222 | 183.0826 | (45) |

Energy content (annual) Total = Sum(45)m = 1790.3616

Distribution loss (46)m = 0.15 x (45)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 27.5464 | 24.2229 | 25.4502 | 22.4169 | 21.3364 | 18.2705 | 16.9801 | 18.9316 | 19.1987 | 22.2998 | 24.4383 | 27.4624 | (46) |

Water storage loss:

Store volume 110.0000 (47)

b) If manufacturer declared loss factor is not known :

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.0152 (51)

Volume factor from Table 2a 1.0294 (52)

Temperature factor from Table 2b 0.6000 (53)

Enter (49) or (54) in (55) 1.0327 (55)

Total storage loss

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (56) |

If cylinder contains dedicated solar storage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (57) |
| 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |

Primary loss / Combi loss

Total heat required for water heating calculated for each month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 238.9194 | 211.4135 | 224.9449 | 202.9397 | 197.5197 | 175.2967 | 168.4777 | 181.4874 | 181.4850 | 203.9420 | 216.4159 | 238.3594 | (62) |
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63a) |
| -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |

WWHRS / PV diverter / Solar input / FGHRS

Output from w/h

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 238.9194 | 211.4135 | 224.9449 | 202.9397 | 197.5197 | 175.2967 | 168.4777 | 181.4874 | 181.4850 | 203.9420 | 216.4159 | 238.3594 | (64) |

Total per year (kWh/year) = Sum(64)m = 2441.2014 (64)

12Total per year (kWh/year) 2441 (64)

Electric shower(s)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)

Heat gains from water heating, kWh/month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 105.2826 | 93.6361 | 100.6361 | 92.4857 | 91.5172 | 83.2944 | 81.8608 | 86.1865 | 85.3521 | 93.6526 | 96.9666 | 105.0964 | (65) |

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## 5. Internal gains (see Table 5 and 5a)

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Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 113.2814 | 113.2814 | 113.2814 | 113.2814 | 113.2814 | 113.2814 | 113.2814 | 113.2814 | 113.2814 | 113.2814 | 113.2814 | 113.2814 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 105.9540 | 117.3062 | 105.9540 | 109.4858 | 105.9540 | 109.4858 | 105.9540 | 105.9540 | 109.4858 | 105.9540 | 109.4858 | 105.9540 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 199.1801 | 201.2470 | 196.0385 | 184.9504 | 170.9536 | 157.7986 | 149.0102 | 146.9434 | 152.1518 | 163.2400 | 177.2368 | 190.3918 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 34.3281 | 34.3281 | 34.3281 | 34.3281 | 34.3281 | 34.3281 | 34.3281 | 34.3281 | 34.3281 | 34.3281 | 34.3281 | 34.3281 | (69) |
| Pumps, fans | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | -90.6251 | -90.6251 | -90.6251 | -90.6251 | -90.6251 | -90.6251 | -90.6251 | -90.6251 | -90.6251 | -90.6251 | -90.6251 | -90.6251 | (71) |
| Water heating gains (Table 5) | 141.5089 | 139.3394 | 135.2636 | 128.4524 | 123.0070 | 115.6867 | 110.0279 | 115.8420 | 118.5445 | 125.8772 | 134.6758 | 141.2586 | (72) |
| Total internal gains | 503.6274 | 514.8770 | 494.2405 | 479.8730 | 456.8990 | 439.9555 | 421.9766 | 425.7238 | 437.1665 | 452.0555 | 478.3828 | 494.5888 | (73) |

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## 6. Solar gains

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| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Northwest | 8.3400 | 11.2829 | 0.4500 | 0.7000 | 0.7700 | 20.5415 | (81) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northwest | | | 2.4000 | | 11.2829 | | 0.4500 | | 0.7000 | | 0.7700 | | 5.9112 (81) |
| Solar gains | 26.4527 | 53.8453 | 97.0121 | 159.3217 | 214.1596 | 228.3168 | 213.5857 | 170.2730 | 118.2107 | 65.8032 | 33.2844 | 21.6026 (83) | |
| Total gains | 530.0801 | 568.7223 | 591.2526 | 639.1947 | 671.0587 | 668.2724 | 635.5623 | 595.9968 | 555.3773 | 517.8587 | 511.6671 | 516.1914 (84) | |

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| tau | 159.1671 | 160.0207 | 160.8835 | 165.3410 | 166.2623 | 171.0272 | 171.0272 | 172.0131 | 169.0888 | 166.2623 | 164.4298 | 162.6373 | |
| alpha | 11.6111 | 11.6680 | 11.7256 | 12.0227 | 12.0842 | 12.4018 | 12.4018 | 12.4675 | 12.2726 | 12.0842 | 11.9620 | 11.8425 | |
| util living area | 0.9978 | 0.9938 | 0.9776 | 0.8647 | 0.6525 | 0.4392 | 0.3175 | 0.3520 | 0.5761 | 0.8963 | 0.9894 | 0.9983 | (86) |
| MIT | 20.6792 | 20.7555 | 20.8592 | 20.9767 | 20.9990 | 21.0000 | 21.0000 | 21.0000 | 20.9998 | 20.9710 | 20.8284 | 20.6776 | (87) |
| Th 2 | 20.3444 | 20.3477 | 20.3510 | 20.3674 | 20.3707 | 20.3873 | 20.3873 | 20.3906 | 20.3806 | 20.3707 | 20.3641 | 20.3575 | (88) |
| util rest of house | 0.9968 | 0.9909 | 0.9679 | 0.8303 | 0.6090 | 0.3972 | 0.2733 | 0.3053 | 0.5245 | 0.8595 | 0.9839 | 0.9974 | (89) |
| MIT 2 | 19.9772 | 20.0765 | 20.2066 | 20.3488 | 20.3702 | 20.3873 | 20.3873 | 20.3906 | 20.3806 | 20.3484 | 20.1826 | 19.9867 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.5146 | (91) |
| MIT | 20.3385 | 20.4259 | 20.5424 | 20.6719 | 20.6938 | 20.7026 | 20.7026 | 20.7042 | 20.6992 | 20.6688 | 20.5149 | 20.3423 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 20.3385 | 20.4259 | 20.5424 | 20.6719 | 20.6938 | 20.7026 | 20.7026 | 20.7042 | 20.6992 | 20.6688 | 20.5149 | 20.3423 | (93) |

8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9968 | 0.9913 | 0.9711 | 0.8474 | 0.6314 | 0.4188 | 0.2961 | 0.3293 | 0.5511 | 0.8778 | 0.9854 | 0.9974 | (94) |
| Useful gains | 528.3809 | 563.7982 | 574.1610 | 541.6588 | 423.6948 | 279.8835 | 188.1596 | 196.2745 | 306.0436 | 454.5752 | 504.1953 | 514.8452 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | 790.3955 | 761.0544 | 684.6439 | 558.4699 | 424.3094 | 279.8868 | 188.1597 | 196.2747 | 306.1355 | 475.0265 | 639.9434 | 778.5348 | (97) |
| Space heating kWh | 194.9389 | 132.5562 | 82.1993 | 12.1040 | 0.4572 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 15.2157 | 97.7386 | 196.1851 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 731.3951 | |
| Solar heating kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | 194.9389 | 132.5562 | 82.1993 | 12.1040 | 0.4572 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 15.2157 | 97.7386 | 196.1851 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 731.3951 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 10.3290 | (99) |

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ext. temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | |
| Heat loss rate W | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 431.1186 | 339.3912 | 346.5661 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (100) |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.9993 | 0.9999 | 0.9998 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (101) |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 430.8334 | 339.3643 | 346.4940 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (102) |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 723.1869 | 687.9132 | 642.9150 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 210.4945 | 259.3204 | 220.5372 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (104) |
| Cooled fraction | | | | | | | | | | fC = cooled area / (4) = | | 0.9886 | (105) |
| Intermittency factor (Table 10b) | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | (106) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 52.0217 | 64.0885 | 54.5036 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) |
| Space cooling requirement | | | | | | | | | | | | 170.6138 | (107) |

9b. Energy requirements

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | 0.0000 | (301) |
| Fraction of space heat from community system | | | | | | | | | | | | 1.0000 | (302) |
| Fraction of heat from community Heat pump-Space and Water | | | | | | | | | | | | 1.0000 | (303a) |
| Factor for control and charging method (Table 4c(3)) for space heating | | | | | | | | | | | | 1.0000 | (305) |
| Factor for charging method (Table 4c(3)) for water heating | | | | | | | | | | | | 1.0000 | (305a) |
| Distribution loss factor (Table 12c) for community heating system | | | | | | | | | | | | 2.0000 | (306) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 | (208) |
| Space heating: | | | | | | | | | | | | | |
| Space heating requirement | 194.9389 | 132.5562 | 82.1993 | 12.1040 | 0.4572 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 15.2157 | 97.7386 | 196.1851 | (98) |
| Space heat from Heat pump = (98) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 307a | 389.8777 | 265.1123 | 164.3986 | 24.2081 | 0.9145 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 30.4315 | 195.4772 | 392.3702 | |
| Space heating requirement | 389.8777 | 265.1123 | 164.3986 | 24.2081 | 0.9145 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 30.4315 | 195.4772 | 392.3702 | (307) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | | | | | | | | | | | 0.0000 | (308) |
| Space heating fuel for secondary/supplementary system | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (309) |
| Water heating | | | | | | | | | | | | | |
| Annual water heating requirement | 238.9194 | 211.4135 | 224.9449 | 202.9397 | 197.5197 | 175.2967 | 168.4777 | 181.4874 | 181.4850 | 203.9420 | 216.4159 | 238.3594 | (64) |
| Water heat from Heat pump = (64) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 310a | 477.8387 | 422.8270 | 449.8899 | 405.8794 | 395.0394 | 350.5934 | 336.9555 | 362.9749 | 362.9700 | 407.8839 | 432.8317 | 476.7189 | |
| Water heating fuel | 477.8387 | 422.8270 | 449.8899 | 405.8794 | 395.0394 | 350.5934 | 336.9555 | 362.9749 | 362.9700 | 407.8839 | 432.8317 | 476.7189 | (310) |
| Cooling System Energy Efficiency Ratio | | | | | | | | | | | | 2.6000 | (314) |
| Space coolin | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 20.0083 | 24.6494 | 20.9629 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (315) |
| Pumps and Fa | 19.4139 | 17.5351 | 19.4139 | 18.7877 | 19.4139 | 18.7877 | 19.4139 | 19.4139 | 18.7877 | 19.4139 | 18.7877 | 19.4139 | (331) |
| Lighting | 22.6850 | 18.1987 | 16.3859 | 12.0050 | 9.2730 | 7.5762 | 8.4592 | 10.9956 | 14.2821 | 18.7390 | 21.1656 | 23.3155 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333a)m | -4.8004 | -7.8005 | -13.0022 | -16.9024 | -20.2553 | -19.6799 | -19.4013 | -17.2243 | -13.7968 | -9.7610 | -5.6071 | -4.0267 | (333a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334a) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335a) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (333b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335b) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - community heating | 1462.7901 | (307) |
| Space heating fuel - secondary | 0.0000 | (309) |
| Water heating fuel - community heating | 4882.4027 | (310) |
| Efficiency of water heater | 0.0000 | (311) |
| Electricity used for heat distribution | 14.6279 | (313) |
| Space cooling fuel | 65.6207 | (321) |
| | | |
| Electricity for pumps and fans: | | |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8820) | | |
| mechanical ventilation fans (SFP = 0.8820) | 228.5832 | (330a) |
| Total electricity for the above, kWh/year | 228.5832 | (331) |
| Electricity for lighting (calculated in Appendix L) | 183.0809 | (332) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -152.2580 | (333) |
| Wind generation | 0.0000 | (334) |
| Hydro-electric generation (Appendix N) | 0.0000 | (335a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (335) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (336) |
| Energy used | 0.0000 | (337) |
| Total delivered energy for all uses | 6670.2196 | (338) |

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12b. Carbon dioxide emissions - Community heating scheme

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (367) |
| Space and Water heating from Heat pump | 2266.1403 | 0.1588 | 82.9699 | (367) |
| Electrical energy for heat distribution (space & water) | 14.6279 | 0.0000 | 9.1982 | (372) |
| Overall CO2 factor for heat network | | | 0.0532 | (386) |
| Total CO2 associated with community systems | | | 337.7048 | (373) |
| Space and water heating | | | 337.7048 | (376) |
| Space cooling | 65.6207 | 0.1141 | 7.4849 | (377) |
| Pumps, fans and electric keep-hot | 228.5832 | 0.1387 | 31.7073 | (378) |
| Energy for lighting | 183.0809 | 0.1443 | 26.4242 | (379) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -152.2580 | 0.1318 | -20.0686 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -20.0686 | (380) |
| Total CO2, kg/year | | | 383.2526 | (383) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 5.4100 | (384) |

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13b. Primary energy - Community heating scheme

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| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (467a) |
| Space and Water heating from Heat pump | 2266.1403 | 1.5879 | 829.5598 | (467) |
| Electrical energy for heat distribution (space & water) | 14.6279 | 0.0000 | 97.4728 | (472) |
| Overall CO2 factor for heat network | | | 0.5640 | (486) |
| Total CO2 associated with community systems | | | 3578.6445 | (473) |
| Space and water heating | | | 3578.6445 | (476) |
| Space cooling | 65.6207 | 1.4204 | 93.2083 | (477) |
| Pumps, fans and electric keep-hot | 228.5832 | 1.5128 | 345.8006 | (478) |
| Energy for lighting | 183.0809 | 1.5338 | 280.8155 | (479) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -152.2580 | 1.4870 | -226.4036 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -226.4036 | (480) |
| Total Primary energy kWh/year | | | 4072.0653 | (483) |
| Dwelling Primary energy Rate (DPER) | | | 57.5100 | (484) |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

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| | | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | |
| Ground floor | | 70.8100 | (1b) | x 3.0000 | (2b) = | 212.4300 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 70.8100 | | | | | | (4) |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | | 212.4300 | (5) |

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2. Ventilation rate

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| | m3 per hour | |
|---|---|---|
| Number of open chimneys | 0 * 80 = 0.0000 | (6a) |

| | | |
|---|---|---|
| Number of open flues | 0 * 20 = | 0.0000 (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 (6f) |
| Number of intermittent extract fans | 3 * 10 = | 30.0000 (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 (7c) |

| | | Air changes per hour | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 30.0000 / (5) = | 0.1412 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3912 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.3912 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.4988 | 0.4890 | 0.4792 | 0.4303 | 0.4206 | 0.3717 | 0.3717 | 0.3619 | 0.3912 | 0.4206 | 0.4401 | 0.4597 | (22b) |
| Effective ac | 0.6244 | 0.6196 | 0.6148 | 0.5926 | 0.5884 | 0.5691 | 0.5691 | 0.5655 | 0.5765 | 0.5884 | 0.5969 | 0.6057 | (25) |

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## 3. Heat losses and heat loss parameter

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| Element | Gross | Openings | NetArea | U-value | A x U | K-value | A x K | |
|---|---|---|---|---|---|---|---|---|
| | m2 | m2 | m2 | W/m2K | W/K | kJ/m2K | kJ/K | |
| Main dwelling | | | | | | | | |
| TER Opaque door | | | 1.8900 | 1.0000 | 1.8900 | | | (26) |
| TER Opening Type | | | 10.7400 | 1.1450 | 12.2977 | | | (27) |
| External Walls | 39.1400 | 10.7400 | 28.4000 | 0.1800 | 5.1120 | | | (29a) |
| Wall to Communal Corridor | 54.9700 | 1.8900 | 53.0800 | 0.1800 | 9.5544 | | | (29a) |
| External Roof | 3.9400 | | 3.9400 | 0.1100 | 0.4334 | | | (30) |
| Total net area of external elements Aum(A, m2) | | | 98.0500 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 29.2875 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 17 | | | 22.0600 | 0.0000 | 0.0000 | | | (32) |

| | | |
|---|---|---|
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | 380.2312 | (35) |

List of Thermal Bridges

| K1 Element | Length | Psi-value | Total |
|---|---|---|---|
| E1 Steel lintel with perforated steel base plate | 6.0200 | 0.0500 | 0.3010 |
| E3 Sill | 1.0225 | 0.0500 | 0.0511 |
| E4 Jamb | 16.1400 | 0.0500 | 0.8070 |
| E7 Party floor between dwellings (in blocks of flats) | 12.7100 | 0.0700 | 0.8897 |
| E18 Party wall between dwellings | 3.0000 | 0.0600 | 0.1800 |
| E7 Party floor between dwellings (in blocks of flats) | 17.8540 | 0.0700 | 1.2498 |
| E16 Corner (normal) | 6.0000 | 0.0900 | 0.5400 |
| E17 Corner (inverted - internal area greater than external area) | 6.0000 | -0.0900 | -0.5400 |
| E23 Balcony within or between dwellings, balcony support penetrates wall insulation | 5.2620 | 0.0200 | 0.1052 |

| | | | |
|---|---|---|---|
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | 3.5838 | (36) |
| Point Thermal bridges | (36a) = | 0.0000 | |
| Total fabric heat loss | (33) + (36) + (36a) = | 32.8714 | (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 43.7720 | 43.4334 | 43.1014 | 41.5423 | 41.2506 | 39.8926 | 39.8926 | 39.6412 | 40.4157 | 41.2506 | 41.8407 | 42.4576 | (38) |
| Heat transfer coeff | 76.6434 | 76.3047 | 75.9728 | 74.4136 | 74.1219 | 72.7640 | 72.7640 | 72.5125 | 73.2870 | 74.1219 | 74.7121 | 75.3290 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 74.4122 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.0824 | 1.0776 | 1.0729 | 1.0509 | 1.0468 | 1.0276 | 1.0276 | 1.0240 | 1.0350 | 1.0468 | 1.0551 | 1.0638 | (40) |
| HLP (average) | | | | | | | | | | | | 1.0509 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

---

## 4. Water heating energy requirements (kWh/year)

---

| | | |
|---|---|---|
| Assumed occupancy | 2.2656 | (42) |

Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 62.2068 | 61.2719 | 59.9097 | 57.3033 | 55.3798 | 53.2347 | 52.0155 | 53.3674 | 54.8494 | 57.1525 | 59.8150 | 61.9684 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 26.8742 | 26.4751 | 25.9130 | 24.8767 | 24.1007 | 23.2403 | 22.7755 | 23.3337 | 23.9413 | 24.8620 | 25.9197 | 26.7833 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 37.8323 | 36.4566 | 35.0809 | 33.7051 | 32.3294 | 30.9537 | 30.9537 | 32.3294 | 33.7051 | 35.0809 | 36.4566 | 37.8323 | (42c) |

| | |
|---|---|
| Average daily hot water use (litres/day) | 116.6622 (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 126.9133 | 124.2036 | 120.9036 | 115.8851 | 111.8099 | 107.4287 | 105.7447 | 109.0305 | 112.4959 | 117.0954 | 122.1912 | 126.5841 | (44) |
| Energy conte | 200.9996 | 176.8642 | 185.8243 | 158.6409 | 150.5177 | 132.0962 | 127.8891 | 135.0025 | 138.7187 | 158.8974 | 174.0838 | 198.2001 | (45) |
| Energy content (annual) | | | | | | | | | | | Total = Sum(45)m = | 1937.7343 | |
| Distribution loss (46)m = 0.15 x (45)m | 30.1499 | 26.5296 | 27.8736 | 23.7961 | 22.5776 | 19.8144 | 19.1834 | 20.2504 | 20.8078 | 23.8346 | 26.1126 | 29.7300 | (46) |

| | |
|---|---|
| Water storage loss: | |
| Store volume | 150.0000 (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | 1.3938 (48) |
| Temperature factor from Table 2b | 0.5400 (49) |
| Enter (49) or (54) in (55) | 0.7527 (55) |

Total storage loss

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (56) |

If cylinder contains dedicated solar storage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (57) |
| Primary loss 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |

Total heat required for water heating calculated for each month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 247.5945 | 218.9500 | 232.4192 | 203.7328 | 197.1126 | 177.1880 | 174.4840 | 181.5974 | 183.8105 | 205.4923 | 219.1756 | 244.7950 | (62) |
| WWHRS -28.4383 | -25.1511 | -26.3368 | -21.8079 | -20.3242 | -17.3915 | -16.3018 | -17.3353 | -17.9940 | -21.2129 | -24.0316 | -27.9117 | (63a) |
| PV diverter -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | | | | | | | | | | | | | |
| | 219.1561 | 193.7989 | 206.0824 | 181.9249 | 176.7884 | 159.7964 | 158.1822 | 164.2621 | 165.8165 | 184.2794 | 195.1440 | 216.8833 | (64) |
| | | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | 2222.1145 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2222 | (64) |
| Electric shower(s) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | | | | | | | | | | | | | |
| | 104.1083 | 92.4759 | 99.0625 | 88.8216 | 87.3230 | 79.9954 | 79.7990 | 82.1643 | 82.1974 | 90.1093 | 93.9563 | 103.1774 | (65) |

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## 5. Internal gains (see Table 5 and 5a)

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| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Metabolic gains (Table 5), Watts | | | | | | | | | | | | | |
| (66)m | 113.2814 | 113.2814 | 113.2814 | 113.2814 | 113.2814 | 113.2814 | 113.2814 | 113.2814 | 113.2814 | 113.2814 | 113.2814 | 113.2814 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 105.9540 | 117.3062 | 105.9540 | 109.4858 | 105.9540 | 109.4858 | 105.9540 | 105.9540 | 109.4858 | 105.9540 | 109.4858 | 105.9540 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 199.1801 | 201.2470 | 196.0385 | 184.9504 | 170.9536 | 157.7986 | 149.0102 | 146.9434 | 152.1518 | 163.2400 | 177.2368 | 190.3918 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 34.3281 | 34.3281 | 34.3281 | 34.3281 | 34.3281 | 34.3281 | 34.3281 | 34.3281 | 34.3281 | 34.3281 | 34.3281 | 34.3281 | (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.0000 | 3.0000 | 3.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | | | | | | | | | | | | | |
| | -90.6251 | -90.6251 | -90.6251 | -90.6251 | -90.6251 | -90.6251 | -90.6251 | -90.6251 | -90.6251 | -90.6251 | -90.6251 | -90.6251 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 139.9305 | 137.6130 | 133.1485 | 123.3633 | 117.3697 | 111.1048 | 107.2568 | 110.4358 | 114.1631 | 121.1147 | 130.4949 | 138.6794 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 505.0490 | 516.1506 | 495.1255 | 477.7839 | 454.2617 | 435.3736 | 419.2054 | 420.3176 | 432.7851 | 450.2930 | 477.2019 | 495.0095 | (73) |

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## 6. Solar gains

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| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Northwest | 10.7400 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 37.0338 | (81) |
| Solar gains | 37.0338 | 75.3834 | 135.8169 | 223.0504 | 299.8235 | 319.6436 | 299.0200 | 238.3822 | 165.4950 | 92.1245 | 46.5981 | 30.2437 | (83) |
| Total gains | 542.0828 | 591.5340 | 630.9424 | 700.8343 | 754.0852 | 755.0172 | 718.2254 | 658.6998 | 598.2802 | 542.4175 | 523.8000 | 525.2532 | (84) |

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## 7. Mean internal temperature (heating season)

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| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, ni1,m (see Table 9a) | | | | | | | | | | | | | |
| tau | 97.5810 | 98.0141 | 98.4423 | 100.5049 | 100.9004 | 102.7835 | 102.7835 | 103.1399 | 102.0499 | 100.9004 | 100.1035 | 99.2836 | |
| alpha | 7.5054 | 7.5343 | 7.5628 | 7.7003 | 7.7267 | 7.8522 | 7.8522 | 7.8760 | 7.8033 | 7.7267 | 7.6736 | 7.6189 | |
| util living area | | | | | | | | | | | | | |
| | 0.9991 | 0.9979 | 0.9936 | 0.9637 | 0.8419 | 0.6114 | 0.4453 | 0.5052 | 0.7996 | 0.9794 | 0.9974 | 0.9993 | (86) |
| MIT | 20.2013 | 20.3092 | 20.4859 | 20.7556 | 20.9408 | 20.9956 | 20.9997 | 20.9992 | 20.9703 | 20.7396 | 20.4398 | 20.1969 | (87) |
| Th 2 | 20.0152 | 20.0192 | 20.0230 | 20.0411 | 20.0445 | 20.0604 | 20.0604 | 20.0633 | 20.0543 | 20.0445 | 20.0377 | 20.0305 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9986 | 0.9968 | 0.9902 | 0.9448 | 0.7815 | 0.5246 | 0.3505 | 0.4031 | 0.7114 | 0.9648 | 0.9958 | 0.9989 | (89) |
| MIT 2 | 19.0948 | 19.2358 | 19.4635 | 19.8085 | 20.0038 | 20.0587 | 20.0603 | 20.0632 | 20.0393 | 19.7981 | 19.4178 | 19.1013 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.5146 | (91) |
| MIT | 19.6642 | 19.7882 | 19.9896 | 20.2959 | 20.4860 | 20.5408 | 20.5437 | 20.5448 | 20.5184 | 20.2826 | 19.9437 | 19.6651 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.6642 | 19.7882 | 19.9896 | 20.2959 | 20.4860 | 20.5408 | 20.5437 | 20.5448 | 20.5184 | 20.2826 | 19.9437 | 19.6651 | (93) |

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## 8. Space heating requirement

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| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9984 | 0.9965 | 0.9900 | 0.9506 | 0.8111 | 0.5694 | 0.3994 | 0.4558 | 0.7570 | 0.9693 | 0.9956 | 0.9987 | (94) |
| Useful gains | 541.2157 | 589.4498 | 624.6567 | 666.2149 | 611.6060 | 429.9443 | 286.8333 | 300.2143 | 452.8862 | 525.7464 | 521.5031 | 524.5852 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | | | | | | | | | | | | | |
| | 1177.5651 | 1136.0386 | 1024.8437 | 848.0102 | 651.2349 | 432.2779 | 286.9615 | 300.5530 | 470.3862 | 717.6951 | 959.5809 | 1164.9702 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 473.4440 | 367.3076 | 297.7391 | 130.8926 | 29.4838 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 142.8098 | 315.4160 | 476.4464 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 2233.5393 | |
| Solar heating kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | | | | | | | | | | | | | |
| | 473.4440 | 367.3076 | 297.7391 | 130.8926 | 29.4838 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 142.8098 | 315.4160 | 476.4464 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 2233.5393 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 31.5427 | (99) |

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## 9a. Energy requirements - Individual heating systems, including micro-CHP

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| | | |
|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | 0.0000 | (201) |
| Fraction of space heat from main system(s) | 1.0000 | (202) |
| Efficiency of main space heating system 1 (in %) | 92.3000 | (206) |
| Efficiency of main space heating system 2 (in %) | 0.0000 | (207) |
| Efficiency of secondary/supplementary heating system, % | 0.0000 | (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement | | | | | | | | | | | | | |
| | 473.4440 | 367.3076 | 297.7391 | 130.8926 | 29.4838 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 142.8098 | 315.4160 | 476.4464 | (98) |
| Space heating efficiency (main heating system 1) | | | | | | | | | | | | | |
| | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.3000 | 92.3000 | 92.3000 | (210) |
| Space heating fuel (main heating system) | | | | | | | | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 512.9404 | 397.9498 | 322.5776 | 141.8121 | 31.9435 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 154.7235 | 341.7291 | 516.1933 (211) |
| Space heating efficiency (main heating system 2) | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (212) |
| Space heating fuel (main heating system 2) | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (213) |
| Space heating fuel (secondary) | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (215) |
| Water heating | | | | | | | | | | | | |
| Water heating requirement | | | | | | | | | | | | |
| | 219.1561 | 193.7989 | 206.0824 | 181.9249 | 176.7884 | 159.7964 | 158.1822 | 164.2621 | 165.8165 | 184.2794 | 195.1440 | 216.8833 (64) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 (216) |
| (217)m | 85.7402 | 85.4706 | 84.8841 | 83.3341 | 80.9730 | 79.8000 | 79.8000 | 79.8000 | 79.8000 | 83.4947 | 85.1303 | 85.7739 (217) |
| Fuel for water heating, kWh/month | | | | | | | | | | | | |
| | 255.6049 | 226.7432 | 242.7809 | 218.3079 | 218.3299 | 200.2462 | 198.2233 | 205.8422 | 207.7902 | 220.7079 | 229.2298 | 252.8546 (219) |
| Space cooling fuel requirement | | | | | | | | | | | | |
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (221) |
| Pumps and Fa | 7.3041 | 6.5973 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 (231) |
| Lighting | 22.0151 | 17.6614 | 15.9021 | 11.6506 | 8.9992 | 7.3524 | 8.2094 | 10.6709 | 13.8604 | 18.1856 | 20.5406 | 22.6270 (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (233a)m | -15.7033 | -23.5545 | -35.9944 | -43.1076 | -48.8243 | -46.4356 | -45.8750 | -42.1430 | -35.9801 | -28.0737 | -17.7610 | -13.4167 (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | |
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (233b)m | -5.0327 | -10.8740 | -22.1603 | -34.1041 | -45.9102 | -46.4293 | -45.8790 | -38.4640 | -27.7006 | -15.8097 | -6.8010 | -3.9583 (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | |
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235d) |

| | |
|---|---|
| Annual totals kWh/year | |
| Space heating fuel - main system 1 | 2419.8692 (211) |
| Space heating fuel - main system 2 | 0.0000 (213) |
| Space heating fuel - secondary | 0.0000 (215) |
| Efficiency of water heater | 79.8000 |
| Water heating fuel used | 2676.6609 (219) |
| Space cooling fuel | 0.0000 (221) |
| Electricity for pumps and fans: | |
| Total electricity for the above, kWh/year | 86.0000 (231) |
| Electricity for lighting (calculated in Appendix L) | 177.6748 (232) |
| Energy saving/generation technologies (Appendices M ,N and Q) | |
| PV generation | -699.9923 (233) |
| Wind generation | 0.0000 (234) |
| Hydro-electric generation (Appendix N) | 0.0000 (235a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 (235) |
| Appendix Q - special features | |
| Energy saved or generated | -0.0000 (236) |
| Energy used | 0.0000 (237) |
| Total delivered energy for all uses | 4660.2126 (238) |

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12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 2419.8692 | 0.2100 | 508.1725 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2676.6609 | 0.2100 | 562.0988 | (264) |
| Space and water heating | | | 1070.2713 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 177.6748 | 0.1443 | 25.6440 | (268) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -396.8691 | 0.1333 | -52.9055 | |
| PV Unit electricity exported | -303.1232 | 0.1252 | -37.9483 | |
| Total | | | -90.8539 | (269) |
| Total CO2, kg/year | | | 1016.9907 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 14.3600 | (273) |

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13a. Primary energy - Individual heating systems including micro-CHP

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| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 2419.8692 | 1.1300 | 2734.4522 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2676.6609 | 1.1300 | 3024.6268 | (278) |
| Space and water heating | | | 5759.0790 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 177.6748 | 1.5338 | 272.5236 | (282) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -396.8691 | 1.4926 | -592.3700 | |
| PV Unit electricity exported | -303.1232 | 0.4595 | -139.2862 | |
| Total | | | -731.6562 | (283) |
| Total Primary energy kWh/year | | | 5430.0472 | (286) |
| Target Primary Energy Rate (TPER) | | | 76.6800 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Property Reference** | Unit 31 | **Issued on Date** | 17/05/2025 |
| **Assessment Reference** | 00001 | **Prop Type Ref** | Unit 31 |
| **Property** | | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 79 C | **DER** | 5.82 | **TER** | 14.65 |
| **Environmental** | 96 A | **% DER < TER** | | | 60.27 |
| **$CO_2$ Emissions (t/year)** | 0.27 | **DFEE** | 30.95 | **TFEE** | 33.11 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 6.54 |
| **% DPER < TPER** | 20.76 | **DPER** | 62.23 | **TPER** | 78.53 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Robert Arnold | **Assessor ID** | BA04-0001 |
| **Client** | | | |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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## 1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 51.4500 | (1b) | x 3.0000 | (2b) = | 154.3500 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 51.4500 | | | | | (4) |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | 154.3500 | (5) |

---

## 2. Ventilation rate

---

| | m3 per hour | |
|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 (6a) |
| Number of open flues | 0 * 20 = | 0.0000 (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 (6f) |
| Number of intermittent extract fans | 0 * 10 = | 0.0000 (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 (7c) |

| | Air changes per hour | |
|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 0.0000 / (5) = | 0.0000 (8) |
| Pressure test | | Yes |
| Pressure Test Method | | Blower Door |
| Measured/design AP50 | | 3.0000 (17) |
| Infiltration rate | | 0.1500 (18) |
| Number of sides sheltered | | 0 (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.1500 (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.1912 | 0.1875 | 0.1837 | 0.1650 | 0.1612 | 0.1425 | 0.1425 | 0.1388 | 0.1500 | 0.1612 | 0.1687 | 0.1762 | (22b) |
| Balanced mechanical ventilation with heat recovery | | | | | | | | | | | | | |
| If mechanical ventilation | | | | | | | | | | | | 0.5000 | (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | | | | | | | | | | | | 0.5000 | (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | | | | | | | | | | | | 81.0000 | (23c) |
| Effective ac | 0.2862 | 0.2825 | 0.2787 | 0.2600 | 0.2562 | 0.2375 | 0.2375 | 0.2337 | 0.2450 | 0.2562 | 0.2637 | 0.2712 | (25) |

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## 3. Heat losses and heat loss parameter

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| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| Windows | | | 6.2900 | 1.0536 | 6.6274 | | | (27) |
| Door | | | 1.8900 | 1.4000 | 2.6460 | | | (26) |
| Glass Door | | | 2.4000 | 1.3258 | 3.1818 | | | (27) |
| External Walls | 29.3100 | 8.6900 | 20.6200 | 0.1500 | 3.0930 | 150.0000 | 3093.0000 | (29a) |
| Wall to Communal Corridor | 23.8400 | 1.8900 | 21.9500 | 0.1400 | 3.0730 | 150.0000 | 3292.5000 | (29a) |
| External Roof | 3.5200 | | 3.5200 | 0.1000 | 0.3520 | 9.0000 | 31.6800 | (30) |
| Total net area of external elements Aum(A, m2) | | | 56.6700 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 18.9732 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 29 | | | 20.1300 | 0.0000 | 0.0000 | 110.0000 | 2214.3000 | (32) |
| Party Wall to Unit 33 | | | 20.1300 | 0.0000 | 0.0000 | 110.0000 | 2214.3000 | (32) |
| Party Floor | | | 51.4500 | | | 80.0000 | 4116.0000 | (32d) |
| Party Ceiling | | | 46.6000 | | | 100.0000 | 4660.0000 | (32b) |
| Internal Walls | | | 71.7100 | | | 9.0000 | 645.3900 | (32c) |

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 20267.1700 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 393.9197 (35)
List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E1 Steel lintel with perforated steel base plate | 4.7700 | 0.0500 | 0.2385 |
| E4 Jamb | 13.1200 | 0.0500 | 0.6560 |
| E7 Party floor between dwellings (in blocks of flats) | 4.2570 | 0.0350 | 0.1490 |
| E7 Party floor between dwellings (in blocks of flats) | 7.9490 | 0.0350 | 0.2782 |
| E16 Corner (normal) | 6.0000 | 0.0900 | 0.5400 |
| E17 Corner (inverted - internal area greater than external area) | 3.0000 | -0.0900 | -0.2700 |
| E23 Balcony within or between dwellings, balcony support penetrates wall insulation | 5.5150 | 0.0200 | 0.1103 |
| E25 Staggered party wall between dwellings | 6.0000 | 0.0600 | 0.3600 |
| E15 Flat roof with parapet | 4.2400 | 0.5600 | 2.3744 |
| E24 Eaves (insulation at ceiling level - inverted) | 7.0750 | 0.1200 | 0.8490 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 5.2854 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 24.2586 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 14.5803 | 14.3893 | 14.1983 | 13.2432 | 13.0522 | 12.0972 | 12.0972 | 11.9062 | 12.4792 | 13.0522 | 13.4342 | 13.8163 | (38) |
| Heat transfer coeff | 38.8389 | 38.6479 | 38.4569 | 37.5019 | 37.3108 | 36.3558 | 36.3558 | 36.1648 | 36.7378 | 37.3108 | 37.6929 | 38.0749 | (39) |

Average = Sum(39)m / 12 = 37.4541

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 0.7549 | 0.7512 | 0.7475 | 0.7289 | 0.7252 | 0.7066 | 0.7066 | 0.7029 | 0.7140 | 0.7252 | 0.7326 | 0.7400 | (40) |
| HLP (average) | | | | | | | | | | | | 0.7280 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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4. Water heating energy requirements (kWh/year)

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Assumed occupancy 1.7328 (42)
Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 51.9277 | 51.1326 | 49.9610 | 48.1587 | 46.5438 | 44.2846 | 42.4977 | 44.5867 | 45.6373 | 47.8750 | 50.2053 | 51.8808 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 22.5192 | 22.1792 | 21.6956 | 20.9714 | 20.3187 | 19.4202 | 18.7386 | 19.5721 | 20.0096 | 20.8998 | 21.8255 | 22.5013 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.3761 | 31.1988 | 30.0214 | 28.8441 | 27.6668 | 26.4895 | 26.4895 | 27.6668 | 28.8441 | 30.0214 | 31.1988 | 32.3761 | (42c) |

Average daily hot water use (litres/day) 98.1867 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 106.8229 | 104.5106 | 101.6781 | 97.9742 | 94.5293 | 90.1943 | 87.7258 | 91.8256 | 94.4910 | 98.7963 | 103.2295 | 106.7582 | (44) |
| Energy conte | 157.2617 | 138.2887 | 145.2959 | 127.9788 | 121.8106 | 104.3067 | 96.9396 | 108.0804 | 109.6049 | 127.3090 | 139.5181 | 156.7822 | (45) |

Energy content (annual) Total = Sum(45)m = 1533.1766

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | |
| 23.5893 | 20.7433 | 21.7944 | 19.1968 | 18.2716 | 15.6460 | 14.5409 | 16.2121 | 16.4407 | 19.0963 | 20.9277 | 23.5173 | (46) |

Water storage loss:
Store volume 110.0000 (47)
b) If manufacturer declared loss factor is not known :
Hot water storage loss factor from Table 2 (kWh/litre/day) 0.0152 (51)
Volume factor from Table 2a 1.0294 (52)
Temperature factor from Table 2b 0.6000 (53)
Enter (49) or (54) in (55) 1.0327 (55)
Total storage loss

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (56) |

If cylinder contains dedicated solar storage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (57) |
| Primary loss 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |

Total heat required for water heating calculated for each month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 212.5385 | 188.2161 | 200.5727 | 181.4725 | 177.0874 | 157.8004 | 152.2164 | 163.3572 | 163.0986 | 182.5858 | 193.0118 | 212.0590 | (62) |
| WWHRS 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63a) |
| PV diverter -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |

Output from w/h

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 212.5385 | 188.2161 | 200.5727 | 181.4725 | 177.0874 | 157.8004 | 152.2164 | 163.3572 | 163.0986 | 182.5858 | 193.0118 | 212.0590 | (64) |

Total per year (kWh/year) = Sum(64)m = 2184.0164 (64)
12Total per year (kWh/year) 2184 (64)
Electric shower(s)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)
Heat gains from water heating, kWh/month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 96.5110 | 85.9229 | 92.5323 | 85.3479 | 84.7235 | 77.4769 | 76.4538 | 80.1582 | 79.2386 | 86.5517 | 89.1847 | 96.3515 | (65) |

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5. Internal gains (see Table 5 and 5a)

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Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 86.6422 | 86.6422 | 86.6422 | 86.6422 | 86.6422 | 86.6422 | 86.6422 | 86.6422 | 86.6422 | 86.6422 | 86.6422 | 86.6422 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 78.6431 | 87.0691 | 78.6431 | 81.2645 | 78.6431 | 81.2645 | 78.6431 | 78.6431 | 81.2645 | 78.6431 | 81.2645 | 78.6431 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 150.9989 | 152.5658 | 148.6173 | 140.2113 | 129.6003 | 119.6275 | 112.9650 | 111.3981 | 115.3466 | 123.7526 | 134.3636 | 144.3364 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 31.6642 | 31.6642 | 31.6642 | 31.6642 | 31.6642 | 31.6642 | 31.6642 | 31.6642 | 31.6642 | 31.6642 | 31.6642 | 31.6642 | (69) |
| Pumps, fans 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (70) | |
| Losses e.g. evaporation (negative values) (Table 5) | -69.3138 | -69.3138 | -69.3138 | -69.3138 | -69.3138 | -69.3138 | -69.3138 | -69.3138 | -69.3138 | -69.3138 | -69.3138 | -69.3138 | (71) |
| Water heating gains (Table 5) | 129.7190 | 127.8615 | 124.3714 | 118.5387 | 113.8756 | 107.6068 | 102.7606 | 107.7395 | 110.0536 | 116.3329 | 123.8676 | 129.5048 | (72) |
| Total internal gains | 408.3537 | 416.4891 | 400.6244 | 389.0073 | 371.1117 | 357.4915 | 343.3613 | 346.7734 | 355.6574 | 367.7212 | 388.4884 | 401.4770 | (73) |

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6. Solar gains

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| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W |
|---|---|---|---|---|---|---|

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southeast | | | | 6.2900 | | 36.7938 | | 0.4500 | | 0.7000 | | 0.7700 | | 50.5207 (77) |
| Southeast | | | | 2.4000 | | 36.7938 | | 0.4500 | | 0.7000 | | 0.7700 | | 19.2766 (77) |
| Solar gains | 69.7973 | 118.8906 | 162.6713 | 201.5577 | 225.7614 | 224.1288 | 216.0841 | 198.0270 | 176.1386 | 131.3995 | 83.6011 | 59.7319 (83) | |
| Total gains | 478.1510 | 535.3797 | 563.2958 | 590.5649 | 596.8731 | 581.6203 | 559.4454 | 544.8004 | 531.7960 | 499.1207 | 472.0895 | 461.2089 (84) | |

7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 (85) | |
| Utilisation factor for gains for living area, ni1,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 144.9518 | 145.6682 | 146.3917 | 150.1198 | 150.8883 | 154.8520 | 154.8520 | 155.6699 | 153.2418 | 150.8883 | 149.3590 | 147.8605 | |
| alpha | 10.6635 | 10.7112 | 10.7594 | 11.0080 | 11.0592 | 11.3235 | 11.3235 | 11.3780 | 11.2161 | 11.0592 | 10.9573 | 10.8574 | |
| util living area | 0.9895 | 0.9663 | 0.9103 | 0.7581 | 0.5807 | 0.4000 | 0.2859 | 0.3054 | 0.4766 | 0.7662 | 0.9556 | 0.9918 (86) | |
| MIT | 20.7357 | 20.8419 | 20.9323 | 20.9909 | 20.9995 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 20.9915 | 20.8900 | 20.7250 (87) | |
| Th 2 | 20.2926 | 20.2958 | 20.2991 | 20.3154 | 20.3186 | 20.3350 | 20.3350 | 20.3383 | 20.3284 | 20.3186 | 20.3121 | 20.3056 (88) | |
| util rest of house | 0.9852 | 0.9544 | 0.8851 | 0.7190 | 0.5385 | 0.3585 | 0.2427 | 0.2614 | 0.4303 | 0.7206 | 0.9386 | 0.9884 (89) | |
| MIT 2 | 20.0025 | 20.1333 | 20.2370 | 20.3086 | 20.3183 | 20.3350 | 20.3350 | 20.3383 | 20.3284 | 20.3129 | 20.2057 | 20.0008 (90) | |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.6369 (91) | |
| MIT | 20.4695 | 20.5847 | 20.6799 | 20.7432 | 20.7522 | 20.7585 | 20.7586 | 20.7597 | 20.7561 | 20.7451 | 20.6416 | 20.4620 (92) | |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 20.4695 | 20.5847 | 20.6799 | 20.7432 | 20.7522 | 20.7585 | 20.7586 | 20.7597 | 20.7561 | 20.7451 | 20.6416 | 20.4620 (93) | |

8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9864 | 0.9597 | 0.8994 | 0.7437 | 0.5654 | 0.3850 | 0.2702 | 0.2894 | 0.4598 | 0.7495 | 0.9474 | 0.9893 (94) | |
| Useful gains | 471.6469 | 513.8106 | 506.6019 | 439.1967 | 337.4734 | 223.8962 | 151.1875 | 157.6691 | 244.5103 | 374.0709 | 447.2525 | 456.2517 (95) | |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 (96) | |
| Heat loss rate W | 628.0051 | 606.1791 | 545.3143 | 444.1407 | 337.7436 | 223.8990 | 151.1875 | 157.6692 | 244.5320 | 378.5235 | 510.4211 | 619.1754 (97) | |
| Space heating kWh | 116.3305 | 62.0716 | 28.8020 | 3.5597 | 0.2011 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.3128 | 45.4813 | 121.2152 (98a) | |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 380.9743 | |
| Solar heating kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (98b) | |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | 116.3305 | 62.0716 | 28.8020 | 3.5597 | 0.2011 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.3128 | 45.4813 | 121.2152 (98c) | |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 380.9743 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 7.4047 (99) | |

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ext. temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | |
| Heat loss rate W | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 341.7446 | 269.0330 | 274.8524 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (100) | |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.9996 | 0.9999 | 0.9999 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (101) | |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 341.6048 | 269.0193 | 274.8301 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (102) | |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 635.9057 | 612.1953 | 595.6722 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (103) | |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 211.8966 | 255.3230 | 238.7065 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (104) | |
| Cooled fraction | | | | | | | | | | fC = cooled area / (4) = | | 0.9913 (105) | |
| Intermittency factor (Table 10b) | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 (106) | |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 52.5108 | 63.2725 | 59.1547 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (107) | |
| Space cooling requirement | | | | | | | | | | | | 174.9380 (107) | |

9b. Energy requirements

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | 0.0000 (301) | |
| Fraction of space heat from community system | | | | | | | | | | | | 1.0000 (302) | |
| Fraction of heat from community Heat pump-Space and Water | | | | | | | | | | | | 1.0000 (303a) | |
| Factor for control and charging method (Table 4c(3)) for space heating | | | | | | | | | | | | 1.0000 (305) | |
| Factor for charging method (Table 4c(3)) for water heating | | | | | | | | | | | | 1.0000 (305a) | |
| Distribution loss factor (Table 12c) for community heating system | | | | | | | | | | | | 2.0000 (306) | |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 (208) | |
| Space heating: | | | | | | | | | | | | | |
| Space heating requirement | 116.3305 | 62.0716 | 28.8020 | 3.5597 | 0.2011 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.3128 | 45.4813 | 121.2152 (98) | |
| Space heat from Heat pump = (98) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 307a | 232.6610 | 124.1433 | 57.6041 | 7.1194 | 0.4022 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 6.6255 | 90.9627 | 242.4304 | |
| Space heating requirement | 232.6610 | 124.1433 | 57.6041 | 7.1194 | 0.4022 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 6.6255 | 90.9627 | 242.4304 (307) | |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | | | | | | | | | | | 0.0000 (308) | |
| Space heating fuel for secondary/supplementary system | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (309) | |
| Water heating | | | | | | | | | | | | | |
| Annual water heating requirement | 212.5385 | 188.2161 | 200.5727 | 181.4725 | 177.0874 | 157.8004 | 152.2164 | 163.3572 | 163.0986 | 182.5858 | 193.0118 | 212.0590 (64) | |
| Water heat from Heat pump = (64) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 310a | 425.0771 | 376.4323 | 401.1454 | 362.9449 | 354.1748 | 315.6008 | 304.4327 | 326.7144 | 326.1971 | 365.1715 | 386.0235 | 424.1181 | |
| Water heating fuel | 425.0771 | 376.4323 | 401.1454 | 362.9449 | 354.1748 | 315.6008 | 304.4327 | 326.7144 | 326.1971 | 365.1715 | 386.0235 | 424.1181 (310) | |
| Cooling System Energy Efficiency Ratio | | | | | | | | | | | | 2.6000 (314) | |
| Space coolin | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 20.1965 | 24.3356 | 22.7518 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (315) | |
| Pumps and Fa | 14.1060 | 12.7409 | 14.1060 | 13.6510 | 14.1060 | 13.6510 | 14.1060 | 14.1060 | 13.6510 | 14.1060 | 13.6510 | 14.1060 (331) | |
| Lighting | 15.2049 | 12.1979 | 10.9829 | 8.0465 | 6.2154 | 5.0780 | 5.6699 | 7.3699 | 9.5728 | 12.5600 | 14.1865 | 15.6275 (332) | |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333a)m | -4.7013 | -7.5788 | -12.5302 | -16.1528 | -19.2357 | -18.6486 | -18.3877 | -16.3833 | -13.2053 | -9.4354 | -5.4723 | -3.9497 (333a) | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (334a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (335a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335a) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (333b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (333b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (334b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (335b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335b) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - community heating | 761.9486 | (307) |
| Space heating fuel - secondary | 0.0000 | (309) |
| Water heating fuel - community heating | 4368.0327 | (310) |
| Efficiency of water heater | 0.0000 | (311) |
| Electricity used for heat distribution | 7.6195 | (313) |
| Space cooling fuel | 67.2838 | (321) |
| | | |
| Electricity for pumps and fans: | | |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8820) | | |
| mechanical ventilation fans (SFP = 0.8820) | 166.0868 | (330a) |
| Total electricity for the above, kWh/year | 166.0868 | (331) |
| Electricity for lighting (calculated in Appendix L) | 122.7123 | (332) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -145.6810 | (333) |
| Wind generation | 0.0000 | (334) |
| Hydro-electric generation (Appendix N) | 0.0000 | (335a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (335) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (336) |
| Energy used | 0.0000 | (337) |
| Total delivered energy for all uses | 5340.3832 | (338) |

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12b. Carbon dioxide emissions - Community heating scheme

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (367) |
| Space and Water heating from Heat pump | 1832.1362 | 0.1599 | 43.5085 | (367) |
| Electrical energy for heat distribution (space & water) | 7.6195 | 0.0000 | 7.3650 | (372) |
| Overall CO2 factor for heat network | | | 0.0527 | (386) |
| Total CO2 associated with community systems | | | 270.4023 | (373) |
| Space and water heating | | | 270.4023 | (376) |
| Space cooling | 67.2838 | 0.1140 | 7.6730 | (377) |
| Pumps, fans and electric keep-hot | 166.0868 | 0.1387 | 23.0383 | (378) |
| Energy for lighting | 122.7123 | 0.1443 | 17.7112 | (379) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -145.6810 | 0.1320 | -19.2232 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -19.2232 | (380) |
| Total CO2, kg/year | | | 299.6016 | (383) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 5.8200 | (384) |

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13b. Primary energy - Community heating scheme

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| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (467a) |
| Space and Water heating from Heat pump | 1832.1362 | 1.5918 | 433.1572 | (467) |
| Electrical energy for heat distribution (space & water) | 7.6195 | 0.0000 | 78.5370 | (472) |
| Overall CO2 factor for heat network | | | 0.5621 | (486) |
| Total CO2 associated with community systems | | | 2883.4284 | (473) |
| Space and water heating | | | 2883.4284 | (476) |
| Space cooling | 67.2838 | 1.4203 | 95.5645 | (477) |
| Pumps, fans and electric keep-hot | 166.0868 | 1.5128 | 251.2561 | (478) |
| Energy for lighting | 122.7123 | 1.5338 | 188.2203 | (479) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -145.6810 | 1.4875 | -216.7044 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -216.7044 | (480) |
| Total Primary energy kWh/year | | | 3201.7649 | (483) |
| Dwelling Primary energy Rate (DPER) | | | 62.2300 | (484) |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 51.4500 | (1b) | x 3.0000 | (2b) = | 154.3500 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 51.4500 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = | 154.3500 | (5) |

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2. Ventilation rate

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m3 per hour

| | | | |
|---|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 | (6a) |
| Number of open flues | 0 * 20 = | 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | 2 * 10 = | 20.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |

| | | Air changes per hour | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 20.0000 / (5) = | 0.1296 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3796 | (18) |
| Number of sides sheltered | | 0 | (19) |

| | | | |
|---|---|---|---|
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.3796 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.4840 | 0.4745 | 0.4650 | 0.4175 | 0.4080 | 0.3606 | 0.3606 | 0.3511 | 0.3796 | 0.4080 | 0.4270 | 0.4460 | (22b) |
| Effective ac | 0.6171 | 0.6126 | 0.6081 | 0.5872 | 0.5832 | 0.5650 | 0.5650 | 0.5616 | 0.5720 | 0.5832 | 0.5912 | 0.5995 | (25) |

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## 3. Heat losses and heat loss parameter

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| Element | Gross | Openings | NetArea | U-value | A x U | K-value | A x K | |
|---|---|---|---|---|---|---|---|---|
| | m2 | m2 | m2 | W/m2K | W/K | kJ/m2K | kJ/K | |
| Main dwelling | | | | | | | | |
| TER Opaque door | | | 1.8900 | 1.0000 | 1.8900 | | | (26) |
| TER Opening Type | | | 8.6900 | 1.1450 | 9.9504 | | | (27) |
| External Walls | 29.3100 | 8.6900 | 20.6200 | 0.1800 | 3.7116 | | | (29a) |
| Wall to Communal Corridor | 23.8400 | 1.8900 | 21.9500 | 0.1800 | 3.9510 | | | (29a) |
| External Roof | 3.5200 | | 3.5200 | 0.1100 | 0.3872 | | | (30) |
| Total net area of external elements Aum(A, m2) | | | 56.6700 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 19.8902 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 29 | | | 20.1300 | 0.0000 | 0.0000 | | | (32) |
| Party Wall to Unit 33 | | | 20.1300 | 0.0000 | 0.0000 | | | (32) |

| | | |
|---|---|---|
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | 375.8051 | (35) |

List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E1 Steel lintel with perforated steel base plate | 4.7700 | 0.0500 | 0.2385 |
| E4 Jamb | 13.1200 | 0.0500 | 0.6560 |
| E7 Party floor between dwellings (in blocks of flats) | 4.2570 | 0.0700 | 0.2980 |
| E7 Party floor between dwellings (in blocks of flats) | 7.9490 | 0.0700 | 0.5564 |
| E16 Corner (normal) | 6.0000 | 0.0900 | 0.5400 |
| E17 Corner (inverted - internal area greater than external area) | 3.0000 | -0.0900 | -0.2700 |
| E23 Balcony within or between dwellings, balcony support penetrates wall insulation | 5.5150 | 0.0200 | 0.1103 |
| E25 Staggered party wall between dwellings | 6.0000 | 0.0600 | 0.3600 |
| E15 Flat roof with parapet | 4.2400 | 0.5600 | 2.3744 |
| E24 Eaves (insulation at ceiling level - inverted) | 7.0750 | 0.2400 | 1.6980 |

| | | | |
|---|---|---|---|
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | 6.5616 | (36) |
| Point Thermal bridges | (36a) = | 0.0000 | |
| Total fabric heat loss | (33) + (36) + (36a) = | 26.4518 | (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 31.4327 | 31.2011 | 30.9740 | 29.9076 | 29.7081 | 28.7793 | 28.7793 | 28.6073 | 29.1371 | 29.7081 | 30.1118 | 30.5337 | (38) |
| Heat transfer coeff | 57.8845 | 57.6529 | 57.4258 | 56.3594 | 56.1599 | 55.2311 | 55.2311 | 55.0591 | 55.5889 | 56.1599 | 56.5636 | 56.9855 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 56.3585 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.1251 | 1.1206 | 1.1161 | 1.0954 | 1.0915 | 1.0735 | 1.0735 | 1.0701 | 1.0804 | 1.0915 | 1.0994 | 1.1076 | (40) |
| HLP (average) | | | | | | | | | | | | 1.0954 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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## 4. Water heating energy requirements (kWh/year)

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| | | |
|---|---|---|
| Assumed occupancy | 1.7328 | (42) |

Hot water usage for mixer showers

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 53.2736 | 52.4730 | 51.3064 | 49.0742 | 47.4270 | 45.5900 | 44.5458 | 45.7036 | 46.9728 | 48.9452 | 51.2253 | 53.0695 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.0326 | 22.6906 | 22.2089 | 21.3207 | 20.6556 | 19.9182 | 19.5199 | 19.9982 | 20.5190 | 21.3081 | 22.2146 | 22.9548 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.3761 | 31.1988 | 30.0214 | 28.8441 | 27.6668 | 26.4895 | 26.4895 | 27.6668 | 28.8441 | 30.0214 | 31.1988 | 32.3761 | (42c) |

| | | |
|---|---|---|
| Average daily hot water use (litres/day) | 99.9041 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 108.6823 | 106.3623 | 103.5367 | 99.2391 | 95.7494 | 91.9977 | 90.5552 | 93.3686 | 96.3359 | 100.2747 | 104.6386 | 108.4003 | (44) |
| Energy conte | 172.1262 | 151.4585 | 159.1320 | 135.8533 | 128.8971 | 113.1219 | 109.5187 | 115.6099 | 118.7918 | 136.0718 | 149.0768 | 169.7287 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1659.3867 | |

Distribution loss (46)m = 0.15 x (45)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 25.8189 | 22.7188 | 23.8698 | 20.3780 | 19.3346 | 16.9683 | 16.4278 | 17.3415 | 17.8188 | 20.4108 | 22.3615 | 25.4593 | (46) |

| | | |
|---|---|---|
| Water storage loss: | | |
| Store volume | 150.0000 | (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | 1.3938 | (48) |
| Temperature factor from Table 2b | 0.5400 | (49) |
| Enter (49) or (54) in (55) | 0.7527 | (55) |

Total storage loss

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (56) |

If cylinder contains dedicated solar storage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (57) |
| Primary loss 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |

Total heat required for water heating calculated for each month

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 218.7211 | 193.5442 | 205.7269 | 180.9451 | 175.4920 | 158.2137 | 156.1136 | 162.2048 | 163.8837 | 182.6667 | 194.1687 | 216.3236 | (62) |
| WWHRS | -24.3545 | -21.5393 | -22.5547 | -18.6762 | -17.4055 | -14.8940 | -13.9608 | -14.8459 | -15.4099 | -18.1666 | -20.5806 | -23.9035 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | | | | | | | | | | | | | |
| | 194.3666 | 172.0049 | 183.1722 | 162.2690 | 158.0865 | 143.3197 | 142.1528 | 147.3589 | 148.4737 | 164.5001 | 173.5881 | 192.4201 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 1981.7126 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 1982 | (64) |
| Electric shower(s) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | | | | | |
| Heat gains from water heating, kWh/month | | | | | | | | | | | | | |
| | 94.5079 | 84.0285 | 90.1873 | 81.2447 | 80.1342 | 73.6865 | 73.6909 | 75.7162 | 75.5718 | 82.5198 | 85.6415 | 93.7107 | (65) |

## 5. Internal gains (see Table 5 and 5a)

| Metabolic gains (Table 5), Watts | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 86.6422 | 86.6422 | 86.6422 | 86.6422 | 86.6422 | 86.6422 | 86.6422 | 86.6422 | 86.6422 | 86.6422 | 86.6422 | 86.6422 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 78.6431 | 87.0691 | 78.6431 | 81.2645 | 78.6431 | 81.2645 | 78.6431 | 78.6431 | 81.2645 | 78.6431 | 81.2645 | 78.6431 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 150.9989 | 152.5658 | 148.6173 | 140.2113 | 129.6003 | 119.6275 | 112.9650 | 111.3981 | 115.3466 | 123.7526 | 134.3636 | 144.3364 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 31.6642 | 31.6642 | 31.6642 | 31.6642 | 31.6642 | 31.6642 | 31.6642 | 31.6642 | 31.6642 | 31.6642 | 31.6642 | 31.6642 | (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.0000 | 3.0000 | 3.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | | | | | | | | | | | | | |
| | -69.3138 | -69.3138 | -69.3138 | -69.3138 | -69.3138 | -69.3138 | -69.3138 | -69.3138 | -69.3138 | -69.3138 | -69.3138 | -69.3138 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 127.0267 | 125.0425 | 121.2195 | 112.8399 | 107.7073 | 102.3424 | 99.0469 | 101.7691 | 104.9608 | 110.9137 | 118.9465 | 125.9553 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 408.6614 | 416.6701 | 400.4725 | 386.3084 | 367.9434 | 352.2270 | 339.6476 | 340.8030 | 350.5646 | 365.3021 | 386.5673 | 400.9275 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Southeast | 8.6900 | 36.7938 | 0.6300 | 0.7000 | 0.7700 | 97.7162 | (77) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 97.7162 | 166.4469 | 227.7399 | 282.1807 | 316.0659 | 313.7803 | 302.5177 | 277.2378 | 246.5941 | 183.9592 | 117.0415 | 83.6247 | (83) |
| Total gains | 506.3776 | 583.1169 | 628.2124 | 668.4891 | 684.0093 | 666.0073 | 642.1653 | 618.0408 | 597.1587 | 549.2613 | 503.6088 | 484.5522 | (84) |

## 7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 92.7861 | 93.1589 | 93.5272 | 95.2969 | 95.6355 | 97.2437 | 97.2437 | 97.5475 | 96.6179 | 95.6355 | 94.9530 | 94.2499 | |
| alpha | 7.1857 | 7.2106 | 7.2351 | 7.3531 | 7.3757 | 7.4829 | 7.4829 | 7.5032 | 7.4412 | 7.3757 | 7.3302 | 7.2833 | |
| util living area | | | | | | | | | | | | | |
| | 0.9954 | 0.9867 | 0.9645 | 0.8889 | 0.7360 | 0.5286 | 0.3783 | 0.4095 | 0.6336 | 0.9058 | 0.9859 | 0.9965 | (86) |
| MIT | 20.3082 | 20.4720 | 20.6605 | 20.8683 | 20.9717 | 20.9978 | 20.9998 | 20.9997 | 20.9922 | 20.8700 | 20.5653 | 20.2888 | (87) |
| Th 2 | 19.9804 | 19.9841 | 19.9877 | 20.0046 | 20.0077 | 20.0225 | 20.0225 | 20.0253 | 20.0168 | 20.0077 | 20.0013 | 19.9946 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9933 | 0.9808 | 0.9495 | 0.8493 | 0.6687 | 0.4491 | 0.2943 | 0.3229 | 0.5478 | 0.8628 | 0.9786 | 0.9949 | (89) |
| MIT 2 | 19.2039 | 19.4125 | 19.6456 | 19.8927 | 19.9900 | 20.0217 | 20.0225 | 20.0252 | 20.0134 | 19.9028 | 19.5452 | 19.1907 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.6369 | (91) |
| MIT | 19.9072 | 20.0873 | 20.2920 | 20.5141 | 20.6153 | 20.6434 | 20.6450 | 20.6459 | 20.6368 | 20.5189 | 20.1949 | 19.8901 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.9072 | 20.0873 | 20.2920 | 20.5141 | 20.6153 | 20.6434 | 20.6450 | 20.6459 | 20.6368 | 20.5189 | 20.1949 | 19.8901 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9931 | 0.9815 | 0.9546 | 0.8708 | 0.7108 | 0.4997 | 0.3478 | 0.3781 | 0.6025 | 0.8867 | 0.9803 | 0.9947 | (94) |
| Useful gains | 502.8730 | 572.3463 | 599.6774 | 582.1298 | 486.1806 | 332.8352 | 223.3560 | 233.6775 | 359.7903 | 487.0347 | 493.6769 | 481.9743 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | | | | | | | | | | | | | |
| | 903.4178 | 875.5935 | 792.0190 | 654.5625 | 500.6807 | 333.7851 | 223.4100 | 233.7762 | 363.3742 | 557.0438 | 740.6955 | 894.1105 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 298.0054 | 203.7821 | 143.1021 | 52.1516 | 10.7881 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 52.0868 | 177.8534 | 306.6293 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 1244.3988 | |
| Solar heating kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | | | | | | | | | | | | | |
| | 298.0054 | 203.7821 | 143.1021 | 52.1516 | 10.7881 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 52.0868 | 177.8534 | 306.6293 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 1244.3988 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 24.1866 | (99) |

## 9a. Energy requirements - Individual heating systems, including micro-CHP

| | | |
|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | 0.0000 | (201) |
| Fraction of space heat from main system(s) | 1.0000 | (202) |
| Efficiency of main space heating system 1 (in %) | 92.3000 | (206) |
| Efficiency of main space heating system 2 (in %) | 0.0000 | (207) |
| Efficiency of secondary/supplementary heating system, % | 0.0000 | (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement | | | | | | | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 298.0054 | 203.7821 | 143.1021 | 52.1516 | 10.7881 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 52.0868 | 177.8534 | 306.6293 (98) |
| Space heating efficiency (main heating system 1) | | | | | | | | | | | | |
| | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.3000 | 92.3000 | 92.3000 (210) |
| Space heating fuel (main heating system) | | | | | | | | | | | | |
| | 322.8660 | 220.7824 | 155.0402 | 56.5023 | 11.6881 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 56.4321 | 192.6906 | 332.2094 (211) |
| Space heating efficiency (main heating system 2) | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (212) |
| Space heating fuel (main heating system 2) | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (213) |
| Space heating fuel (secondary) | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (215) |
| Water heating | | | | | | | | | | | | |
| Water heating requirement | | | | | | | | | | | | |
| | 194.3666 | 172.0049 | 183.1722 | 162.2690 | 158.0865 | 143.3197 | 142.1528 | 147.3589 | 148.4737 | 164.5001 | 173.5881 | 192.4201 (64) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 (216) |
| (217)m | 85.0150 | 84.4410 | 83.5123 | 81.8168 | 80.3200 | 79.8000 | 79.8000 | 79.8000 | 79.8000 | 81.7936 | 84.1143 | 85.0994 (217) |
| Fuel for water heating, kWh/month | | | | | | | | | | | | |
| | 228.6262 | 203.6985 | 219.3356 | 198.3320 | 196.8208 | 179.5986 | 178.1363 | 184.6602 | 186.0573 | 201.1160 | 206.3717 | 226.1122 (219) |
| Space cooling fuel requirement | | | | | | | | | | | | |
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (221) |
| Pumps and Fa | 7.3041 | 6.5973 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 (231) |
| Lighting | 16.3405 | 13.1089 | 11.8031 | 8.6475 | 6.6796 | 5.4573 | 6.0933 | 7.9203 | 10.2877 | 13.4981 | 15.2460 | 16.7946 (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (233a)m | -11.5114 | -17.3234 | -26.5640 | -31.9368 | -36.2955 | -34.5810 | -34.1780 | -31.3441 | -26.6732 | -20.7106 | -13.0436 | -9.8300 (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | |
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (233b)m | -3.5552 | -7.6920 | -15.6907 | -24.1646 | -32.5378 | -32.8939 | -32.4898 | -27.2243 | -19.5967 | -11.1747 | -4.8029 | -2.7946 (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | |
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235d) |

| | |
|---|---|
| Annual totals kWh/year | |
| Space heating fuel - main system 1 | 1348.2111 (211) |
| Space heating fuel - main system 2 | 0.0000 (213) |
| Space heating fuel - secondary | 0.0000 (215) |
| Efficiency of water heater | 79.8000 |
| Water heating fuel used | 2408.8654 (219) |
| Space cooling fuel | 0.0000 (221) |
| Electricity for pumps and fans: | |
| Total electricity for the above, kWh/year | 86.0000 (231) |
| Electricity for lighting (calculated in Appendix L) | 131.8770 (232) |
| Energy saving/generation technologies (Appendices M ,N and Q) | |
| PV generation | -508.6090 (233) |
| Wind generation | 0.0000 (234) |
| Hydro-electric generation (Appendix N) | 0.0000 (235a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 (235) |
| Appendix Q - special features | |
| Energy saved or generated | -0.0000 (236) |
| Energy used | 0.0000 (237) |
| Total delivered energy for all uses | 3466.3445 (238) |

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 1348.2111 | 0.2100 | 283.1243 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2408.8654 | 0.2100 | 505.8617 | (264) |
| Space and water heating | | | 788.9861 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 131.8770 | 0.1443 | 19.0339 | (268) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -293.9918 | 0.1332 | -39.1670 | |
| PV Unit electricity exported | -214.6173 | 0.1252 | -26.8664 | |
| Total | | | -66.0334 | (269) |
| Total CO2, kg/year | | | 753.9158 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 14.6500 | (273) |

13a. Primary energy - Individual heating systems including micro-CHP

| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 1348.2111 | 1.1300 | 1523.4785 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2408.8654 | 1.1300 | 2722.0179 | (278) |
| Space and water heating | | | 4245.4964 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 131.8770 | 1.5338 | 202.2774 | (282) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -293.9918 | 1.4923 | -438.7236 | |
| PV Unit electricity exported | -214.6173 | 0.4595 | -98.6110 | |
| Total | | | -537.3346 | (283) |
| Total Primary energy kWh/year | | | 4040.5400 | (286) |
| Target Primary Energy Rate (TPER) | | | 78.5300 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Property Reference** | Unit 32 | **Issued on Date** | 17/05/2025 |
| **Assessment Reference** | 00001 | **Prop Type Ref** | Unit 32 |
| **Property** | | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 71 C | **DER** | 8.66 | **TER** | 21.52 |
| **Environmental** | 93 A | **% DER < TER** | | | 59.76 |
| **$CO_2$ Emissions (t/year)** | 0.52 | **DFEE** | 63.45 | **TFEE** | 71.02 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 10.66 |
| **% DPER < TPER** | 21.47 | **DPER** | 90.43 | **TPER** | 115.15 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Robert Arnold | **Assessor ID** | BA04-0001 |
| **Client** | | | |

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SAP 10 WORKSHEET FOR New Build (As Designed)  (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 69.5900 | (1b) | x 3.0000 | (2b) = | 208.7700 | (1b) - (3b) |
| | | | | | | (4) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 69.5900 | | | | | |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = | 208.7700 | (5) |

---

2. Ventilation rate

---

| | | m3 per hour | |
|---|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 | (6a) |
| Number of open flues | 0 * 20 = | 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | 0 * 10 = | 0.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |

| | | Air changes per hour | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 0.0000 / (5) = | 0.0000 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 3.0000 | (17) |
| Infiltration rate | | 0.1500 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.1500 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.1912 | 0.1875 | 0.1837 | 0.1650 | 0.1612 | 0.1425 | 0.1425 | 0.1388 | 0.1500 | 0.1612 | 0.1687 | 0.1762 | (22b) |

Balanced mechanical ventilation with heat recovery

| | | |
|---|---|---|
| If mechanical ventilation | | 0.5000 (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | | 0.5000 (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | | 81.0000 (23c) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective ac | 0.2862 | 0.2825 | 0.2787 | 0.2600 | 0.2562 | 0.2375 | 0.2375 | 0.2337 | 0.2450 | 0.2562 | 0.2637 | 0.2712 | (25) |

---

3. Heat losses and heat loss parameter

---

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| Windows | | | 11.8200 | 1.0536 | 12.4540 | | | (27) |
| Door | | | 1.8900 | 1.4000 | 2.6460 | | | (26) |
| Glass Door | | | 2.4000 | 1.3258 | 3.1818 | | | (27) |
| Heatloss Floor | | | 69.5900 | 0.1000 | 6.9590 | 0.0000 | 0.0000 | (28b) |
| External Walls | 125.2900 | 14.2200 | 111.0700 | 0.1500 | 16.6605 | 150.0000 | 16660.5000 | (29a) |
| Wall to Communal Corridor | 30.8700 | 1.8900 | 28.9800 | 0.1400 | 4.0572 | 150.0000 | 4347.0000 | (29a) |
| Total net area of external elements Aum(A, m2) | | | 225.7500 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 45.9585 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 15 | | | 22.0600 | 0.0000 | 0.0000 | 110.0000 | 2426.6000 | (32) |
| Party Ceiling | | | 69.5900 | | | 100.0000 | 6959.0000 | (32b) |
| Internal Wall 1 | | | 158.3600 | | | 9.0000 | 1425.2400 | (32c) |

| | | |
|---|---|---|
| Heat capacity Cm = Sum(A x k) | (28)...(30) + (32) + (32a)...(32e) = | 31818.3400 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | | 457.2258 (35) |

List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E1 Steel lintel with perforated steel base plate | 7.3600 | 0.0500 | 0.3680 |
| E3 Sill | 1.0225 | 0.0500 | 0.0511 |
| E4 Jamb | 18.0200 | 0.0600 | 1.0812 |
| E7 Party floor between dwellings (in blocks of flats) | 15.0700 | 0.0350 | 0.5275 |
| E16 Corner (normal) | 9.0000 | 0.0900 | 0.8100 |
| E18 Party wall between dwellings | 3.0000 | 0.0300 | 0.0900 |
| E7 Party floor between dwellings (in blocks of flats) | 10.0250 | 0.0350 | 0.3509 |
| E17 Corner (inverted - internal area greater than external area) | 6.0000 | -0.0900 | -0.5400 |
| E23 Balcony within or between dwellings, balcony support penetrates wall insulation | 5.2870 | 0.0200 | 0.1057 |
| E15 Flat roof with parapet | 22.9115 | 0.5600 | 12.8304 |
| E24 Eaves (insulation at ceiling level - inverted) | 14.5775 | 0.1200 | 1.7493 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 17.4241 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 63.3827 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 19.7209 | 19.4626 | 19.2042 | 17.9125 | 17.6541 | 16.3623 | 16.3623 | 16.1040 | 16.8791 | 17.6541 | 18.1708 | 18.6875 | (38) |
| Heat transfer coeff | 83.1036 | 82.8453 | 82.5869 | 81.2951 | 81.0368 | 79.7450 | 79.7450 | 79.4867 | 80.2617 | 81.0368 | 81.5535 | 82.0702 | (39) |

Average = Sum(39)m / 12 = 81.2305

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.1942 | 1.1905 | 1.1868 | 1.1682 | 1.1645 | 1.1459 | 1.1459 | 1.1422 | 1.1534 | 1.1645 | 1.1719 | 1.1793 | (40) |
| HLP (average) | | | | | | | | | | | | 1.1673 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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4. Water heating energy requirements (kWh/year)

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Assumed occupancy 2.2361 (42)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hot water usage for mixer showers | 60.1530 | 59.2321 | 57.8749 | 55.7870 | 53.9164 | 51.2993 | 49.2294 | 51.6492 | 52.8663 | 55.4584 | 58.1578 | 60.0988 | (42a) |
| Hot water usage for baths | 26.0671 | 25.6736 | 25.1138 | 24.2755 | 23.5200 | 22.4799 | 21.6909 | 22.6558 | 23.1621 | 24.1927 | 25.2641 | 26.0465 | (42b) |
| Hot water usage for other uses | 37.5302 | 36.1655 | 34.8007 | 33.4360 | 32.0713 | 30.7065 | 30.7065 | 32.0713 | 33.4360 | 34.8007 | 36.1655 | 37.5302 | (42c) |

Average daily hot water use (litres/day) 113.7452 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 123.7504 | 121.0712 | 117.7895 | 113.4985 | 109.5076 | 104.4858 | 101.6268 | 106.3763 | 109.4645 | 114.4518 | 119.5874 | 123.6755 | (44) |
| Energy conte | 182.1819 | 160.2017 | 168.3187 | 148.2575 | 141.1117 | 120.8343 | 112.3006 | 125.2068 | 126.9733 | 147.4828 | 161.6264 | 181.6265 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1776.1222 | |
| Distribution loss (46)m = 0.15 x (45)m | 27.3273 | 24.0303 | 25.2478 | 22.2386 | 21.1667 | 18.1251 | 16.8451 | 18.7810 | 19.0460 | 22.1224 | 24.2440 | 27.2440 | (46) |

Water storage loss:
Store volume 110.0000 (47)
b) If manufacturer declared loss factor is not known :
Hot water storage loss factor from Table 2 (kWh/litre/day) 0.0152 (51)
Volume factor from Table 2a 1.0294 (52)
Temperature factor from Table 2b 0.6000 (53)
Enter (49) or (54) in (55) 1.0327 (55)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total storage loss | 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (56) |
| If cylinder contains dedicated solar storage | 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (57) |
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | 237.4587 | 210.1291 | 223.5955 | 201.7511 | 196.3885 | 174.3280 | 167.5774 | 180.4836 | 180.4670 | 202.7596 | 215.1201 | 236.9033 | (62) |
| WWHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | 237.4587 | 210.1291 | 223.5955 | 201.7511 | 196.3885 | 174.3280 | 167.5774 | 180.4836 | 180.4670 | 202.7596 | 215.1201 | 236.9033 | (64) |

Total per year (kWh/year) = Sum(64)m = 2426.9620 (64)
12Total per year (kWh/year) 2427 (64)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Electric shower(s) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Heat gains from water heating, kWh/month | 104.7969 | 93.2090 | 100.1874 | 92.0906 | 91.1411 | 82.9724 | 81.5614 | 85.8527 | 85.0136 | 93.2595 | 96.5357 | 104.6122 | (65) |

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5. Internal gains (see Table 5 and 5a)

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Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 111.8065 | 111.8065 | 111.8065 | 111.8065 | 111.8065 | 111.8065 | 111.8065 | 111.8065 | 111.8065 | 111.8065 | 111.8065 | 111.8065 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 99.5197 | 110.1825 | 99.5197 | 102.8370 | 99.5197 | 102.8370 | 99.5197 | 99.5197 | 102.8370 | 99.5197 | 102.8370 | 99.5197 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 196.3383 | 198.3756 | 193.2415 | 182.3116 | 168.5145 | 155.5472 | 146.8842 | 144.8468 | 149.9810 | 160.9109 | 174.7080 | 187.6753 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 34.1806 | 34.1806 | 34.1806 | 34.1806 | 34.1806 | 34.1806 | 34.1806 | 34.1806 | 34.1806 | 34.1806 | 34.1806 | 34.1806 | (69) |
| Pumps, fans | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | -89.4452 | -89.4452 | -89.4452 | -89.4452 | -89.4452 | -89.4452 | -89.4452 | -89.4452 | -89.4452 | -89.4452 | -89.4452 | -89.4452 | (71) |
| Water heating gains (Table 5) | 140.8561 | 138.7039 | 134.6605 | 127.9035 | 122.5014 | 115.2394 | 109.6255 | 115.3934 | 118.0744 | 125.3487 | 134.0774 | 140.6079 | (72) |
| Total internal gains | 493.2560 | 503.8040 | 483.9637 | 469.5941 | 447.0776 | 430.1655 | 412.5714 | 416.3019 | 427.4343 | 442.3213 | 468.1643 | 484.3448 | (73) |

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6. Solar gains

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| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W |
|---|---|---|---|---|---|---|

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northeast | | | | 3.9900 | | 11.2829 | | 0.4500 | | 0.7000 | | 0.7700 | | 9.8274 | (75) |
| Northwest | | | | 7.8300 | | 11.2829 | | 0.4500 | | 0.7000 | | 0.7700 | | 19.2854 | (81) |
| Northwest | | | | 2.4000 | | 11.2829 | | 0.4500 | | 0.7000 | | 0.7700 | | 5.9112 | (81) |
| Solar gains | 35.0240 | 71.2924 | 128.4462 | 210.9455 | 283.5521 | 302.2966 | 282.7923 | 225.4453 | 156.5137 | 87.1249 | 44.0693 | 28.6024 | (83) |
| Total gains | 528.2800 | 575.0963 | 612.4098 | 680.5396 | 730.6297 | 732.4621 | 695.3636 | 641.7471 | 583.9480 | 529.4462 | 512.2336 | 512.9471 | (84) |

## 7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, ni1,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 106.3543 | 106.6860 | 107.0197 | 108.7203 | 109.0669 | 110.8336 | 110.8336 | 111.1938 | 110.1201 | 109.0669 | 108.3758 | 107.6935 | |
| alpha | 8.0903 | 8.1124 | 8.1346 | 8.2480 | 8.2711 | 8.3889 | 8.3889 | 8.4129 | 8.3413 | 8.2711 | 8.2251 | 8.1796 | |
| util living area | 0.9997 | 0.9994 | 0.9979 | 0.9847 | 0.9054 | 0.6862 | 0.5038 | 0.5676 | 0.8678 | 0.9919 | 0.9992 | 0.9998 | (86) |
| MIT | 20.2038 | 20.2967 | 20.4565 | 20.7088 | 20.9144 | 20.9928 | 20.9995 | 20.9987 | 20.9562 | 20.7049 | 20.4228 | 20.1968 | (87) |
| Th 2 | 19.9247 | 19.9276 | 19.9306 | 19.9455 | 19.9485 | 19.9635 | 19.9635 | 19.9665 | 19.9575 | 19.9485 | 19.9425 | 19.9366 | (88) |
| util rest of house | 0.9996 | 0.9990 | 0.9964 | 0.9733 | 0.8484 | 0.5813 | 0.3856 | 0.4415 | 0.7755 | 0.9839 | 0.9986 | 0.9997 | (89) |
| MIT 2 | 19.0091 | 19.1306 | 19.3372 | 19.6648 | 19.8907 | 19.9612 | 19.9634 | 19.9663 | 19.9368 | 19.6663 | 19.3042 | 19.0097 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.5226 | (91) |
| MIT | 19.6335 | 19.7400 | 19.9222 | 20.2104 | 20.4257 | 20.5003 | 20.5049 | 20.5059 | 20.4696 | 20.2091 | 19.8888 | 19.6301 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.6335 | 19.7400 | 19.9222 | 20.2104 | 20.4257 | 20.5003 | 20.5049 | 20.5059 | 20.4696 | 20.2091 | 19.8888 | 19.6301 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9995 | 0.9989 | 0.9964 | 0.9769 | 0.8770 | 0.6367 | 0.4475 | 0.5077 | 0.8249 | 0.9865 | 0.9985 | 0.9996 | (94) |
| Useful gains | 528.0307 | 574.4515 | 610.2040 | 664.7854 | 640.7413 | 466.3486 | 311.1932 | 325.8185 | 481.7175 | 522.2745 | 511.4806 | 512.7591 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | 1274.2718 | 1229.4271 | 1108.4951 | 919.4840 | 707.1036 | 470.5218 | 311.3967 | 326.3622 | 511.2357 | 778.6933 | 1042.9713 | 1266.3493 | (97) |
| Space heating kWh | 555.2034 | 440.1436 | 370.7286 | 183.3830 | 49.3735 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 190.7756 | 382.6733 | 560.6711 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 2732.9521 | |
| Solar heating kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | 555.2034 | 440.1436 | 370.7286 | 183.3830 | 49.3735 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 190.7756 | 382.6733 | 560.6711 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 2732.9521 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 39.2722 | (99) |

## 8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ext. temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | |
| Heat loss rate W | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 749.6032 | 590.1131 | 604.0987 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (100) |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.9222 | 0.9713 | 0.9480 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (101) |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 691.2965 | 573.2024 | 572.6807 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (102) |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 804.4615 | 763.7933 | 702.1977 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 81.4788 | 141.7997 | 96.3606 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (104) |
| Cooled fraction | | | | | | | | | fC = cooled area / (4) = | | | 0.9915 | (105) |
| Intermittency factor (Table 10b) | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | (106) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 20.1970 | 35.1494 | 23.8859 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) |
| Space cooling requirement | | | | | | | | | | | | 79.2323 | (107) |

## 9b. Energy requirements

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | 0.0000 | (301) |
| Fraction of space heat from community system | | | | | | | | | | | | 1.0000 | (302) |
| Fraction of heat from community Heat pump-Space and Water | | | | | | | | | | | | 1.0000 | (303a) |
| Factor for control and charging method (Table 4c(3)) for space heating | | | | | | | | | | | | 1.0000 | (305) |
| Factor for charging method (Table 4c(3)) for water heating | | | | | | | | | | | | 1.0000 | (305a) |
| Distribution loss factor (Table 12c) for community heating system | | | | | | | | | | | | 2.0000 | (306) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 | (208) |
| Space heating: | | | | | | | | | | | | | |
| Space heating requirement | 555.2034 | 440.1436 | 370.7286 | 183.3830 | 49.3735 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 190.7756 | 382.6733 | 560.6711 | (98) |
| Space heat from Heat pump = (98) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 307a | 1110.4069 | 880.2872 | 741.4571 | 366.7660 | 98.7470 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 381.5512 | 765.3465 | 1121.3422 | |
| Space heating requirement | 1110.4069 | 880.2872 | 741.4571 | 366.7660 | 98.7470 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 381.5512 | 765.3465 | 1121.3422 | (307) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | | | | | | | | | | | 0.0000 | (308) |
| Space heating fuel for secondary/supplementary system | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (309) |
| Water heating | | | | | | | | | | | | | |
| Annual water heating requirement | 237.4587 | 210.1291 | 223.5955 | 201.7511 | 196.3885 | 174.3280 | 167.5774 | 180.4836 | 180.4670 | 202.7596 | 215.1201 | 236.9033 | (64) |
| Water heat from Heat pump = (64) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 310a | 474.9175 | 420.2583 | 447.1911 | 403.5023 | 392.7769 | 348.6560 | 335.1548 | 360.9673 | 360.9340 | 405.5191 | 430.2401 | 473.8066 | |
| Water heating fuel | 474.9175 | 420.2583 | 447.1911 | 403.5023 | 392.7769 | 348.6560 | 335.1548 | 360.9673 | 360.9340 | 405.5191 | 430.2401 | 473.8066 | (310) |
| Cooling System Energy Efficiency Ratio | | | | | | | | | | | | 2.6000 | (314) |
| Space coolin | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 7.7681 | 13.5190 | 9.1869 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (315) |
| Pumps and Fa | 19.0794 | 17.2330 | 19.0794 | 18.4640 | 19.0794 | 18.4640 | 19.0794 | 19.0794 | 18.4640 | 19.0794 | 18.4640 | 19.0794 | (331) |
| Lighting | 21.1859 | 16.9961 | 15.3031 | 11.2117 | 8.6603 | 7.0755 | 7.9002 | 10.2690 | 13.3384 | 17.5006 | 19.7669 | 21.7747 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333a)m | -4.7942 | -7.7869 | -12.9740 | -16.8588 | -20.1973 | -19.6217 | -19.3433 | -17.1746 | -13.7606 | -9.7405 | -5.5986 | -4.0219 | (333a) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335a) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (333b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335b) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - community heating | 5465.9042 | (307) |
| Space heating fuel - secondary | 0.0000 | (309) |
| Water heating fuel - community heating | 4853.9239 | (310) |
| Efficiency of water heater | 0.0000 | (311) |
| Electricity used for heat distribution | 54.6590 | (313) |
| Space cooling fuel | 30.4740 | (321) |
| | | |
| Electricity for pumps and fans: | | |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8820) | | |
| mechanical ventilation fans (SFP = 0.8820) | 224.6449 | (330a) |
| Total electricity for the above, kWh/year | 224.6449 | (331) |
| Electricity for lighting (calculated in Appendix L) | 170.9824 | (332) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -151.8726 | (333) |
| Wind generation | 0.0000 | (334) |
| Hydro-electric generation (Appendix N) | 0.0000 | (335a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (335) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (336) |
| Energy used | 0.0000 | (337) |
| Total delivered energy for all uses | 10594.0568 | (338) |

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12b. Carbon dioxide emissions - Community heating scheme

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (367) |
| Space and Water heating from Heat pump | 3685.6529 | 0.1557 | 303.9302 | (367) |
| Electrical energy for heat distribution (space & water) | 54.6590 | 0.0000 | 15.3448 | (372) |
| Overall CO2 factor for heat network | | | 0.0546 | (386) |
| Total CO2 associated with community systems | | | 563.3717 | (373) |
| Space and water heating | | | 563.3717 | (376) |
| Space cooling | 30.4740 | 0.1136 | 3.4617 | (377) |
| Pumps, fans and electric keep-hot | 224.6449 | 0.1387 | 31.1610 | (378) |
| Energy for lighting | 170.9824 | 0.1443 | 24.6780 | (379) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -151.8726 | 0.1318 | -20.0190 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -20.0190 | (380) |
| Total CO2, kg/year | | | 602.6535 | (383) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 8.6600 | (384) |

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13b. Primary energy - Community heating scheme

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| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (467a) |
| Space and Water heating from Heat pump | 3685.6529 | 1.5764 | 3077.3781 | (467) |
| Electrical energy for heat distribution (space & water) | 54.6590 | 0.0000 | 159.9778 | (472) |
| Overall CO2 factor for heat network | | | 0.5691 | (486) |
| Total CO2 associated with community systems | | | 5873.4720 | (473) |
| Space and water heating | | | 5873.4720 | (476) |
| Space cooling | 30.4740 | 1.4188 | 43.2366 | (477) |
| Pumps, fans and electric keep-hot | 224.6449 | 1.5128 | 339.8428 | (478) |
| Energy for lighting | 170.9824 | 1.5338 | 262.2586 | (479) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -151.8726 | 1.4870 | -225.8349 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -225.8349 | (480) |
| Total Primary energy kWh/year | | | 6292.9751 | (483) |
| Dwelling Primary energy Rate (DPER) | | | 90.4300 | (484) |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 69.5900 | (1b) x | 3.0000 | (2b) = | 208.7700 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 69.5900 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | | 208.7700 | (5) |

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2. Ventilation rate

---

m3 per hour

| | | | |
|---|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 | (6a) |
| Number of open flues | 0 * 20 = | 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | 2 * 10 = | 20.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |

| | | Air changes per hour | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 20.0000 / (5) = | 0.0958 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3458 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.3458 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.4409 | 0.4322 | 0.4236 | 0.3804 | 0.3717 | 0.3285 | 0.3285 | 0.3199 | 0.3458 | 0.3717 | 0.3890 | 0.4063 | (22b) |
| Effective ac | 0.5972 | 0.5934 | 0.5897 | 0.5723 | 0.5691 | 0.5540 | 0.5540 | 0.5512 | 0.5598 | 0.5691 | 0.5757 | 0.5825 | (25) |

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## 3. Heat losses and heat loss parameter

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| Element | Gross | Openings | NetArea | U-value | A x U | K-value | A x K | |
|---|---|---|---|---|---|---|---|---|
| | m2 | m2 | m2 | W/m2K | W/K | kJ/m2K | kJ/K | |
| Main dwelling | | | | | | | | |
| TER Opaque door | | | 1.8900 | 1.0000 | 1.8900 | | | (26) |
| TER Opening Type | | | 14.2200 | 1.1450 | 16.2824 | | | (27) |
| Heatloss Floor | | | 69.5900 | 0.1300 | 9.0467 | | | (28b) |
| External Walls | 125.2900 | 14.2200 | 111.0700 | 0.1800 | 19.9926 | | | (29a) |
| Wall to Communal Corridor | 30.8700 | 1.8900 | 28.9800 | 0.1800 | 5.2164 | | | (29a) |
| Total net area of external elements Aum(A, m2) | | | 225.7500 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 52.4281 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 15 | | | 22.0600 | 0.0000 | 0.0000 | | | (32) |

| | | |
|---|---|---|
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | 437.2258 | (35) |
| List of Thermal Bridges | | |

| K1 Element | Length | Psi-value | Total |
|---|---|---|---|
| E1 Steel lintel with perforated steel base plate | 7.3600 | 0.0500 | 0.3680 |
| E3 Sill | 1.0225 | 0.0500 | 0.0511 |
| E4 Jamb | 18.0200 | 0.0500 | 0.9010 |
| E7 Party floor between dwellings (in blocks of flats) | 15.0700 | 0.0700 | 1.0549 |
| E16 Corner (normal) | 9.0000 | 0.0900 | 0.8100 |
| E18 Party wall between dwellings | 3.0000 | 0.0600 | 0.1800 |
| E7 Party floor between dwellings (in blocks of flats) | 10.0250 | 0.0700 | 0.7018 |
| E17 Corner (inverted - internal area greater than external area) | 6.0000 | -0.0900 | -0.5400 |
| E23 Balcony within or between dwellings, balcony support penetrates wall insulation | 5.2870 | 0.0200 | 0.1057 |
| E15 Flat roof with parapet | 22.9115 | 0.5600 | 12.8304 |
| E24 Eaves (insulation at ceiling level - inverted) | 14.5775 | 0.2400 | 3.4986 |

| | | |
|---|---|---|
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | 19.9616 | (36) |
| Point Thermal bridges | (36a) = 0.0000 | |
| Total fabric heat loss | (33) + (36) + (36a) = 72.3897 | (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 41.1431 | 40.8831 | 40.6282 | 39.4311 | 39.2072 | 38.1645 | 38.1645 | 37.9714 | 38.5661 | 39.2072 | 39.6603 | 40.1340 | (38) |
| Heat transfer coeff | 113.5328 | 113.2728 | 113.0179 | 111.8208 | 111.5969 | 110.5542 | 110.5542 | 110.3611 | 110.9558 | 111.5969 | 112.0500 | 112.5236 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 111.8198 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.6315 | 1.6277 | 1.6241 | 1.6069 | 1.6036 | 1.5887 | 1.5887 | 1.5859 | 1.5944 | 1.6036 | 1.6101 | 1.6170 | (40) |
| HLP (average) | | | | | | | | | | | | 1.6068 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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## 4. Water heating energy requirements (kWh/year)

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| | | |
|---|---|---|
| Assumed occupancy | 2.2361 | (42) |

Hot water usage for mixer showers

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 61.7122 | 60.7848 | 59.4333 | 56.8476 | 54.9395 | 52.8115 | 51.6019 | 52.9431 | 54.4133 | 56.6981 | 59.3394 | 61.4757 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 26.6615 | 26.2655 | 25.7079 | 24.6798 | 23.9100 | 23.0564 | 22.5953 | 23.1490 | 23.7519 | 24.6653 | 25.7145 | 26.5714 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 37.5302 | 36.1655 | 34.8007 | 33.4360 | 32.0713 | 30.7065 | 30.7065 | 32.0713 | 33.4360 | 34.8007 | 36.1655 | 37.5302 | (42c) |

| | | |
|---|---|---|
| Average daily hot water use (litres/day) | 115.7343 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 125.9039 | 123.2158 | 119.9420 | 114.9635 | 110.9207 | 106.5744 | 104.9037 | 108.1634 | 111.6012 | 116.1641 | 121.2194 | 125.5773 | (44) |
| Energy conte | 199.4010 | 175.4576 | 184.3464 | 157.3792 | 149.3206 | 131.0456 | 126.8720 | 133.9288 | 137.6154 | 157.6336 | 172.6992 | 196.6237 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1922.3232 | |

Distribution loss (46)m = 0.15 x (45)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 29.9101 | 26.3186 | 27.6520 | 23.6069 | 22.3981 | 19.6568 | 19.0308 | 20.0893 | 20.6423 | 23.6450 | 25.9049 | 29.4936 | (46) |

| | | |
|---|---|---|
| Water storage loss: | | |
| Store volume | 150.0000 | (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | 1.3938 | (48) |
| Temperature factor from Table 2b | 0.5400 | (49) |
| Enter (49) or (54) in (55) | 0.7527 | (55) |

Total storage loss

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (56) |

If cylinder contains dedicated solar storage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (57) |
| Primary loss 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |

Total heat required for water heating calculated for each month

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 245.9959 | 217.5433 | 230.9413 | 202.4711 | 195.9155 | 176.1375 | 173.4669 | 180.5237 | 182.7072 | 204.2285 | 217.7911 | 243.2186 | (62) |
| WWHRS | -28.2122 | -24.9511 | -26.1274 | -21.6345 | -20.1626 | -17.2533 | -16.1722 | -17.1975 | -17.8509 | -21.0442 | -23.8406 | -27.6898 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | | | | | | | | | | | | | |
| | 217.7836 | 192.5922 | 204.8139 | 180.8366 | 175.7529 | 158.8842 | 157.2947 | 163.3262 | 164.8563 | 183.1843 | 193.9505 | 215.5288 | (64) |
| | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | | 2208.8043 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2209 | (64) |
| Electric shower(s) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | | | | | | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | | | | | | | | | | | | | |
| | 103.5767 | 92.0082 | 98.5711 | 88.4021 | 86.9250 | 79.6461 | 79.4609 | 81.8073 | 81.8306 | 89.6891 | 93.4960 | 102.6533 | (65) |

## 5. Internal gains (see Table 5 and 5a)

| Metabolic gains (Table 5), Watts | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 111.8065 | 111.8065 | 111.8065 | 111.8065 | 111.8065 | 111.8065 | 111.8065 | 111.8065 | 111.8065 | 111.8065 | 111.8065 | 111.8065 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 99.5197 | 110.1825 | 99.5197 | 102.8370 | 99.5197 | 102.8370 | 99.5197 | 99.5197 | 102.8370 | 99.5197 | 102.8370 | 99.5197 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 196.3383 | 198.3756 | 193.2415 | 182.3116 | 168.5145 | 155.5472 | 146.8842 | 144.8468 | 149.9810 | 160.9109 | 174.7080 | 187.6753 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 34.1806 | 34.1806 | 34.1806 | 34.1806 | 34.1806 | 34.1806 | 34.1806 | 34.1806 | 34.1806 | 34.1806 | 34.1806 | 34.1806 | (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.0000 | 3.0000 | 3.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | | | | | | | | | | | | | |
| | -89.4452 | -89.4452 | -89.4452 | -89.4452 | -89.4452 | -89.4452 | -89.4452 | -89.4452 | -89.4452 | -89.4452 | -89.4452 | -89.4452 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 139.2161 | 136.9170 | 132.4880 | 122.7807 | 116.8347 | 110.6196 | 106.8022 | 109.9560 | 113.6536 | 120.5499 | 129.8555 | 137.9749 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 494.6159 | 505.0171 | 484.7912 | 467.4712 | 444.4108 | 425.5458 | 409.7481 | 410.8644 | 423.0135 | 440.5224 | 466.9424 | 484.7118 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Northeast | 3.9900 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 13.7584 | (75) |
| Northwest | 10.2300 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 35.2752 | (81) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 49.0336 | 99.8093 | 179.8246 | 295.3237 | 396.9730 | 423.2152 | 395.9092 | 315.6234 | 219.1191 | 121.9749 | 61.6970 | 40.0433 | (83) |
| Total gains | 543.6495 | 604.8264 | 664.6158 | 762.7949 | 841.3838 | 848.7610 | 805.6572 | 726.4878 | 642.1326 | 562.4973 | 528.6394 | 524.7551 | (84) |

## 7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, ni1,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 74.4438 | 74.6147 | 74.7830 | 75.5836 | 75.7353 | 76.4495 | 76.4495 | 76.5833 | 76.1728 | 75.7353 | 75.4290 | 75.1115 | |
| alpha | 5.9629 | 5.9743 | 5.9855 | 6.0389 | 6.0490 | 6.0966 | 6.0966 | 6.1056 | 6.0782 | 6.0490 | 6.0286 | 6.0074 | |
| util living area | | | | | | | | | | | | | |
| | 0.9996 | 0.9991 | 0.9973 | 0.9861 | 0.9311 | 0.7706 | 0.5924 | 0.6732 | 0.9222 | 0.9935 | 0.9990 | 0.9997 | (86) |
| MIT | 19.7596 | 19.8813 | 20.1043 | 20.4475 | 20.7660 | 20.9507 | 20.9916 | 20.9829 | 20.8403 | 20.4465 | 20.0538 | 19.7455 | (87) |
| Th 2 | 19.5904 | 19.5931 | 19.5957 | 19.6083 | 19.6107 | 19.6217 | 19.6217 | 19.6237 | 19.6174 | 19.6107 | 19.6059 | 19.6009 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9993 | 0.9985 | 0.9954 | 0.9751 | 0.8779 | 0.6362 | 0.4135 | 0.4865 | 0.8374 | 0.9867 | 0.9983 | 0.9995 | (89) |
| MIT 2 | 18.1869 | 18.3447 | 18.6318 | 19.0731 | 19.4405 | 19.6037 | 19.6206 | 19.6209 | 19.5295 | 19.0789 | 18.5755 | 18.1766 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.5226 | (91) |
| MIT | 19.0088 | 19.1478 | 19.4014 | 19.7914 | 20.1332 | 20.3077 | 20.3371 | 20.3327 | 20.2146 | 19.7936 | 19.3481 | 18.9965 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.0088 | 19.1478 | 19.4014 | 19.7914 | 20.1332 | 20.3077 | 20.3371 | 20.3327 | 20.2146 | 19.7936 | 19.3481 | 18.9965 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9992 | 0.9982 | 0.9950 | 0.9770 | 0.9014 | 0.7078 | 0.5085 | 0.5868 | 0.8812 | 0.9879 | 0.9980 | 0.9993 | (94) |
| Useful gains | 543.1943 | 603.7508 | 661.3214 | 745.2467 | 758.4529 | 600.7555 | 409.6908 | 426.2975 | 565.8526 | 555.6984 | 527.6051 | 524.4058 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | | | | | | | | | | | | | |
| | 1669.9352 | 1613.8850 | 1458.0874 | 1217.8864 | 941.1237 | 631.0085 | 413.1530 | 434.0199 | 678.4465 | 1025.9793 | 1372.4033 | 1664.9617 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 838.2952 | 678.8102 | 592.7939 | 340.3006 | 135.9071 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 349.8890 | 608.2547 | 848.5736 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 4392.8243 | |
| Solar heating kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | | | | | | | | | | | | | |
| | 838.2952 | 678.8102 | 592.7939 | 340.3006 | 135.9071 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 349.8890 | 608.2547 | 848.5736 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 4392.8243 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 63.1244 | (99) |

## 9a. Energy requirements - Individual heating systems, including micro-CHP

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | 0.0000 | (201) |
| Fraction of space heat from main system(s) | | | | | | | | | | | | 1.0000 | (202) |
| Efficiency of main space heating system 1 (in %) | | | | | | | | | | | | 92.3000 | (206) |
| Efficiency of main space heating system 2 (in %) | | | | | | | | | | | | 0.0000 | (207) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 | (208) |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement | | | | | | | | | | | | | |
| | 838.2952 | 678.8102 | 592.7939 | 340.3006 | 135.9071 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 349.8890 | 608.2547 | 848.5736 | (98) |
| Space heating efficiency (main heating system 1) | | | | | | | | | | | | | |
| | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.3000 | 92.3000 | 92.3000 | (210) |
| Space heating fuel (main heating system) | | | | | | | | | | | | | |
| | 908.2289 | 735.4390 | 642.2469 | 368.6897 | 147.2449 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 379.0780 | 658.9975 | 919.3647 | (211) |
| Space heating efficiency (main heating system 2) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (212) |
| Space heating fuel (main heating system 2) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (213) |
| Space heating fuel (secondary) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (215) |
| | | | | | | | | | | | | | |
| Water heating | | | | | | | | | | | | | |
| Water heating requirement | | | | | | | | | | | | | |
| | 217.7836 | 192.5922 | 204.8139 | 180.8366 | 175.7529 | 158.8842 | 157.2947 | 163.3262 | 164.8563 | 183.1843 | 193.9505 | 215.5288 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 | (216) |
| (217)m | 86.7817 | 86.6404 | 86.3007 | 85.4556 | 83.4900 | 79.8000 | 79.8000 | 79.8000 | 79.8000 | 85.4869 | 86.4429 | 86.8168 | (217) |
| Fuel for water heating, kWh/month | | | | | | | | | | | | | |
| | 250.9559 | 222.2892 | 237.3260 | 211.6146 | 210.5078 | 199.1030 | 197.1111 | 204.6695 | 206.5869 | 214.2836 | 224.3683 | 248.2570 | (219) |
| Space cooling fuel requirement | | | | | | | | | | | | | |
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (221) |
| Pumps and Fa | 7.3041 | 6.5973 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | (231) |
| Lighting | 20.6782 | 16.5888 | 14.9364 | 10.9431 | 8.4527 | 6.9060 | 7.7109 | 10.0229 | 13.0187 | 17.0813 | 19.2932 | 21.2529 | (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233a)m | -15.4331 | -23.1514 | -35.3846 | -42.3879 | -48.0217 | -45.6783 | -45.1242 | -41.4429 | -35.3717 | -27.5928 | -17.4551 | -13.1855 | (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233b)m | -4.9456 | -10.6839 | -21.7681 | -33.4934 | -45.0806 | -45.5867 | -45.0490 | -37.7753 | -27.2118 | -15.5346 | -6.6837 | -3.8902 | (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235d) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - main system 1 | 4759.2896 | (211) |
| Space heating fuel - main system 2 | 0.0000 | (213) |
| Space heating fuel - secondary | 0.0000 | (215) |
| Efficiency of water heater | 79.8000 | |
| Water heating fuel used | 2627.0728 | (219) |
| Space cooling fuel | 0.0000 | (221) |
| | | |
| Electricity for pumps and fans: | | |
| Total electricity for the above, kWh/year | 86.0000 | (231) |
| Electricity for lighting (calculated in Appendix L) | 166.8851 | (232) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -687.9320 | (233) |
| Wind generation | 0.0000 | (234) |
| Hydro-electric generation (Appendix N) | 0.0000 | (235a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (235) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (236) |
| Energy used | 0.0000 | (237) |
| Total delivered energy for all uses | 6951.3155 | (238) |

---

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

---

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 4759.2896 | 0.2100 | 999.4508 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2627.0728 | 0.2100 | 551.6853 | (264) |
| Space and water heating | | | 1551.1361 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 166.8851 | 0.1443 | 24.0867 | (268) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -390.2292 | 0.1333 | -52.0187 | |
| PV Unit electricity exported | -297.7028 | 0.1252 | -37.2714 | |
| Total | | | -89.2901 | (269) |
| Total CO2, kg/year | | | 1497.8620 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 21.5200 | (273) |

---

13a. Primary energy - Individual heating systems including micro-CHP

---

| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 4759.2896 | 1.1300 | 5377.9972 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2627.0728 | 1.1300 | 2968.5923 | (278) |
| Space and water heating | | | 8346.5895 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 166.8851 | 1.5338 | 255.9740 | (282) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -390.2292 | 1.4926 | -582.4529 | |
| PV Unit electricity exported | -297.7028 | 0.4595 | -136.8015 | |
| Total | | | -719.2544 | (283) |
| Total Primary energy kWh/year | | | 8013.4098 | (286) |
| Target Primary Energy Rate (TPER) | | | 115.1500 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Property Reference** | Unit 33 | **Issued on Date** | 17/05/2025 |
| **Assessment Reference** | 00001 | **Prop Type Ref** | Unit 33 |
| **Property** | | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 77 C | **DER** | 6.62 | **TER** | 16.21 |
| **Environmental** | 95 A | **% DER < TER** | | | 59.16 |
| **$CO_2$ Emissions (t/year)** | 0.3 | **DFEE** | 38.86 | **TFEE** | 40.46 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 3.96 |
| **% DPER < TPER** | 19.01 | **DPER** | 70.34 | **TPER** | 86.85 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Robert Arnold | **Assessor ID** | BA04-0001 |
| **Client** | | | |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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## 1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 51.0700 | (1b) | x 3.0000 | (2b) = | 153.2100 | (1b) - (3b) (4) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 51.0700 | | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | 153.2100 | (5) |

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## 2. Ventilation rate

---

| | m3 per hour | |
|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 (6a) |
| Number of open flues | 0 * 20 = | 0.0000 (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 (6f) |
| Number of intermittent extract fans | 0 * 10 = | 0.0000 (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 (7c) |

| | Air changes per hour | |
|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 0.0000 / (5) = | 0.0000 (8) |
| Pressure test | | Yes |
| Pressure Test Method | | Blower Door |
| Measured/design AP50 | | 3.0000 (17) |
| Infiltration rate | | 0.1500 (18) |
| Number of sides sheltered | | 0 (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.1500 (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.1912 | 0.1875 | 0.1837 | 0.1650 | 0.1612 | 0.1425 | 0.1425 | 0.1388 | 0.1500 | 0.1612 | 0.1687 | 0.1762 | (22b) |

Balanced mechanical ventilation with heat recovery

| | | |
|---|---|---|
| If mechanical ventilation | | 0.5000 (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | | 0.5000 (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | | 81.0000 (23c) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective ac | 0.2862 | 0.2825 | 0.2787 | 0.2600 | 0.2562 | 0.2375 | 0.2375 | 0.2337 | 0.2450 | 0.2562 | 0.2637 | 0.2712 | (25) |

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## 3. Heat losses and heat loss parameter

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| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| Windows | | | 12.5700 | 1.0536 | 13.2443 | | | (27) |
| Door | | | 1.8900 | 1.4000 | 2.6460 | | | (26) |
| Glass Door | | | 2.4000 | 1.3258 | 3.1818 | | | (27) |
| External Walls | 48.2000 | 14.9700 | 33.2300 | 0.1500 | 4.9845 | 150.0000 | 4984.5000 | (29a) |
| Wall to Communal Corridor | 21.2200 | 1.8900 | 19.3300 | 0.1400 | 2.7062 | 150.0000 | 2899.5000 | (29a) |
| External Roof | 2.1300 | | 2.1300 | 0.1000 | 0.2130 | 9.0000 | 19.1700 | (30) |
| Total net area of external elements Aum(A, m2) | | | 71.5500 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 26.9758 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 16 | | | 20.1300 | 0.0000 | 0.0000 | 110.0000 | 2214.3000 | (32) |
| Party Floor | | | 51.0700 | | | 80.0000 | 4085.6000 | (32d) |
| Party Ceiling | | | 47.1500 | | | 100.0000 | 4715.0000 | (32b) |
| Internal Walls | | | 105.2400 | | | 9.0000 | 947.1600 | (32c) |

| | | |
|---|---|---|
| Heat capacity Cm = Sum(A x k) | (28)...(30) + (32) + (32a)...(32e) = | 19865.2300 (34) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 388.9804 (35)

List of Thermal Bridges

| | K1 Element | Length | Psi-value | Total |
|---|---|---|---|---|
| E1 | Steel lintel with perforated steel base plate | 7.4700 | 0.0500 | 0.3735 |
| E3 | Sill | 3.6200 | 0.0500 | 0.1810 |
| E4 | Jamb | 15.9800 | 0.0500 | 0.7990 |
| E7 | Party floor between dwellings (in blocks of flats) | 10.9800 | 0.0350 | 0.3843 |
| E16 | Corner (normal) | 6.0000 | 0.0900 | 0.5400 |
| E17 | Corner (inverted - internal area greater than external area) | 3.0000 | -0.0900 | -0.2700 |
| E7 | Party floor between dwellings (in blocks of flats) | 7.0750 | 0.0350 | 0.2476 |
| E23 | Balcony within or between dwellings, balcony support penetrates wall insulation | 5.0750 | 0.0200 | 0.1015 |
| E25 | Staggered party wall between dwellings | 3.0000 | 0.0600 | 0.1800 |
| E15 | Flat roof with parapet | 3.8175 | 0.5600 | 2.1378 |
| E24 | Eaves (insulation at ceiling level - inverted) | 7.0875 | 0.1200 | 0.8505 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 5.5252 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 32.5010 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 14.4726 | 14.2830 | 14.0934 | 13.1454 | 12.9558 | 12.0078 | 12.0078 | 11.8182 | 12.3870 | 12.9558 | 13.3350 | 13.7142 | (38) |
| Heat transfer coeff | 46.9736 | 46.7840 | 46.5944 | 45.6464 | 45.4568 | 44.5088 | 44.5088 | 44.3192 | 44.8880 | 45.4568 | 45.8360 | 46.2152 | (39) |

Average = Sum(39)m / 12 = 45.5990

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 0.9198 | 0.9161 | 0.9124 | 0.8938 | 0.8901 | 0.8715 | 0.8715 | 0.8678 | 0.8790 | 0.8901 | 0.8975 | 0.9049 | (40) |
| HLP (average) | | | | | | | | | | | | 0.8929 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

## 4. Water heating energy requirements (kWh/year)

Assumed occupancy 1.7216 (42)

Hot water usage for mixer showers

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 51.7445 | 50.9523 | 49.7848 | 47.9888 | 46.3796 | 44.1284 | 42.3478 | 44.4294 | 45.4763 | 47.7061 | 50.0281 | 51.6978 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 22.4401 | 22.1014 | 21.6195 | 20.8978 | 20.2474 | 19.3521 | 18.6728 | 19.5034 | 19.9394 | 20.8265 | 21.7489 | 22.4223 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.2613 | 31.0881 | 29.9150 | 28.7419 | 27.5687 | 26.3956 | 26.3956 | 27.5687 | 28.7419 | 29.9150 | 31.0881 | 32.2613 | (42c) |

Average daily hot water use (litres/day) 97.8401 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 106.4459 | 104.1418 | 101.3193 | 97.6284 | 94.1957 | 89.8760 | 87.4162 | 91.5015 | 94.1576 | 98.4476 | 102.8651 | 106.3814 | (44) |
| Energy conte | 156.7067 | 137.8006 | 144.7831 | 127.5271 | 121.3807 | 103.9386 | 96.5974 | 107.6990 | 109.2181 | 126.8597 | 139.0257 | 156.2289 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1527.7657 | |
| Distribution loss (46)m = 0.15 x (45)m | 23.5060 | 20.6701 | 21.7175 | 19.1291 | 18.2071 | 15.5908 | 14.4896 | 16.1548 | 16.3827 | 19.0289 | 20.8539 | 23.4343 | (46) |

Water storage loss:

Store volume 110.0000 (47)

b) If manufacturer declared loss factor is not known :

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.0152 (51)

Volume factor from Table 2a 1.0294 (52)

Temperature factor from Table 2b 0.6000 (53)

Enter (49) or (54) in (55) 1.0327 (55)

Total storage loss

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (56) |

If cylinder contains dedicated solar storage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (57) |
| Primary loss 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |

Total heat required for water heating calculated for each month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 211.9835 | 187.7281 | 200.0599 | 181.0208 | 176.6575 | 157.4323 | 151.8743 | 162.9758 | 162.7117 | 182.1365 | 192.5194 | 211.5057 | (62) |
| WWHRS 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63a) |
| PV diverter -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | | | | | | | | | | | | | |
| 211.9835 | 187.7281 | 200.0599 | 181.0208 | 176.6575 | 157.4323 | 151.8743 | 162.9758 | 162.7117 | 182.1365 | 192.5194 | 211.5057 | (64) |
| | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | | 2178.6055 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | 2179 | (64) | |

Electric shower(s)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)

Heat gains from water heating, kWh/month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 96.3264 | 85.7607 | 92.3618 | 85.1977 | 84.5805 | 77.3545 | 76.3401 | 80.0314 | 79.1099 | 86.4023 | 89.0210 | 96.1676 | (65) |

## 5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 86.0818 | 86.0818 | 86.0818 | 86.0818 | 86.0818 | 86.0818 | 86.0818 | 86.0818 | 86.0818 | 86.0818 | 86.0818 | 86.0818 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 75.6641 | 83.7710 | 75.6641 | 78.1862 | 75.6641 | 78.1862 | 75.6641 | 75.6641 | 78.1862 | 75.6641 | 78.1862 | 75.6641 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 150.0125 | 151.5692 | 147.6465 | 139.2954 | 128.7537 | 118.8460 | 112.2271 | 110.6704 | 114.5932 | 122.9442 | 133.4859 | 143.3936 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 31.6082 | 31.6082 | 31.6082 | 31.6082 | 31.6082 | 31.6082 | 31.6082 | 31.6082 | 31.6082 | 31.6082 | 31.6082 | 31.6082 | (69) |
| Pumps, fans 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (70) | |
| Losses e.g. evaporation (negative values) (Table 5) | -68.8654 | -68.8654 | -68.8654 | -68.8654 | -68.8654 | -68.8654 | -68.8654 | -68.8654 | -68.8654 | -68.8654 | -68.8654 | -68.8654 | (71) |
| Water heating gains (Table 5) | 129.4710 | 127.6200 | 124.1423 | 118.3302 | 113.6835 | 107.4369 | 102.6077 | 107.5690 | 109.8749 | 116.1321 | 123.6403 | 129.2575 | (72) |
| Total internal gains | 403.9722 | 411.7847 | 396.2773 | 384.6363 | 366.9259 | 353.2937 | 339.3234 | 342.7281 | 351.4788 | 363.5649 | 384.1369 | 397.1397 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W |
|---|---|---|---|---|---|---|

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northeast | | | 6.2800 | | 11.2829 | | 0.4500 | 0.7000 | | 0.7700 | | 15.4677 | (75) |
| Southeast | | | 6.2900 | | 36.7938 | | 0.4500 | 0.7000 | | 0.7700 | | 50.5207 | (77) |
| Southeast | | | 2.4000 | | 36.7938 | | 0.4500 | 0.7000 | | 0.7700 | | 19.2766 | (77) |
| Solar gains | 85.2650 | 150.3756 | 219.3972 | 294.7178 | 350.9869 | 357.6325 | 340.9740 | 297.5907 | 245.2600 | 169.8766 | 103.0634 | 72.3636 | (83) |
| Total gains | 489.2372 | 562.1603 | 615.6745 | 679.3542 | 717.9128 | 710.9261 | 680.2974 | 640.3188 | 596.7389 | 533.4415 | 487.2003 | 469.5033 | (84) |

7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, ni1,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 117.4728 | 117.9489 | 118.4288 | 120.8883 | 121.3926 | 123.9781 | 123.9781 | 124.5085 | 122.9308 | 121.3926 | 120.3883 | 119.4005 | |
| alpha | 8.8315 | 8.8633 | 8.8953 | 9.0592 | 9.0928 | 9.2652 | 9.2652 | 9.3006 | 9.1954 | 9.0928 | 9.0259 | 8.9600 | |
| util living area | 0.9941 | 0.9799 | 0.9354 | 0.7864 | 0.5869 | 0.4006 | 0.2879 | 0.3184 | 0.5184 | 0.8385 | 0.9776 | 0.9956 | (86) |
| MIT | 20.5523 | 20.6959 | 20.8501 | 20.9727 | 20.9979 | 20.9999 | 21.0000 | 21.0000 | 20.9995 | 20.9616 | 20.7577 | 20.5350 | (87) |
| Th 2 | 20.1507 | 20.1539 | 20.1570 | 20.1728 | 20.1759 | 20.1918 | 20.1918 | 20.1949 | 20.1854 | 20.1759 | 20.1696 | 20.1633 | (88) |
| util rest of house | 0.9915 | 0.9717 | 0.9131 | 0.7416 | 0.5358 | 0.3501 | 0.2350 | 0.2627 | 0.4576 | 0.7889 | 0.9669 | 0.9936 | (89) |
| MIT 2 | 19.6506 | 19.8311 | 20.0140 | 20.1520 | 20.1747 | 20.1918 | 20.1918 | 20.1949 | 20.1852 | 20.1479 | 19.9223 | 19.6395 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.6524 | (91) |
| MIT | 20.2389 | 20.3953 | 20.5595 | 20.6875 | 20.7118 | 20.7190 | 20.7191 | 20.7202 | 20.7165 | 20.6788 | 20.4673 | 20.2238 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 20.2389 | 20.3953 | 20.5595 | 20.6875 | 20.7118 | 20.7190 | 20.7191 | 20.7202 | 20.7165 | 20.6788 | 20.4673 | 20.2238 | (93) |

8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9918 | 0.9743 | 0.9245 | 0.7700 | 0.5691 | 0.3831 | 0.2695 | 0.2990 | 0.4973 | 0.8201 | 0.9712 | 0.9938 | (94) |
| Useful gains | 485.2195 | 547.7330 | 569.1890 | 523.0880 | 408.5721 | 272.3285 | 183.3351 | 191.4657 | 296.7556 | 437.4908 | 473.1845 | 466.5758 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | 748.7066 | 724.9342 | 655.0937 | 538.0567 | 409.6466 | 272.3517 | 183.3358 | 191.4675 | 296.9997 | 458.1508 | 612.7060 | 740.5428 | (97) |
| Space heating kWh | 196.0344 | 119.0792 | 63.9131 | 10.7775 | 0.7994 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 15.3710 | 100.4555 | 203.8314 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 710.2615 | |
| Solar heating kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | 196.0344 | 119.0792 | 63.9131 | 10.7775 | 0.7994 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 15.3710 | 100.4555 | 203.8314 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 710.2615 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 13.9076 | (99) |

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ext. temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | |
| Heat loss rate W | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 418.3830 | 329.3653 | 336.8262 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (100) |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.9987 | 0.9997 | 0.9995 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (101) |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 417.8377 | 329.2814 | 336.6542 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (102) |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 790.0829 | 756.3683 | 710.1672 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 268.0166 | 317.7527 | 277.8937 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (104) |
| Cooled fraction | | | | | | | | | | fC = cooled area / (4) = | | 0.9986 | (105) |
| Intermittency factor (Table 10b) | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | (106) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 66.9123 | 79.3293 | 69.3782 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) |
| Space cooling requirement | | | | | | | | | | | | 215.6198 | (107) |

9b. Energy requirements

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | 0.0000 | (301) |
| Fraction of space heat from community system | | | | | | | | | | | | 1.0000 | (302) |
| Fraction of heat from community Heat pump-Space and Water | | | | | | | | | | | | 1.0000 | (303a) |
| Factor for control and charging method (Table 4c(3)) for space heating | | | | | | | | | | | | 1.0000 | (305) |
| Factor for charging method (Table 4c(3)) for water heating | | | | | | | | | | | | 1.0000 | (305a) |
| Distribution loss factor (Table 12c) for community heating system | | | | | | | | | | | | 2.0000 | (306) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 | (208) |
| Space heating: | | | | | | | | | | | | | |
| Space heating requirement | 196.0344 | 119.0792 | 63.9131 | 10.7775 | 0.7994 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 15.3710 | 100.4555 | 203.8314 | (98) |
| Space heat from Heat pump = (98) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 307a | 392.0688 | 238.1584 | 127.8261 | 21.5550 | 1.5988 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 30.7421 | 200.9109 | 407.6628 | |
| Space heating requirement | 392.0688 | 238.1584 | 127.8261 | 21.5550 | 1.5988 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 30.7421 | 200.9109 | 407.6628 | (307) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | | | | | | | | | | | 0.0000 | (308) |
| Space heating fuel for secondary/supplementary system | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (309) |
| Water heating | | | | | | | | | | | | | |
| Annual water heating requirement | 211.9835 | 187.7281 | 200.0599 | 181.0208 | 176.6575 | 157.4323 | 151.8743 | 162.9758 | 162.7117 | 182.1365 | 192.5194 | 211.5057 | (64) |
| Water heat from Heat pump = (64) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 310a | 423.9670 | 375.4562 | 400.1199 | 362.0416 | 353.3151 | 314.8646 | 303.7485 | 325.9516 | 325.4235 | 364.2729 | 385.0387 | 423.0114 | |
| Water heating fuel | 423.9670 | 375.4562 | 400.1199 | 362.0416 | 353.3151 | 314.8646 | 303.7485 | 325.9516 | 325.4235 | 364.2729 | 385.0387 | 423.0114 | (310) |
| Cooling System Energy Efficiency Ratio | | | | | | | | | | | | 2.6000 | (314) |
| Space coolin | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 25.7355 | 30.5113 | 26.6839 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (315) |
| Pumps and Fa | 14.0018 | 12.6468 | 14.0018 | 13.5501 | 14.0018 | 13.5501 | 14.0018 | 14.0018 | 13.5501 | 14.0018 | 13.5501 | 14.0018 | (331) |
| Lighting | 14.6289 | 11.7359 | 10.5669 | 7.7417 | 5.9799 | 4.8857 | 5.4551 | 7.0907 | 9.2102 | 12.0843 | 13.6491 | 15.0355 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (333a)m | -4.6980 | -7.5717 | -12.5158 | -16.1309 | -19.2069 | -18.6199 | -18.3590 | -16.3584 | -13.1869 | -9.4248 | -5.4678 | -3.9472 | (333a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335a) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (333b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335b) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - community heating | 1420.5230 | (307) |
| Space heating fuel - secondary | 0.0000 | (309) |
| Water heating fuel - community heating | 4357.2110 | (310) |
| Efficiency of water heater | 0.0000 | (311) |
| Electricity used for heat distribution | 14.2052 | (313) |
| Space cooling fuel | 82.9307 | (321) |
| | | |
| Electricity for pumps and fans: | | |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8820) | | |
| mechanical ventilation fans (SFP = 0.8820) | 164.8601 | (330a) |
| Total electricity for the above, kWh/year | 164.8601 | (331) |
| Electricity for lighting (calculated in Appendix L) | 118.0640 | (332) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -145.4873 | (333) |
| Wind generation | 0.0000 | (334) |
| Hydro-electric generation (Appendix N) | 0.0000 | (335a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (335) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (336) |
| Energy used | 0.0000 | (337) |
| Total delivered energy for all uses | 5998.1014 | (338) |

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12b. Carbon dioxide emissions - Community heating scheme

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (367) |
| Space and Water heating from Heat pump | 2063.4764 | 0.1590 | 80.6539 | (367) |
| Electrical energy for heat distribution (space & water) | 14.2052 | 0.0000 | 8.3898 | (372) |
| Overall CO2 factor for heat network | | | 0.0533 | (386) |
| Total CO2 associated with community systems | | | 308.0252 | (373) |
| Space and water heating | | | 308.0252 | (376) |
| Space cooling | 82.9307 | 0.1141 | 9.4636 | (377) |
| Pumps, fans and electric keep-hot | 164.8601 | 0.1387 | 22.8681 | (378) |
| Energy for lighting | 118.0640 | 0.1443 | 17.0403 | (379) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -145.4873 | 0.1320 | -19.1982 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -19.1982 | (380) |
| Total CO2, kg/year | | | 338.1991 | (383) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 6.6200 | (384) |

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13b. Primary energy - Community heating scheme

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| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (467a) |
| Space and Water heating from Heat pump | 2063.4764 | 1.5884 | 805.8625 | (467) |
| Electrical energy for heat distribution (space & water) | 14.2052 | 0.0000 | 88.8078 | (472) |
| Overall CO2 factor for heat network | | | 0.5643 | (486) |
| Total CO2 associated with community systems | | | 3260.5163 | (473) |
| Space and water heating | | | 3260.5163 | (476) |
| Space cooling | 82.9307 | 1.4206 | 117.8101 | (477) |
| Pumps, fans and electric keep-hot | 164.8601 | 1.5128 | 249.4003 | (478) |
| Energy for lighting | 118.0640 | 1.5338 | 181.0905 | (479) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -145.4873 | 1.4875 | -216.4184 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -216.4184 | (480) |
| Total Primary energy kWh/year | | | 3592.3988 | (483) |
| Dwelling Primary energy Rate (DPER) | | | 70.3400 | (484) |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 51.0700 | (1b) | x 3.0000 | (2b) = | 153.2100 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 51.0700 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = | 153.2100 | (5) |

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2. Ventilation rate

---

| | | | |
|---|---|---|---|
| | | m3 per hour | |
| Number of open chimneys | 0 * 80 = | 0.0000 | (6a) |
| Number of open flues | 0 * 20 = | 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | 2 * 10 = | 20.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |
| | | Air changes per hour | |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 20.0000 / (5) = | 0.1305 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3805 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.3805 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.4852 | 0.4757 | 0.4662 | 0.4186 | 0.4091 | 0.3615 | 0.3615 | 0.3520 | 0.3805 | 0.4091 | 0.4281 | 0.4471 | (22b) |
| Effective ac | 0.6177 | 0.6131 | 0.6087 | 0.5876 | 0.5837 | 0.5653 | 0.5653 | 0.5620 | 0.5724 | 0.5837 | 0.5916 | 0.6000 | (25) |

## 3. Heat losses and heat loss parameter

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| TER Opaque door | | | 1.8900 | 1.0000 | 1.8900 | | | (26) |
| TER Opening Type | | | 10.8700 | 1.1450 | 12.4466 | | | (27) |
| External Walls | 48.2000 | 10.8700 | 37.3300 | 0.1800 | 6.7194 | | | (29a) |
| Wall to Communal Corridor | 21.2200 | 1.8900 | 19.3300 | 0.1800 | 3.4794 | | | (29a) |
| External Roof | 2.1300 | | 2.1300 | 0.1100 | 0.2343 | | | (30) |
| Total net area of external elements Aum(A, m2) | | | 71.5500 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 24.7697 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 16 | | | 20.1300 | 0.0000 | 0.0000 | | | (32) |

| | | |
|---|---|---|
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | 370.5156 | (35) |
| List of Thermal Bridges | | |

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E1 Steel lintel with perforated steel base plate | 7.4700 | 0.0500 | 0.3735 |
| E3 Sill | 3.6200 | 0.0500 | 0.1810 |
| E4 Jamb | 15.9800 | 0.0500 | 0.7990 |
| E7 Party floor between dwellings (in blocks of flats) | 10.9800 | 0.0700 | 0.7686 |
| E16 Corner (normal) | 6.0000 | 0.0900 | 0.5400 |
| E17 Corner (inverted - internal area greater than external area) | 3.0000 | -0.0900 | -0.2700 |
| E7 Party floor between dwellings (in blocks of flats) | 7.0750 | 0.0700 | 0.4953 |
| E23 Balcony within or between dwellings, balcony support penetrates wall insulation | 5.0750 | 0.0200 | 0.1015 |
| E25 Staggered party wall between dwellings | 3.0000 | 0.0600 | 0.1800 |
| E15 Flat roof with parapet | 3.8175 | 0.5600 | 2.1378 |
| E24 Eaves (insulation at ceiling level - inverted) | 7.0875 | 0.2400 | 1.7010 |

| | | | |
|---|---|---|---|
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | 7.0076 | (36) |
| Point Thermal bridges | (36a) = | 0.0000 | |
| Total fabric heat loss | (33) + (36) + (36a) = | 31.7773 | (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 31.2307 | 30.9996 | 30.7731 | 29.7092 | 29.5101 | 28.5835 | 28.5835 | 28.4119 | 28.9404 | 29.5101 | 29.9128 | 30.3338 | (38) |
| Heat transfer coeff | 63.0080 | 62.7769 | 62.5504 | 61.4865 | 61.2874 | 60.3608 | 60.3608 | 60.1892 | 60.7177 | 61.2874 | 61.6901 | 62.1111 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 61.4855 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.2338 | 1.2292 | 1.2248 | 1.2040 | 1.2001 | 1.1819 | 1.1819 | 1.1786 | 1.1889 | 1.2001 | 1.2080 | 1.2162 | (40) |
| HLP (average) | | | | | | | | | | | | 1.2039 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

## 4. Water heating energy requirements (kWh/year)

| | | |
|---|---|---|
| Assumed occupancy | 1.7216 | (42) |

Hot water usage for mixer showers

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 53.0857 | 52.2879 | 51.1254 | 48.9011 | 47.2597 | 45.4291 | 44.3887 | 45.5424 | 46.8071 | 48.7725 | 51.0445 | 52.8823 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 22.9518 | 22.6109 | 22.1309 | 21.2459 | 20.5831 | 19.8483 | 19.4514 | 19.9280 | 20.4470 | 21.2333 | 22.1366 | 22.8742 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.2613 | 31.0881 | 29.9150 | 28.7419 | 27.5687 | 26.3956 | 26.3956 | 27.5687 | 28.7419 | 29.9150 | 31.0881 | 32.2613 | (42c) |

| | | |
|---|---|---|
| Average daily hot water use (litres/day) | 99.5516 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 108.2987 | 105.9870 | 103.1713 | 98.8888 | 95.4115 | 91.6730 | 90.2356 | 93.0391 | 95.9959 | 99.9208 | 104.2693 | 108.0177 | (44) |
| Energy conte | 171.5187 | 150.9240 | 158.5704 | 135.3739 | 128.4423 | 112.7227 | 109.1322 | 115.2019 | 118.3726 | 135.5916 | 148.5507 | 169.1297 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1653.5306 | |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | | |
| | 25.7278 | 22.6386 | 23.7856 | 20.3061 | 19.2663 | 16.9084 | 16.3698 | 17.2803 | 17.7559 | 20.3387 | 22.2826 | 25.3695 | (46) |
| Water storage loss: | | | | | | | | | | | | | |
| Store volume | | | | | | | | | | | | 150.0000 | (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | | | | | | | | | | | | 1.3938 | (48) |
| Temperature factor from Table 2b | | | | | | | | | | | | 0.5400 | (49) |
| Enter (49) or (54) in (55) | | | | | | | | | | | | 0.7527 | (55) |
| Total storage loss | | | | | | | | | | | | | |
| | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (56) |
| If cylinder contains dedicated solar storage | | | | | | | | | | | | | |
| | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (57) |
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |

Total heat required for water heating calculated for each month

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 218.1136 | 193.0097 | 205.1653 | 180.4657 | 175.0372 | 157.8145 | 155.7271 | 161.7968 | 163.4644 | 182.1865 | 193.6425 | 215.7246 | (62) |
| WWHRS | -24.2685 | -21.4633 | -22.4751 | -18.6103 | -17.3441 | -14.8415 | -13.9115 | -14.7935 | -15.3556 | -18.1025 | -20.5080 | -23.8191 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | | | | | | | | | | | | | |
| | 193.8451 | 171.5464 | 182.6902 | 161.8554 | 157.6930 | 142.9730 | 141.8155 | 147.0033 | 148.1088 | 164.0840 | 173.1346 | 191.9055 | (64) |
| | | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | 1976.6548 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 1977 | (64) |
| Electric shower(s) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | | | | | | | | | | | | | |
| | 94.3059 | 83.8508 | 90.0006 | 81.0853 | 79.9830 | 73.5538 | 73.5624 | 75.5805 | 75.4324 | 82.3601 | 85.4666 | 93.5115 | (65) |

## 5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 86.0818 | 86.0818 | 86.0818 | 86.0818 | 86.0818 | 86.0818 | 86.0818 | 86.0818 | 86.0818 | 86.0818 | 86.0818 | 86.0818 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 75.8053 | 83.9273 | 75.8053 | 78.3322 | 75.8053 | 78.3322 | 75.8053 | 75.8053 | 78.3322 | 75.8053 | 78.3322 | 75.8053 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 150.0125 | 151.5692 | 147.6465 | 139.2954 | 128.7537 | 118.8460 | 112.2271 | 110.6704 | 114.5932 | 122.9442 | 133.4859 | 143.3936 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 31.6082 | 31.6082 | 31.6082 | 31.6082 | 31.6082 | 31.6082 | 31.6082 | 31.6082 | 31.6082 | 31.6082 | 31.6082 | 31.6082 | (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.0000 | 3.0000 | 3.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | | | | | | | | | | | | | |
| | -68.8654 | -68.8654 | -68.8654 | -68.8654 | -68.8654 | -68.8654 | -68.8654 | -68.8654 | -68.8654 | -68.8654 | -68.8654 | -68.8654 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 126.7552 | 124.7780 | 120.9685 | 112.6185 | 107.5040 | 102.1580 | 98.8741 | 101.5868 | 104.7672 | 110.6991 | 118.7036 | 125.6876 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 404.3976 | 412.0990 | 396.2449 | 382.0706 | 363.8876 | 348.1608 | 335.7311 | 336.8870 | 346.5170 | 361.2732 | 382.3462 | 396.7110 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Northeast | 4.5600 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 15.7239 | (75) |
| Southeast | 6.3100 | 36.7938 | 0.6300 | 0.7000 | 0.7700 | 70.9539 | (77) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 86.6777 | 152.8671 | 223.0322 | 299.6006 | 356.8018 | 363.5574 | 346.6230 | 302.5210 | 249.3234 | 172.6912 | 104.7711 | 73.5626 | (83) |
| Total gains | 491.0754 | 564.9661 | 619.2771 | 681.6712 | 720.6894 | 711.7181 | 682.3541 | 639.4081 | 595.8405 | 533.9643 | 487.1173 | 470.2736 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| tau | 83.4208 | 83.7279 | 84.0310 | 85.4850 | 85.7627 | 87.0793 | 87.0793 | 87.3275 | 86.5674 | 85.7627 | 85.2029 | 84.6254 | |
| alpha | 6.5614 | 6.5819 | 6.6021 | 6.6990 | 6.7175 | 6.8053 | 6.8053 | 6.8218 | 6.7712 | 6.7175 | 6.6802 | 6.6417 | |
| util living area | | | | | | | | | | | | | |
| | 0.9964 | 0.9903 | 0.9730 | 0.9049 | 0.7500 | 0.5389 | 0.3888 | 0.4322 | 0.6826 | 0.9337 | 0.9900 | 0.9972 | (86) |
| MIT | 20.1538 | 20.3213 | 20.5418 | 20.8081 | 20.9555 | 20.9958 | 20.9996 | 20.9992 | 20.9815 | 20.7904 | 20.4340 | 20.1344 | (87) |
| Th 2 | 19.8931 | 19.8967 | 19.9002 | 19.9168 | 19.9199 | 19.9345 | 19.9345 | 19.9372 | 19.9289 | 19.9199 | 19.9136 | 19.9071 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9947 | 0.9858 | 0.9607 | 0.8674 | 0.6788 | 0.4513 | 0.2949 | 0.3328 | 0.5868 | 0.8978 | 0.9845 | 0.9959 | (89) |
| MIT 2 | 18.9402 | 19.1546 | 19.4304 | 19.7500 | 19.8917 | 19.9329 | 19.9344 | 19.9370 | 19.9205 | 19.7421 | 19.3119 | 18.9264 | (90) |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.6524 | (91) |
| MIT | 19.7320 | 19.9158 | 20.1555 | 20.4404 | 20.5858 | 20.6264 | 20.6294 | 20.6300 | 20.6127 | 20.4260 | 20.0440 | 19.7146 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.7320 | 19.9158 | 20.1555 | 20.4404 | 20.5858 | 20.6264 | 20.6294 | 20.6300 | 20.6127 | 20.4260 | 20.0440 | 19.7146 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9944 | 0.9859 | 0.9640 | 0.8869 | 0.7239 | 0.5085 | 0.3562 | 0.3977 | 0.6492 | 0.9165 | 0.9853 | 0.9956 | (94) |
| Useful gains | 488.3107 | 557.0132 | 596.9614 | 604.5662 | 521.6884 | 361.9008 | 243.0770 | 254.3159 | 386.7975 | 489.3617 | 479.9620 | 468.2124 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | | | | | | | | | | | | | |
| | 972.3380 | 942.6456 | 854.1589 | 709.5762 | 544.5849 | 363.7570 | 243.2169 | 254.6027 | 395.4387 | 602.2128 | 798.5172 | 963.6267 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 360.1163 | 259.1450 | 191.3549 | 75.6072 | 17.0350 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 83.9612 | 229.3598 | 368.5882 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 1585.1676 | |
| Solar heating kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | | | | | | | | | | | | | |
| | 360.1163 | 259.1450 | 191.3549 | 75.6072 | 17.0350 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 83.9612 | 229.3598 | 368.5882 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 1585.1676 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 31.0391 | (99) |

## 9a. Energy requirements - Individual heating systems, including micro-CHP

| | | |
|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | 0.0000 | (201) |
| Fraction of space heat from main system(s) | 1.0000 | (202) |
| Efficiency of main space heating system 1 (in %) | 92.3000 | (206) |
| Efficiency of main space heating system 2 (in %) | 0.0000 | (207) |
| Efficiency of secondary/supplementary heating system, % | 0.0000 | (208) |

# Full SAP Calculation Printout

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement | | | | | | | | | | | | | |
| | 360.1163 | 259.1450 | 191.3549 | 75.6072 | 17.0350 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 83.9612 | 229.3598 | 368.5882 | (98) |
| Space heating efficiency (main heating system 1) | | | | | | | | | | | | | |
| | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.3000 | 92.3000 | 92.3000 | (210) |
| Space heating fuel (main heating system) | | | | | | | | | | | | | |
| | 390.1585 | 280.7638 | 207.3185 | 81.9146 | 18.4561 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 90.9655 | 248.4938 | 399.3372 | (211) |
| Space heating efficiency (main heating system 2) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (212) |
| Space heating fuel (main heating system 2) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (213) |
| Space heating fuel (secondary) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (215) |
| | | | | | | | | | | | | | |
| Water heating | | | | | | | | | | | | | |
| Water heating requirement | | | | | | | | | | | | | |
| | 193.8451 | 171.5464 | 182.6902 | 161.8554 | 157.6930 | 142.9730 | 141.8155 | 147.0033 | 148.1088 | 164.0840 | 173.1346 | 191.9055 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 | (216) |
| (217)m | 85.4285 | 84.9825 | 84.1639 | 82.4610 | 80.5964 | 79.8000 | 79.8000 | 79.8000 | 79.8000 | 82.6349 | 84.6913 | 85.4985 | (217) |
| Fuel for water heating, kWh/month | | | | | | | | | | | | | |
| | 226.9090 | 201.8610 | 217.0649 | 196.2812 | 195.6577 | 179.1642 | 177.7137 | 184.2146 | 185.6001 | 198.5649 | 204.4301 | 224.4548 | (219) |
| Space cooling fuel requirement | | | | | | | | | | | | | |
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (221) |
| Pumps and Fa | 7.3041 | 6.5973 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | (231) |
| Lighting | 15.7509 | 12.6359 | 11.3772 | 8.3355 | 6.4385 | 5.2603 | 5.8735 | 7.6345 | 9.9165 | 13.0110 | 14.6959 | 16.1886 | (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233a)m | -11.4250 | -17.1935 | -26.3662 | -31.7020 | -36.0326 | -34.3326 | -33.9313 | -31.1141 | -26.4738 | -20.5544 | -12.9453 | -9.7561 | (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233b)m | -3.5303 | -7.6372 | -15.5765 | -23.9851 | -32.2923 | -32.6440 | -32.2441 | -27.0218 | -19.4543 | -11.0955 | -4.7695 | -2.7752 | (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235d) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - main system 1 | 1717.4080 | (211) |
| Space heating fuel - main system 2 | 0.0000 | (213) |
| Space heating fuel - secondary | 0.0000 | (215) |
| Efficiency of water heater | 79.8000 | |
| Water heating fuel used | 2391.9162 | (219) |
| Space cooling fuel | 0.0000 | (221) |
| | | |
| Electricity for pumps and fans: | | |
| Total electricity for the above, kWh/year | 86.0000 | (231) |
| Electricity for lighting (calculated in Appendix L) | 127.1184 | (232) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -504.8525 | (233) |
| Wind generation | 0.0000 | (234) |
| Hydro-electric generation (Appendix N) | 0.0000 | (235a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (235) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (236) |
| Energy used | 0.0000 | (237) |
| Total delivered energy for all uses | 3817.5901 | (238) |

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 1717.4080 | 0.2100 | 360.6557 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2391.9162 | 0.2100 | 502.3024 | (264) |
| Space and water heating | | | 862.9581 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 127.1184 | 0.1443 | 18.3471 | (268) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -291.8267 | 0.1332 | -38.8782 | |
| PV Unit electricity exported | -213.0258 | 0.1252 | -26.6680 | |
| Total | | | -65.5462 | (269) |
| Total CO2, kg/year | | | 827.6883 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 16.2100 | (273) |

13a. Primary energy - Individual heating systems including micro-CHP

| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 1717.4080 | 1.1300 | 1940.6711 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2391.9162 | 1.1300 | 2702.8653 | (278) |
| Space and water heating | | | 4643.5364 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 127.1184 | 1.5338 | 194.9784 | (282) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -291.8267 | 1.4923 | -435.4911 | |
| PV Unit electricity exported | -213.0258 | 0.4595 | -97.8828 | |
| Total | | | -533.3739 | (283) |
| Total Primary energy kWh/year | | | 4435.2417 | (286) |
| Target Primary Energy Rate (TPER) | | | 86.8500 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Property Reference** | Unit 34 | **Issued on Date** | 17/05/2025 |
| **Assessment Reference** | 00001 | **Prop Type Ref** | Unit 34 |
| **Property** | | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 77 C | **DER** | 6.10 | **TER** | 14.54 |
| **Environmental** | 95 A | **% DER < TER** | | | 58.05 |
| **$CO_2$ Emissions (t/year)** | 0.45 | **DFEE** | 42.15 | **TFEE** | 43.95 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 4.10 |
| **% DPER < TPER** | 17.02 | **DPER** | 64.25 | **TPER** | 77.43 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Robert Arnold | **Assessor ID** | BA04-0001 |
| **Client** | | | |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 84.5000 | (1b) | x 2.9500 | (2b) = | 249.2750 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 84.5000 | | | | | (4) |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | 249.2750 | (5) |

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2. Ventilation rate

---

| | m3 per hour | |
|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 (6a) |
| Number of open flues | 0 * 20 = | 0.0000 (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 (6f) |
| Number of intermittent extract fans | 0 * 10 = | 0.0000 (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 (7c) |

| | Air changes per hour | |
|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 0.0000 / (5) = | 0.0000 (8) |
| Pressure test | | Yes |
| Pressure Test Method | | Blower Door |
| Measured/design AP50 | | 3.0000 (17) |
| Infiltration rate | | 0.1500 (18) |
| Number of sides sheltered | | 0 (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.1500 (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.1912 | 0.1875 | 0.1837 | 0.1650 | 0.1612 | 0.1425 | 0.1425 | 0.1388 | 0.1500 | 0.1612 | 0.1687 | 0.1762 | (22b) |
| Balanced mechanical ventilation with heat recovery | | | | | | | | | | | | | |
| If mechanical ventilation | | | | | | | | | | | | 0.5000 | (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | | | | | | | | | | | | 0.5000 | (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | | | | | | | | | | | | 81.0000 | (23c) |
| Effective ac | 0.2862 | 0.2825 | 0.2787 | 0.2600 | 0.2562 | 0.2375 | 0.2375 | 0.2337 | 0.2450 | 0.2562 | 0.2637 | 0.2712 | (25) |

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3. Heat losses and heat loss parameter

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| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| Windows | | | 15.5500 | 1.0536 | 16.3841 | | | (27) |
| Front Door | | | 1.8900 | 1.4000 | 2.6460 | | | (26) |
| Glass Door | | | 7.2600 | 1.3258 | 9.6250 | | | (27) |
| External Walls | 71.4600 | 24.7000 | 46.7600 | 0.1500 | 7.0140 | 150.0000 | 7014.0000 | (29a) |
| Wall to Communal Corridor | 21.5700 | | 21.5700 | 0.1500 | 3.2355 | 150.0000 | 3235.5000 | (29a) |
| External Roof | 12.6000 | | 12.6000 | 0.1000 | 1.2600 | 9.0000 | 113.4000 | (30) |
| Total net area of external elements Aum(A, m2) | | | 105.6300 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 40.1646 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 37 | | | 14.9700 | 0.0000 | 0.0000 | 110.0000 | 1646.7000 | (32) |
| Party Wall to Unit 35 | | | 15.0100 | 0.0000 | 0.0000 | 110.0000 | 1651.1000 | (32) |
| Party Floor | | | 84.5000 | | | 80.0000 | 6760.0000 | (32d) |
| Party Ceiling | | | 67.2200 | | | 100.0000 | 6722.0000 | (32b) |
| Internal Walls | | | 150.8500 | | | 9.0000 | 1357.6500 | (32c) |

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 28500.3500 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 337.2822 (35)
List of Thermal Bridges

| | K1 Element | Length | Psi-value | Total |
|---|---|---|---|---|
| | E1 Steel lintel with perforated steel base plate | 11.0100 | 0.0500 | 0.5505 |
| | E4 Jamb | 35.7200 | 0.0500 | 1.7860 |
| | E7 Party floor between dwellings (in blocks of flats) | 13.4500 | 0.0350 | 0.4708 |
| | E16 Corner (normal) | 11.8000 | 0.0900 | 1.0620 |
| | E18 Party wall between dwellings | 2.9500 | 0.0300 | 0.0885 |
| | E7 Party floor between dwellings (in blocks of flats) | 7.3145 | 0.0350 | 0.2560 |
| | E17 Corner (inverted - internal area greater than external area) | 5.9000 | -0.0900 | -0.5310 |
| | E25 Staggered party wall between dwellings | 2.9500 | 0.0300 | 0.0885 |
| | E24 Eaves (insulation at ceiling level - inverted) | 10.7750 | 0.1200 | 1.2930 |
| | E24 Eaves (insulation at ceiling level - inverted) | 6.9220 | 0.1200 | 0.8306 |
| | E15 Flat roof with parapet | 12.0900 | 0.5600 | 6.7704 |
| | E23 Balcony within or between dwellings, balcony support penetrates wall insulation | 7.0860 | 0.0200 | 0.1417 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 12.8070 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 52.9716 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 23.5471 | 23.2387 | 22.9302 | 21.3878 | 21.0793 | 19.5369 | 19.5369 | 19.2285 | 20.1539 | 21.0793 | 21.6963 | 22.3132 | (38) |
| Heat transfer coeff | 76.5188 | 76.2103 | 75.9018 | 74.3594 | 74.0509 | 72.5085 | 72.5085 | 72.2001 | 73.1255 | 74.0509 | 74.6679 | 75.2848 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 74.2823 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 0.9055 | 0.9019 | 0.8982 | 0.8800 | 0.8763 | 0.8581 | 0.8581 | 0.8544 | 0.8654 | 0.8763 | 0.8836 | 0.8909 | (40) |
| HLP (average) | | | | | | | | | | | | 0.8791 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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4. Water heating energy requirements (kWh/year)
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Assumed occupancy 2.5427 (42)
Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 65.1638 | 64.1661 | 62.6959 | 60.4341 | 58.4076 | 55.5726 | 53.3302 | 55.9516 | 57.2701 | 60.0781 | 63.0024 | 65.1050 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 28.2285 | 27.8024 | 27.1962 | 26.2883 | 25.4702 | 24.3439 | 23.4894 | 24.5343 | 25.0826 | 26.1986 | 27.3589 | 28.2061 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 40.6700 | 39.1911 | 37.7122 | 36.2333 | 34.7544 | 33.2755 | 33.2755 | 34.7544 | 36.2333 | 37.7122 | 39.1911 | 40.6700 | (42c) |

Average daily hot water use (litres/day) 123.2232 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 134.0623 | 131.1596 | 127.6042 | 122.9557 | 118.6322 | 113.1919 | 110.0951 | 115.2403 | 118.5860 | 123.9889 | 129.5524 | 133.9812 | (44) |
| Energy conte | 197.3629 | 173.5507 | 182.3438 | 160.6109 | 152.8695 | 130.9026 | 121.6583 | 135.6399 | 137.5539 | 159.7723 | 175.0944 | 196.7612 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1924.1204 | |
| Distribution loss (46)m = 0.15 x (45)m | 29.6044 | 26.0326 | 27.3516 | 24.0916 | 22.9304 | 19.6354 | 18.2487 | 20.3460 | 20.6331 | 23.9658 | 26.2642 | 29.5142 | (46) |
| Water storage loss: | | | | | | | | | | | | | |
| Store volume | | | | | | | | | | | | 110.0000 | (47) |
| b) If manufacturer declared loss factor is not known : | | | | | | | | | | | | | |
| Hot water storage loss factor from Table 2 (kWh/litre/day) | | | | | | | | | | | | 0.0152 | (51) |
| Volume factor from Table 2a | | | | | | | | | | | | 1.0294 | (52) |
| Temperature factor from Table 2b | | | | | | | | | | | | 0.6000 | (53) |
| Enter (49) or (54) in (55) | | | | | | | | | | | | 1.0327 | (55) |
| Total storage loss | 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (56) |
| If cylinder contains dedicated solar storage | 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (57) |
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | 252.6397 | 223.4782 | 237.6206 | 214.1046 | 208.1463 | 184.3963 | 176.9351 | 190.9167 | 191.0476 | 215.0491 | 228.5881 | 252.0380 | (62) |
| WWHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | 252.6397 | 223.4782 | 237.6206 | 214.1046 | 208.1463 | 184.3963 | 176.9351 | 190.9167 | 191.0476 | 215.0491 | 228.5881 | 252.0380 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2574.9602 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2575 | (64) |
| Electric shower(s) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | 109.8446 | 97.6476 | 104.8508 | 96.1981 | 95.0506 | 86.3201 | 84.6728 | 89.3217 | 88.5316 | 97.3457 | 101.0138 | 109.6445 | (65) |

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5. Internal gains (see Table 5 and 5a)
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Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 127.1361 | 127.1361 | 127.1361 | 127.1361 | 127.1361 | 127.1361 | 127.1361 | 127.1361 | 127.1361 | 127.1361 | 127.1361 | 127.1361 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 115.2965 | 127.6496 | 115.2965 | 119.1397 | 115.2965 | 119.1397 | 115.2965 | 115.2965 | 119.1397 | 115.2965 | 119.1397 | 115.2965 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 228.5881 | 230.9601 | 224.9827 | 212.2575 | 196.1941 | 181.0968 | 171.0109 | 168.6389 | 174.6163 | 187.3416 | 203.4049 | 218.5022 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 35.7136 | 35.7136 | 35.7136 | 35.7136 | 35.7136 | 35.7136 | 35.7136 | 35.7136 | 35.7136 | 35.7136 | 35.7136 | 35.7136 | (69) |
| Pumps, fans | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | -101.7089 | -101.7089 | -101.7089 | -101.7089 | -101.7089 | -101.7089 | -101.7089 | -101.7089 | -101.7089 | -101.7089 | -101.7089 | -101.7089 | (71) |
| Water heating gains (Table 5) | 147.6406 | 145.3089 | 140.9285 | 133.6084 | 127.7561 | 119.8890 | 113.8076 | 120.0561 | 122.9606 | 130.8410 | 140.2970 | 147.3717 | (72) |
| Total internal gains | 552.6660 | 565.0595 | 542.3485 | 526.1464 | 500.3875 | 481.2663 | 461.2558 | 465.1322 | 477.8574 | 494.6199 | 523.9824 | 542.3112 | (73) |

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6. Solar gains
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| [Jan] | Area | Solar flux | g | FF | Access | Gains |
|---|---|---|---|---|---|---|

| | m2 | Table 6a W/m2 | Specific data or Table 6b | Specific data or Table 6c | factor Table 6d | W | |
|---|---|---|---|---|---|---|---|
| Southwest | 3.5000 | 36.7938 | 0.4500 | 0.7000 | 0.7700 | 28.1117 | (79) |
| Northwest | 12.0500 | 11.2829 | 0.4500 | 0.7000 | 0.7700 | 29.6793 | (81) |
| Southwest | 4.9700 | 36.7938 | 0.4500 | 0.7000 | 0.7700 | 39.9186 | (79) |
| Northwest | 2.2900 | 11.2829 | 0.4500 | 0.7000 | 0.7700 | 5.6403 | (81) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 103.3498 | 187.7747 | 288.0832 | 409.1806 | 505.9909 | 523.3022 | 495.7923 | 420.3614 | 329.5139 | 215.9330 | 125.9257 | 87.0635 | (83) |
| Total gains | 656.0158 | 752.8342 | 830.4316 | 935.3269 | 1006.3784 | 1004.5686 | 957.0480 | 885.4937 | 807.3713 | 710.5529 | 649.9081 | 629.3746 | (84) |

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| tau | 103.4617 | 103.8805 | 104.3027 | 106.4662 | 106.9097 | 109.1839 | 109.1839 | 109.6504 | 108.2627 | 106.9097 | 106.0264 | 105.1575 | |
| alpha | 7.8974 | 7.9254 | 7.9535 | 8.0977 | 8.1273 | 8.2789 | 8.2789 | 8.3100 | 8.2175 | 8.1273 | 8.0684 | 8.0105 | |
| util living area | 0.9975 | 0.9918 | 0.9716 | 0.8721 | 0.6741 | 0.4615 | 0.3333 | 0.3750 | 0.6200 | 0.9227 | 0.9913 | 0.9981 | (86) |
| MIT | 20.3577 | 20.5050 | 20.6971 | 20.9130 | 20.9894 | 20.9996 | 21.0000 | 20.9999 | 20.9958 | 20.8816 | 20.5932 | 20.3428 | (87) |
| Th 2 | 20.1628 | 20.1659 | 20.1690 | 20.1845 | 20.1877 | 20.2033 | 20.2033 | 20.2064 | 20.1970 | 20.1877 | 20.1814 | 20.1752 | (88) |
| util rest of house | 0.9964 | 0.9886 | 0.9607 | 0.8361 | 0.6194 | 0.4043 | 0.2730 | 0.3103 | 0.5503 | 0.8901 | 0.9872 | 0.9973 | (89) |
| MIT 2 | 19.4224 | 19.6115 | 19.8518 | 20.1088 | 20.1807 | 20.2031 | 20.2033 | 20.2064 | 20.1950 | 20.0847 | 19.7369 | 19.4135 | (90) |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.5504 | (91) |
| MIT | 19.9372 | 20.1033 | 20.3170 | 20.5514 | 20.6258 | 20.6415 | 20.6418 | 20.6432 | 20.6358 | 20.5233 | 20.2082 | 19.9250 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.9372 | 20.1033 | 20.3170 | 20.5514 | 20.6258 | 20.6415 | 20.6418 | 20.6432 | 20.6358 | 20.5233 | 20.2082 | 19.9250 | (93) |

8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9961 | 0.9883 | 0.9629 | 0.8531 | 0.6492 | 0.4358 | 0.3062 | 0.3459 | 0.5887 | 0.9048 | 0.9873 | 0.9970 | (94) |
| Useful gains | 653.4303 | 743.9953 | 799.6090 | 797.9201 | 653.3561 | 437.8028 | 293.0527 | 306.3274 | 475.2878 | 642.9009 | 641.6832 | 627.4998 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | 1196.5380 | 1158.6445 | 1048.7376 | 866.3948 | 660.9647 | 438.0591 | 293.0640 | 306.3570 | 477.9323 | 734.8309 | 978.7633 | 1183.8535 | (97) |
| Space heating kWh | 404.0721 | 278.6442 | 185.3516 | 49.3018 | 5.6609 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 68.3959 | 242.6977 | 413.9271 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 1648.0514 | |
| Solar heating kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | 404.0721 | 278.6442 | 185.3516 | 49.3018 | 5.6609 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 68.3959 | 242.6977 | 413.9271 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 1648.0514 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 19.5036 | (99) |

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ext. temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | |
| Heat loss rate W | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 681.5803 | 536.5632 | 548.7205 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (100) |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.9934 | 0.9983 | 0.9965 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (101) |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 677.0508 | 535.6379 | 546.7787 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (102) |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 1115.7337 | 1063.2693 | 981.1309 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 315.8517 | 392.5577 | 323.1581 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (104) |
| Cooled fraction | | | | | | | | | fC = cooled area / (4) = | | | 0.9941 | (105) |
| Intermittency factor (Table 10b) | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | (106) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 78.4957 | 97.5587 | 80.3115 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) |
| Space cooling requirement | | | | | | | | | | | | 256.3659 | (107) |

9b. Energy requirements

| | | |
|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | 0.0000 | (301) |
| Fraction of space heat from community system | 1.0000 | (302) |
| Fraction of heat from community Heat pump-Space and Water | 1.0000 | (303a) |
| Factor for control and charging method (Table 4c(3)) for space heating | 1.0000 | (305) |
| Factor for charging method (Table 4c(3)) for water heating | 1.0000 | (305a) |
| Distribution loss factor (Table 12c) for community heating system | 2.0000 | (306) |
| Efficiency of secondary/supplementary heating system, % | 0.0000 | (208) |

Space heating:

Space heating requirement

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 404.0721 | 278.6442 | 185.3516 | 49.3018 | 5.6609 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 68.3959 | 242.6977 | 413.9271 | (98) |
| Space heat from Heat pump = (98) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 307a | 808.1442 | 557.2885 | 370.7033 | 98.6035 | 11.3217 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 136.7919 | 485.3954 | 827.8543 | |
| Space heating requirement | | | | | | | | | | | | | |
| | 808.1442 | 557.2885 | 370.7033 | 98.6035 | 11.3217 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 136.7919 | 485.3954 | 827.8543 | (307) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | | | | | | | | | | | 0.0000 | (308) |
| Space heating fuel for secondary/supplementary system | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (309) |

Water heating

Annual water heating requirement

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 252.6397 | 223.4782 | 237.6206 | 214.1046 | 208.1463 | 184.3963 | 176.9351 | 190.9167 | 191.0476 | 215.0491 | 228.5881 | 252.0380 | (64) |
| Water heat from Heat pump = (64) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 310a | 505.2794 | 446.9563 | 475.2413 | 428.2091 | 416.2927 | 368.7926 | 353.8702 | 381.8335 | 382.0951 | 430.0982 | 457.1761 | 504.0759 | |
| Water heating fuel | | | | | | | | | | | | | |
| | 505.2794 | 446.9563 | 475.2413 | 428.2091 | 416.2927 | 368.7926 | 353.8702 | 381.8335 | 382.0951 | 430.0982 | 457.1761 | 504.0759 | (310) |
| Cooling System Energy Efficiency Ratio | | | | | | | | | | | | 2.6000 | (314) |
| Space coolin | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 30.1907 | 37.5226 | 30.8890 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (315) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pumps and Fa | 22.7812 | 20.5765 | 22.7812 | 22.0463 | 22.7812 | 22.0463 | 22.7812 | 22.7812 | 22.0463 | 22.7812 | 22.0463 | 22.7812 | (331) |
| Lighting | 25.9858 | 20.8468 | 18.7702 | 13.7519 | 10.6223 | 8.6785 | 9.6901 | 12.5955 | 16.3603 | 21.4656 | 24.2454 | 26.7080 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333a)m | -4.8442 | -7.8995 | -13.2153 | -17.2450 | -20.7259 | -20.1580 | -19.8704 | -17.6103 | -14.0651 | -9.9066 | -5.6668 | -4.0607 | (333a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335a) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (333b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335b) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - community heating | 3296.1028 | (307) |
| Space heating fuel - secondary | 0.0000 | (309) |
| Water heating fuel - community heating | 5149.9204 | (310) |
| Efficiency of water heater | 0.0000 | (311) |
| Electricity used for heat distribution | 32.9610 | (313) |
| Space cooling fuel | 98.6023 | (321) |
| | | |
| Electricity for pumps and fans: | | |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8820) | | |
| mechanical ventilation fans (SFP = 0.8820) | 268.2299 | (330a) |
| Total electricity for the above, kWh/year | 268.2299 | (331) |
| Electricity for lighting (calculated in Appendix L) | 209.7204 | (332) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -155.2676 | (333) |
| Wind generation | 0.0000 | (334) |
| Hydro-electric generation (Appendix N) | 0.0000 | (335a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (335) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (336) |
| Energy used | 0.0000 | (337) |
| Total delivered energy for all uses | 8867.3082 | (338) |

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12b. Carbon dioxide emissions - Community heating scheme

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (367) |
| Space and Water heating from Heat pump | 3016.4369 | 0.1578 | 185.7302 | (367) |
| Electrical energy for heat distribution (space & water) | 32.9610 | 0.0000 | 12.4542 | (372) |
| Overall CO2 factor for heat network | | | 0.0541 | (386) |
| Total CO2 associated with community systems | | | 457.2477 | (373) |
| Space and water heating | | | 457.2477 | (376) |
| Space cooling | 98.6023 | 0.1141 | 11.2475 | (377) |
| Pumps, fans and electric keep-hot | 268.2299 | 0.1387 | 37.2068 | (378) |
| Energy for lighting | 209.7204 | 0.1443 | 30.2691 | (379) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -155.2676 | 0.1317 | -20.4550 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -20.4550 | (380) |
| Total CO2, kg/year | | | 515.5160 | (383) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 6.1000 | (384) |

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13b. Primary energy - Community heating scheme

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| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (467a) |
| Space and Water heating from Heat pump | 3016.4369 | 1.5841 | 1864.7245 | (467) |
| Electrical energy for heat distribution (space & water) | 32.9610 | 0.0000 | 130.5331 | (472) |
| Overall CO2 factor for heat network | | | 0.5674 | (486) |
| Total CO2 associated with community systems | | | 4792.4304 | (473) |
| Space and water heating | | | 4792.4304 | (476) |
| Space cooling | 98.6023 | 1.4204 | 140.0578 | (477) |
| Pumps, fans and electric keep-hot | 268.2299 | 1.5128 | 405.7781 | (478) |
| Energy for lighting | 209.7204 | 1.5338 | 321.6762 | (479) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -155.2676 | 1.4867 | -230.8403 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -230.8403 | (480) |
| Total Primary energy kWh/year | | | 5429.1022 | (483) |
| Dwelling Primary energy Rate (DPER) | | | 64.2500 | (484) |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

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| | | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | |
| Ground floor | | 84.5000 | (1b) | x 2.9500 | (2b) = | 249.2750 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 84.5000 | | | | | | (4) |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | | 249.2750 | (5) |

## 2. Ventilation rate

| | | | |
|---|---|---|---|
| | | m3 per hour | |
| Number of open chimneys | 0 * 80 = | 0.0000 | (6a) |
| Number of open flues | 0 * 20 = | 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | 3 * 10 = | 30.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |
| | | Air changes per hour | |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 30.0000 / (5) = | 0.1203 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3703 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.3703 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.4722 | 0.4629 | 0.4537 | 0.4074 | 0.3981 | 0.3518 | 0.3518 | 0.3426 | 0.3703 | 0.3981 | 0.4166 | 0.4352 | (22b) |
| Effective ac | 0.6115 | 0.6072 | 0.6029 | 0.5830 | 0.5793 | 0.5619 | 0.5619 | 0.5587 | 0.5686 | 0.5793 | 0.5868 | 0.5947 | (25) |

## 3. Heat losses and heat loss parameter

| Element | Gross | Openings | NetArea | U-value | A x U | K-value | A x K | |
|---|---|---|---|---|---|---|---|---|
| | m2 | m2 | m2 | W/m2K | W/K | kJ/m2K | kJ/K | |
| Main dwelling | | | | | | | | |
| TER Opaque door | | | 1.8900 | 1.0000 | 1.8900 | | | (26) |
| TER Opening Type | | | 19.2400 | 1.1450 | 22.0305 | | | (27) |
| External Walls | 71.4600 | 21.1300 | 50.3300 | 0.1800 | 9.0594 | | | (29a) |
| Wall to Communal Corridor | 21.5700 | | 21.5700 | 0.1800 | 3.8826 | | | (29a) |
| External Roof | 12.6000 | | 12.6000 | 0.1100 | 1.3860 | | | (30) |
| Total net area of external elements Aum(A, m2) | | | 105.6300 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 38.2485 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 37 | | | 14.9700 | 0.0000 | 0.0000 | | | (32) |
| Party Wall to Unit 35 | | | 15.0100 | 0.0000 | 0.0000 | | | (32) |

| | | |
|---|---|---|
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | 321.3722 | (35) |
| List of Thermal Bridges | | |

| K1 Element | Length | Psi-value | Total |
|---|---|---|---|
| E1 Steel lintel with perforated steel base plate | 11.0100 | 0.0500 | 0.5505 |
| E4 Jamb | 35.7200 | 0.0500 | 1.7860 |
| E7 Party floor between dwellings (in blocks of flats) | 13.4500 | 0.0700 | 0.9415 |
| E16 Corner (normal) | 11.8000 | 0.0900 | 1.0620 |
| E18 Party wall between dwellings | 2.9500 | 0.0600 | 0.1770 |
| E7 Party floor between dwellings (in blocks of flats) | 7.3145 | 0.0700 | 0.5120 |
| E17 Corner (inverted - internal area greater than external area) | 5.9000 | -0.0900 | -0.5310 |
| E25 Staggered party wall between dwellings | 2.9500 | 0.0600 | 0.1770 |
| E24 Eaves (insulation at ceiling level - inverted) | 10.7750 | 0.2400 | 2.5860 |
| E24 Eaves (insulation at ceiling level - inverted) | 6.9220 | 0.2400 | 1.6613 |
| E15 Flat roof with parapet | 12.0900 | 0.5600 | 6.7704 |
| E23 Balcony within or between dwellings, balcony support penetrates wall insulation | 7.0860 | 0.0200 | 0.1417 |

| | | | |
|---|---|---|---|
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | 15.8344 | (36) |
| Point Thermal bridges | (36a) = | 0.0000 | |
| Total fabric heat loss | (33) + (36) + (36a) = | 54.0829 | (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 50.3011 | 49.9450 | 49.5960 | 47.9564 | 47.6497 | 46.2217 | 46.2217 | 45.9573 | 46.7718 | 47.6497 | 48.2702 | 48.9190 | (38) |
| Heat transfer coeff | 104.3841 | 104.0280 | 103.6789 | 102.0394 | 101.7326 | 100.3047 | 100.3047 | 100.0402 | 100.8547 | 101.7326 | 102.3532 | 103.0019 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 102.0379 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.2353 | 1.2311 | 1.2270 | 1.2076 | 1.2039 | 1.1870 | 1.1870 | 1.1839 | 1.1935 | 1.2039 | 1.2113 | 1.2190 | (40) |
| HLP (average) | | | | | | | | | | | | 1.2075 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

## 4. Water heating energy requirements (kWh/year)

| | | |
|---|---|---|
| Assumed occupancy | 2.5427 | (42) |

Hot water usage for mixer showers

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 66.8528 | 65.8482 | 64.3842 | 61.5831 | 59.5159 | 57.2107 | 55.9004 | 57.3533 | 58.9460 | 61.4211 | 64.2824 | 66.5967 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 28.8721 | 28.4433 | 27.8395 | 26.7262 | 25.8925 | 24.9681 | 24.4688 | 25.0684 | 25.7212 | 26.7104 | 27.8467 | 28.7745 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 40.6700 | 39.1911 | 37.7122 | 36.2333 | 34.7544 | 33.2755 | 33.2755 | 34.7544 | 36.2333 | 37.7122 | 39.1911 | 40.6700 | (42c) |

| | | |
|---|---|---|
| Average daily hot water use (litres/day) | 125.3778 | (43) |

Daily hot water use

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 136.3950 | 133.4826 | 129.9359 | 124.5425 | 120.1628 | 115.4542 | 113.6446 | 117.1760 | 120.9005 | 125.8437 | 131.3201 | 136.0412 | (44) |
| 216.0163 | 190.0775 | 199.7066 | 170.4925 | 161.7622 | 141.9644 | 137.4433 | 145.0884 | 149.0824 | 170.7687 | 187.0896 | 213.0077 | (45) |

| | | |
|---|---|---|
| Energy content (annual) | Total = Sum(45)m = | 2082.4996 |

Distribution loss (46)m = 0.15 x (45)m

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.4024 | 28.5116 | 29.9560 | 25.5739 | 24.2643 | 21.2947 | 20.6165 | 21.7633 | 22.3624 | 25.6153 | 28.0634 | 31.9512 | (46) |

| | | |
|---|---|---|
| Water storage loss: | | |
| Store volume | 150.0000 | (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | 1.3938 | (48) |
| Temperature factor from Table 2b | 0.5400 | (49) |
| Enter (49) or (54) in (55) | 0.7527 | (55) |
| Total storage loss | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (56) |
| If cylinder contains dedicated solar storage | | | | | | | | | | | | | |
| | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (57) |
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | | | | | | | | | | | | | |
| | 262.6112 | 232.1632 | 246.3015 | 215.5843 | 208.3571 | 187.0563 | 184.0382 | 191.6833 | 194.1742 | 217.3636 | 232.1814 | 259.6026 | (62) |
| WWHRS | -30.5623 | -27.0296 | -28.3038 | -23.4367 | -21.8421 | -18.6905 | -17.5193 | -18.6301 | -19.3379 | -22.7972 | -25.8265 | -29.9964 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | | | | | | | | | | | | | |
| | 232.0489 | 205.1336 | 217.9977 | 192.1476 | 186.5150 | 168.3658 | 166.5189 | 173.0533 | 174.8363 | 194.5664 | 206.3549 | 229.6062 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2347.1447 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2347 | (64) |
| Electric shower(s) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | | | | | | | | | | | | | |
| | 109.1013 | 96.8693 | 103.6784 | 92.7622 | 91.0619 | 83.2767 | 82.9758 | 85.5178 | 85.6434 | 94.0565 | 98.2808 | 108.1010 | (65) |

## 5. Internal gains (see Table 5 and 5a)

| Metabolic gains (Table 5), Watts | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 127.1361 | 127.1361 | 127.1361 | 127.1361 | 127.1361 | 127.1361 | 127.1361 | 127.1361 | 127.1361 | 127.1361 | 127.1361 | 127.1361 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 115.2728 | 127.6234 | 115.2728 | 119.1152 | 115.2728 | 119.1152 | 115.2728 | 115.2728 | 119.1152 | 115.2728 | 119.1152 | 115.2728 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 228.5881 | 230.9601 | 224.9827 | 212.2575 | 196.1941 | 181.0968 | 171.0109 | 168.6389 | 174.6163 | 187.3416 | 203.4049 | 218.5022 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 35.7136 | 35.7136 | 35.7136 | 35.7136 | 35.7136 | 35.7136 | 35.7136 | 35.7136 | 35.7136 | 35.7136 | 35.7136 | 35.7136 | (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.0000 | 3.0000 | 3.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | | | | | | | | | | | | | |
| | -101.7089 | -101.7089 | -101.7089 | -101.7089 | -101.7089 | -101.7089 | -101.7089 | -101.7089 | -101.7089 | -101.7089 | -101.7089 | -101.7089 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 146.6416 | 144.1508 | 139.3526 | 128.8364 | 122.3950 | 115.6620 | 111.5266 | 114.9433 | 118.9491 | 126.4200 | 136.5011 | 145.2970 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 554.6433 | 566.8752 | 543.7490 | 524.3499 | 498.0027 | 477.0149 | 458.9512 | 459.9958 | 473.8215 | 493.1752 | 523.1620 | 543.2128 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Southwest | 7.1400 | 36.7938 | 0.6300 | 0.7000 | 0.7700 | 80.2870 | (79) |
| Northwest | 12.1000 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 41.7234 | (81) |
| Solar gains | 122.0104 | 221.6876 | 340.1341 | 483.1444 | 597.4805 | 617.9324 | 585.4436 | 496.3564 | 389.0617 | 254.9373 | 148.6641 | 102.7823 | (83) |
| Total gains | 676.6537 | 788.5628 | 883.8831 | 1007.4943 | 1095.4832 | 1094.9473 | 1044.3947 | 956.3522 | 862.8831 | 748.1125 | 671.8261 | 645.9952 | (84) |

## 7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 72.2650 | 72.5124 | 72.7565 | 73.9256 | 74.1485 | 75.2041 | 75.2041 | 75.4029 | 74.7939 | 74.1485 | 73.6989 | 73.2347 | |
| alpha | 5.8177 | 5.8342 | 5.8504 | 5.9284 | 5.9432 | 6.0136 | 6.0136 | 6.0269 | 5.9863 | 5.9432 | 5.9133 | 5.8823 | |
| util living area | | | | | | | | | | | | | |
| | 0.9975 | 0.9934 | 0.9811 | 0.9271 | 0.7865 | 0.5763 | 0.4212 | 0.4781 | 0.7511 | 0.9590 | 0.9937 | 0.9981 | (86) |
| MIT | 19.9082 | 20.0883 | 20.3490 | 20.6914 | 20.9132 | 20.9887 | 20.9985 | 20.9970 | 20.9508 | 20.6503 | 20.2255 | 19.8877 | (87) |
| Th 2 | 19.8919 | 19.8952 | 19.8985 | 19.9140 | 19.9169 | 19.9304 | 19.9304 | 19.9329 | 19.9252 | 19.9169 | 19.9110 | 19.9049 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9965 | 0.9907 | 0.9730 | 0.8980 | 0.7203 | 0.4849 | 0.3196 | 0.3690 | 0.6575 | 0.9360 | 0.9906 | 0.9973 | (89) |
| MIT 2 | 18.6416 | 18.8733 | 19.2036 | 19.6254 | 19.8551 | 19.9255 | 19.9301 | 19.9322 | 19.8986 | 19.5906 | 19.0611 | 18.6252 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.5504 | (91) |
| MIT | 19.3388 | 19.5421 | 19.8341 | 20.2122 | 20.4375 | 20.5107 | 20.5182 | 20.5183 | 20.4778 | 20.1739 | 19.7020 | 19.3201 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.3388 | 19.5421 | 19.8341 | 20.2122 | 20.4375 | 20.5107 | 20.5182 | 20.5183 | 20.4778 | 20.1739 | 19.7020 | 19.3201 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9957 | 0.9895 | 0.9724 | 0.9070 | 0.7537 | 0.5352 | 0.3756 | 0.4293 | 0.7079 | 0.9424 | 0.9898 | 0.9967 | (94) |
| Useful gains | 673.7656 | 780.3038 | 859.4629 | 913.7605 | 825.6581 | 585.9845 | 392.3221 | 410.5222 | 610.8620 | 705.0535 | 664.9491 | 643.8547 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | | | | | | | | | | | | | |
| | 1569.8075 | 1523.1833 | 1382.4603 | 1154.2865 | 888.8884 | 592.8715 | 393.0096 | 411.9916 | 643.2270 | 973.9747 | 1289.8550 | 1557.4005 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 666.6552 | 499.2150 | 389.1101 | 173.1787 | 47.0433 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 200.0774 | 449.9322 | 679.6781 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 3104.8900 | |
| Solar heating kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | | | | | | | | | | | | | |
| | 666.6552 | 499.2150 | 389.1101 | 173.1787 | 47.0433 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 200.0774 | 449.9322 | 679.6781 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 3104.8900 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 36.7443 | (99) |

## 9a. Energy requirements - Individual heating systems, including micro-CHP

| | | |
|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | 0.0000 | (201) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction of space heat from main system(s) | | | | | | | | | | | | 1.0000 | (202) |
| Efficiency of main space heating system 1 (in %) | | | | | | | | | | | | 92.3000 | (206) |
| Efficiency of main space heating system 2 (in %) | | | | | | | | | | | | 0.0000 | (207) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 | (208) |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| Space heating requirement | | | | | | | | | | | | | |
| | 666.6552 | 499.2150 | 389.1101 | 173.1787 | 47.0433 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 200.0774 | 449.9322 | 679.6781 | (98) |
| Space heating efficiency (main heating system 1) | | | | | | | | | | | | | |
| | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.3000 | 92.3000 | 92.3000 | (210) |
| Space heating fuel (main heating system) | | | | | | | | | | | | | |
| | 722.2700 | 540.8613 | 421.5710 | 187.6259 | 50.9679 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 216.7686 | 487.4672 | 736.3793 | (211) |
| Space heating efficiency (main heating system 2) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (212) |
| Space heating fuel (main heating system 2) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (213) |
| Space heating fuel (secondary) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (215) |
| Water heating | | | | | | | | | | | | | |
| Water heating requirement | | | | | | | | | | | | | |
| | 232.0489 | 205.1336 | 217.9977 | 192.1476 | 186.5150 | 168.3658 | 166.5189 | 173.0533 | 174.8363 | 194.5664 | 206.3549 | 229.6062 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 | (216) |
| (217)m | 86.2873 | 85.9760 | 85.3438 | 83.8274 | 81.4630 | 79.8000 | 79.8000 | 79.8000 | 79.8000 | 84.1225 | 85.7588 | 86.3411 | (217) |
| Fuel for water heating, kWh/month | | | | | | | | | | | | | |
| | 268.9260 | 238.5941 | 255.4347 | 229.2181 | 228.9567 | 210.9847 | 208.6703 | 216.8587 | 219.0932 | 231.2893 | 240.6224 | 265.9293 | (219) |
| Space cooling fuel requirement | | | | | | | | | | | | | |
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (221) |
| Pumps and Fa | 7.3041 | 6.5973 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | (231) |
| Lighting | 23.9514 | 19.2147 | 17.3007 | 12.6752 | 9.7907 | 7.9991 | 8.9314 | 11.6094 | 15.0795 | 19.7851 | 22.3472 | 24.6171 | (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233a)m | -18.5968 | -27.8196 | -42.3990 | -50.6355 | -57.2186 | -54.3603 | -53.6875 | -49.3711 | -42.2418 | -33.0786 | -21.0023 | -15.8961 | (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233b)m | -6.1481 | -13.2650 | -26.9990 | -41.5038 | -55.8314 | -56.4586 | -55.8057 | -46.8200 | -33.7505 | -19.2890 | -8.3083 | -4.8382 | (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235d) |
| Annual totals kWh/year | | | | | | | | | | | | | |
| Space heating fuel - main system 1 | | | | | | | | | | | | 3363.9112 | (211) |
| Space heating fuel - main system 2 | | | | | | | | | | | | 0.0000 | (213) |
| Space heating fuel - secondary | | | | | | | | | | | | 0.0000 | (215) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 | |
| Water heating fuel used | | | | | | | | | | | | 2814.5774 | (219) |
| Space cooling fuel | | | | | | | | | | | | 0.0000 | (221) |
| Electricity for pumps and fans: | | | | | | | | | | | | | |
| Total electricity for the above, kWh/year | | | | | | | | | | | | 86.0000 | (231) |
| Electricity for lighting (calculated in Appendix L) | | | | | | | | | | | | 193.3015 | (232) |
| Energy saving/generation technologies (Appendices M ,N and Q) | | | | | | | | | | | | | |
| PV generation | | | | | | | | | | | | -835.3248 | (233) |
| Wind generation | | | | | | | | | | | | 0.0000 | (234) |
| Hydro-electric generation (Appendix N) | | | | | | | | | | | | 0.0000 | (235a) |
| Electricity generated - Micro CHP (Appendix N) | | | | | | | | | | | | 0.0000 | (235) |
| Appendix Q - special features | | | | | | | | | | | | | |
| Energy saved or generated | | | | | | | | | | | | -0.0000 | (236) |
| Energy used | | | | | | | | | | | | 0.0000 | (237) |
| Total delivered energy for all uses | | | | | | | | | | | | 5622.4652 | (238) |

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 3363.9112 | 0.2100 | 706.4213 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2814.5774 | 0.2100 | 591.0612 | (264) |
| Space and water heating | | | 1297.4826 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 193.3015 | 0.1443 | 27.8994 | (268) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -466.3072 | 0.1334 | -62.1899 | |
| PV Unit electricity exported | -369.0177 | 0.1252 | -46.2072 | |
| Total | | | -108.3971 | (269) |
| Total CO2, kg/year | | | 1228.9141 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 14.5400 | (273) |

13a. Primary energy - Individual heating systems including micro-CHP

| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 3363.9112 | 1.1300 | 3801.2196 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2814.5774 | 1.1300 | 3180.4724 | (278) |
| Space and water heating | | | 6981.6920 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 193.3015 | 1.5338 | 296.4924 | (282) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -466.3072 | 1.4928 | -696.1181 | |
| PV Unit electricity exported | -369.0177 | 0.4596 | -169.6000 | |
| Total | | | -865.7181 | (283) |
| Total Primary energy kWh/year | | | 6542.5672 | (286) |
| Target Primary Energy Rate (TPER) | | | 77.4300 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Property Reference** | Unit 35 | **Issued on Date** | 17/05/2025 |
| **Assessment Reference** | 00001 | **Prop Type Ref** | Unit 35 |
| **Property** | | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 76 C | **DER** | 6.97 | **TER** | 16.75 |
| **Environmental** | 95 A | **% DER < TER** | | | 58.39 |
| **$CO_2$ Emissions (t/year)** | 0.32 | **DFEE** | 40.76 | **TFEE** | 42.60 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 4.32 |
| **% DPER < TPER** | 17.65 | **DPER** | 73.92 | **TPER** | 89.76 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Robert Arnold | **Assessor ID** | BA04-0001 |
| **Client** | | | |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

## 1. Overall dwelling characteristics

| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 51.3600 | (1b) | x 2.9500 | (2b) = | 151.5120 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 51.3600 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = | 151.5120 | (5) |

## 2. Ventilation rate

| | m3 per hour | |
|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 (6a) |
| Number of open flues | 0 * 20 = | 0.0000 (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 (6f) |
| Number of intermittent extract fans | 0 * 10 = | 0.0000 (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 (7c) |
| | Air changes per hour | |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 0.0000 / (5) = | 0.0000 (8) |
| Pressure test | | Yes |
| Pressure Test Method | | Blower Door |
| Measured/design AP50 | | 3.0000 (17) |
| Infiltration rate | | 0.1500 (18) |
| Number of sides sheltered | | 0 (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.1500 (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.1912 | 0.1875 | 0.1837 | 0.1650 | 0.1612 | 0.1425 | 0.1425 | 0.1388 | 0.1500 | 0.1612 | 0.1687 | 0.1762 | (22b) |

Balanced mechanical ventilation with heat recovery

| | | |
|---|---|---|
| If mechanical ventilation | | 0.5000 (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | | 0.5000 (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | | 81.0000 (23c) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective ac | 0.2862 | 0.2825 | 0.2787 | 0.2600 | 0.2562 | 0.2375 | 0.2375 | 0.2337 | 0.2450 | 0.2562 | 0.2637 | 0.2712 | (25) |

## 3. Heat losses and heat loss parameter

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| Windows | | | 12.0200 | 1.0536 | 12.6648 | | | (27) |
| Front Door | | | 1.8900 | 1.4000 | 2.6460 | | | (26) |
| Glass Door | | | 2.2900 | 1.3258 | 3.0360 | | | (27) |
| External Walls | 29.7600 | 14.3100 | 15.4500 | 0.1500 | 2.3175 | 150.0000 | 2317.5000 | (29a) |
| Wall to Communal Corridor | 14.0900 | 1.8900 | 12.2000 | 0.1500 | 1.8300 | 150.0000 | 1830.0000 | (29a) |
| External Roof | 40.9500 | | 40.9500 | 0.1000 | 4.0950 | 9.0000 | 368.5500 | (30) |
| Total net area of external elements Aum(A, m2) | | | 84.8000 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 26.5892 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 34 | | | 15.0100 | 0.0000 | 0.0000 | 110.0000 | 1651.1000 | (32) |
| Party Wall to Unit 36 | | | 10.0500 | 0.0000 | 0.0000 | 110.0000 | 1105.5000 | (32) |
| Party Floor | | | 51.3600 | | | 80.0000 | 4108.8000 | (32d) |
| Party Ceiling | | | 7.6800 | | | 100.0000 | 768.0000 | (32b) |
| Internal Walls | | | 98.6500 | | | 9.0000 | 887.8500 | (32c) |

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 13037.3000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 253.8415 (35)
List of Thermal Bridges

| | Length | Psi-value | Total | |
|---|---|---|---|---|
| K1 Element | | | | |
| E1 Steel lintel with perforated steel base plate | 7.2600 | 0.0500 | 0.3630 | |
| E4 Jamb | 17.6400 | 0.0500 | 0.8820 | |
| E7 Party floor between dwellings (in blocks of flats) | 10.0900 | 0.0700 | 0.7063 | |
| E18 Party wall between dwellings | 11.8000 | 0.0600 | 0.7080 | |
| E25 Staggered party wall between dwellings | 2.9500 | 0.0600 | 0.1770 | |
| E24 Eaves (insulation at ceiling level - inverted) | 10.0910 | 0.1200 | 1.2109 | |
| E24 Eaves (insulation at ceiling level - inverted) | 8.6180 | 0.1200 | 1.0342 | |
| E15 Flat roof with parapet | 10.0910 | 0.5600 | 5.6510 | |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 10.7323 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 37.3216 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 14.3122 | 14.1247 | 13.9372 | 12.9997 | 12.8122 | 11.8748 | 11.8748 | 11.6873 | 12.2497 | 12.8122 | 13.1872 | 13.5622 | (38) |
| Heat transfer coeff | 51.6338 | 51.4463 | 51.2588 | 50.3213 | 50.1338 | 49.1963 | 49.1963 | 49.0088 | 49.5713 | 50.1338 | 50.5088 | 50.8838 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 50.2744 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.0053 | 1.0017 | 0.9980 | 0.9798 | 0.9761 | 0.9579 | 0.9579 | 0.9542 | 0.9652 | 0.9761 | 0.9834 | 0.9907 | (40) |
| HLP (average) | | | | | | | | | | | | 0.9789 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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## 4. Water heating energy requirements (kWh/year)

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Assumed occupancy 1.7302 (42)
Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 51.8843 | 51.0899 | 49.9193 | 48.1184 | 46.5049 | 44.2476 | 42.4622 | 44.5494 | 45.5992 | 47.8350 | 50.1633 | 51.8375 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 22.5005 | 22.1608 | 21.6776 | 20.9540 | 20.3018 | 19.4041 | 18.7230 | 19.5558 | 19.9929 | 20.8825 | 21.8073 | 22.4826 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.3489 | 31.1725 | 29.9962 | 28.8199 | 27.6436 | 26.4673 | 26.4673 | 27.6436 | 28.8199 | 29.9962 | 31.1725 | 32.3489 | (42c) |

Average daily hot water use (litres/day) 98.1046 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 106.7336 | 104.4233 | 101.5931 | 97.8923 | 94.4503 | 90.1189 | 87.6524 | 91.7488 | 94.4120 | 98.7137 | 103.1432 | 106.6690 | (44) |
| Energy conte | 157.1303 | 138.1731 | 145.1744 | 127.8718 | 121.7088 | 104.2195 | 96.8585 | 107.9901 | 109.5133 | 127.2025 | 139.4014 | 156.6512 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1531.8950 | |
| Distribution loss (46)m = 0.15 x (45)m | 23.5695 | 20.7260 | 21.7762 | 19.1808 | 18.2563 | 15.6329 | 14.5288 | 16.1985 | 16.4270 | 19.0804 | 20.9102 | 23.4977 | (46) |

Water storage loss:
Store volume 110.0000 (47)
b) If manufacturer declared loss factor is not known :
Hot water storage loss factor from Table 2 (kWh/litre/day) 0.0152 (51)
Volume factor from Table 2a 1.0294 (52)
Temperature factor from Table 2b 0.6000 (53)
Enter (49) or (54) in (55) 1.0327 (55)
Total storage loss

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (56) |

If cylinder contains dedicated solar storage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (57) |
| 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |

Primary loss
Combi loss
Total heat required for water heating calculated for each month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 212.4071 | 188.1005 | 200.4513 | 181.3655 | 176.9856 | 157.7132 | 152.1353 | 163.2669 | 163.0069 | 182.4793 | 192.8951 | 211.9280 | (62) |
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63a) |
| -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |

WWHRS
PV diverter
Solar input
FGHRS
Output from w/h

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 212.4071 | 188.1005 | 200.4513 | 181.3655 | 176.9856 | 157.7132 | 152.1353 | 163.2669 | 163.0069 | 182.4793 | 192.8951 | 211.9280 | (64) |

Total per year (kWh/year) = Sum(64)m = 2182.7347 (64)
12Total per year (kWh/year) 2183 (64)
Electric shower(s)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)
Heat gains from water heating, kWh/month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 96.4673 | 85.8845 | 92.4919 | 85.3123 | 84.6896 | 77.4479 | 76.4269 | 80.1281 | 79.2081 | 86.5163 | 89.1459 | 96.3080 | (65) |

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## 5. Internal gains (see Table 5 and 5a)

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Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 86.5095 | 86.5095 | 86.5095 | 86.5095 | 86.5095 | 86.5095 | 86.5095 | 86.5095 | 86.5095 | 86.5095 | 86.5095 | 86.5095 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 76.0438 | 84.1913 | 76.0438 | 78.5786 | 76.0438 | 78.5786 | 76.0438 | 76.0438 | 78.5786 | 76.0438 | 78.5786 | 76.0438 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 150.7653 | 152.3298 | 148.3874 | 139.9944 | 129.3998 | 119.4424 | 112.7903 | 111.2258 | 115.1682 | 123.5612 | 134.1557 | 144.1132 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 31.6509 | 31.6509 | 31.6509 | 31.6509 | 31.6509 | 31.6509 | 31.6509 | 31.6509 | 31.6509 | 31.6509 | 31.6509 | 31.6509 | (69) |
| Pumps, fans | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | -69.2076 | -69.2076 | -69.2076 | -69.2076 | -69.2076 | -69.2076 | -69.2076 | -69.2076 | -69.2076 | -69.2076 | -69.2076 | -69.2076 | (71) |
| Water heating gains (Table 5) | 129.6603 | 127.8043 | 124.3171 | 118.4893 | 113.8301 | 107.5666 | 102.7243 | 107.6991 | 110.0113 | 116.2853 | 123.8138 | 129.4462 | (72) |
| Total internal gains | 405.4223 | 413.2783 | 397.7011 | 386.0152 | 368.2266 | 354.5404 | 340.5112 | 343.9215 | 352.7109 | 364.8431 | 385.5010 | 398.5560 | (73) |

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## 6. Solar gains

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| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Southwest | 12.0200 | 36.7938 | 0.4500 | 0.7000 | 0.7700 | 96.5436 | (79) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southwest | | | 2.2900 | | 36.7938 | | 0.4500 | | 0.7000 | | 0.7700 | | 18.3931 (79) |
| Solar gains | 114.9366 | 195.7796 | 267.8742 | 331.9091 | 371.7659 | 369.0774 | 355.8300 | 326.0951 | 290.0511 | 216.3782 | 137.6676 | 98.3618 | (83) |
| Total gains | 520.3589 | 609.0579 | 665.5753 | 717.9243 | 739.9925 | 723.6179 | 696.3413 | 670.0167 | 642.7620 | 581.2213 | 523.1685 | 496.9178 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| tau | 70.1377 | 70.3933 | 70.6508 | 71.9670 | 72.2361 | 73.6127 | 73.6127 | 73.8943 | 73.0558 | 72.2361 | 71.6998 | 71.1714 | |
| alpha | 5.6758 | 5.6929 | 5.7101 | 5.7978 | 5.8157 | 5.9075 | 5.9075 | 5.9263 | 5.8704 | 5.8157 | 5.7800 | 5.7448 | |
| util living area | 0.9766 | 0.9473 | 0.8936 | 0.7745 | 0.6135 | 0.4333 | 0.3106 | 0.3361 | 0.5259 | 0.8032 | 0.9461 | 0.9810 | (86) |
| MIT | 20.2503 | 20.4675 | 20.6852 | 20.8876 | 20.9739 | 20.9972 | 20.9997 | 20.9995 | 20.9915 | 20.8839 | 20.5598 | 20.2200 | (87) |
| Th 2 | 20.0789 | 20.0819 | 20.0850 | 20.1002 | 20.1033 | 20.1186 | 20.1186 | 20.1217 | 20.1125 | 20.1033 | 20.0972 | 20.0911 | (88) |
| util rest of house | 0.9701 | 0.9341 | 0.8695 | 0.7336 | 0.5598 | 0.3745 | 0.2485 | 0.2721 | 0.4609 | 0.7570 | 0.9304 | 0.9756 | (89) |
| MIT 2 | 19.2369 | 19.5052 | 19.7650 | 19.9995 | 20.0841 | 20.1172 | 20.1185 | 20.1215 | 20.1076 | 20.0038 | 19.6342 | 19.2089 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.6145 | (91) |
| MIT | 19.8597 | 20.0965 | 20.3305 | 20.5452 | 20.6309 | 20.6579 | 20.6600 | 20.6610 | 20.6507 | 20.5446 | 20.2029 | 19.8302 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.8597 | 20.0965 | 20.3305 | 20.5452 | 20.6309 | 20.6579 | 20.6600 | 20.6610 | 20.6507 | 20.5446 | 20.2029 | 19.8302 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9683 | 0.9343 | 0.8764 | 0.7545 | 0.5918 | 0.4106 | 0.2867 | 0.3115 | 0.5006 | 0.7807 | 0.9324 | 0.9737 | (94) |
| Useful gains | 503.8706 | 569.0546 | 583.3410 | 541.6717 | 437.8999 | 297.0976 | 199.6465 | 208.6837 | 321.7830 | 453.7587 | 487.8235 | 483.8646 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | 803.4037 | 781.8044 | 708.9328 | 586.0036 | 447.7383 | 298.0283 | 199.7356 | 208.8273 | 324.7288 | 498.5599 | 661.8131 | 795.3260 | (97) |
| Space heating kWh | 222.8526 | 142.9679 | 93.4403 | 31.9190 | 7.3198 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 33.3321 | 125.2725 | 231.7273 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 888.8315 | |
| Solar heating kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | 222.8526 | 142.9679 | 93.4403 | 31.9190 | 7.3198 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 33.3321 | 125.2725 | 231.7273 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 888.8315 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 17.3059 | (99) |

## 8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ext. temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | |
| Heat loss rate W | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 462.4455 | 364.0528 | 372.4671 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (100) |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.9835 | 0.9939 | 0.9917 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (101) |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 454.8238 | 361.8158 | 369.3748 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (102) |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 804.7399 | 774.9520 | 744.7147 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 251.9396 | 307.3733 | 279.2529 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (104) |
| Cooled fraction | | | | | | | | | | fC = cooled area / (4) = | | 0.9930 | (105) |
| Intermittency factor (Table 10b) | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | (106) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 62.5434 | 76.3047 | 69.3239 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) |
| Space cooling requirement | | | | | | | | | | | | 208.1720 | (107) |

## 9b. Energy requirements

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | 0.0000 | (301) |
| Fraction of space heat from community system | | | | | | | | | | | | 1.0000 | (302) |
| Fraction of heat from community Heat pump-Space and Water | | | | | | | | | | | | 1.0000 | (303a) |
| Factor for control and charging method (Table 4c(3)) for space heating | | | | | | | | | | | | 1.0000 | (305) |
| Factor for charging method (Table 4c(3)) for water heating | | | | | | | | | | | | 1.0000 | (305a) |
| Distribution loss factor (Table 12c) for community heating system | | | | | | | | | | | | 2.0000 | (306) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 | (208) |
| Space heating: | | | | | | | | | | | | | |
| Space heating requirement | 222.8526 | 142.9679 | 93.4403 | 31.9190 | 7.3198 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 33.3321 | 125.2725 | 231.7273 | (98) |
| Space heat from Heat pump = (98) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 307a | 445.7052 | 285.9358 | 186.8806 | 63.8380 | 14.6395 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 66.6642 | 250.5451 | 463.4545 | |
| Space heating requirement | 445.7052 | 285.9358 | 186.8806 | 63.8380 | 14.6395 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 66.6642 | 250.5451 | 463.4545 | (307) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | | | | | | | | | | | 0.0000 | (308) |
| Space heating fuel for secondary/supplementary system | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (309) |
| Water heating | | | | | | | | | | | | | |
| Annual water heating requirement | 212.4071 | 188.1005 | 200.4513 | 181.3655 | 176.9856 | 157.7132 | 152.1353 | 163.2669 | 163.0069 | 182.4793 | 192.8951 | 211.9280 | (64) |
| Water heat from Heat pump = (64) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 310a | 424.8142 | 376.2011 | 400.9025 | 362.7310 | 353.9712 | 315.4264 | 304.2707 | 326.5338 | 326.0139 | 364.9587 | 385.7902 | 423.8560 | |
| Water heating fuel | 424.8142 | 376.2011 | 400.9025 | 362.7310 | 353.9712 | 315.4264 | 304.2707 | 326.5338 | 326.0139 | 364.9587 | 385.7902 | 423.8560 | (310) |
| Cooling System Energy Efficiency Ratio | | | | | | | | | | | | 2.6000 | (314) |
| Space coolin | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 24.0552 | 29.3480 | 26.6630 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (315) |
| Pumps and Fa | 13.8466 | 12.5066 | 13.8466 | 13.4000 | 13.8466 | 13.4000 | 13.8466 | 13.8466 | 13.4000 | 13.8466 | 13.4000 | 13.8466 | (331) |
| Lighting | 14.7024 | 11.7948 | 10.6199 | 7.7806 | 6.0099 | 4.9102 | 5.4825 | 7.1263 | 9.2564 | 12.1449 | 13.7176 | 15.1110 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333a)m | -4.6994 | -7.5748 | -12.5224 | -16.1411 | -19.2204 | -18.6332 | -18.3718 | -16.3690 | -13.1945 | -9.4291 | -5.4697 | -3.9483 | (333a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334a) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335a) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (333b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335b) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - community heating | 1777.6630 | (307) |
| Space heating fuel - secondary | 0.0000 | (309) |
| Water heating fuel - community heating | 4365.4695 | (310) |
| Efficiency of water heater | 0.0000 | (311) |
| Electricity used for heat distribution | 17.7766 | (313) |
| Space cooling fuel | 80.0662 | (321) |
| | | |
| Electricity for pumps and fans: | | |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8820) | | |
| mechanical ventilation fans (SFP = 0.8820) | 163.0330 | (330a) |
| Total electricity for the above, kWh/year | 163.0330 | (331) |
| Electricity for lighting (calculated in Appendix L) | 118.6565 | (332) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -145.5737 | (333) |
| Wind generation | 0.0000 | (334) |
| Hydro-electric generation (Appendix N) | 0.0000 | (335a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (335) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (336) |
| Energy used | 0.0000 | (337) |
| Total delivered energy for all uses | 6359.3143 | (338) |

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12b. Carbon dioxide emissions - Community heating scheme

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (367) |
| Space and Water heating from Heat pump | 2193.9759 | 0.1578 | 100.1769 | (367) |
| Electrical energy for heat distribution (space & water) | 17.7766 | 0.0000 | 8.9481 | (372) |
| Overall CO2 factor for heat network | | | 0.0535 | (386) |
| Total CO2 associated with community systems | | | 328.5242 | (373) |
| Space and water heating | | | 328.5242 | (376) |
| Space cooling | 80.0662 | 0.1140 | 9.1305 | (377) |
| Pumps, fans and electric keep-hot | 163.0330 | 0.1387 | 22.6147 | (378) |
| Energy for lighting | 118.6565 | 0.1443 | 17.1258 | (379) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -145.5737 | 0.1320 | -19.2093 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -19.2093 | (380) |
| Total CO2, kg/year | | | 358.1858 | (383) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 6.9700 | (384) |

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13b. Primary energy - Community heating scheme

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| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (467a) |
| Space and Water heating from Heat pump | 2193.9759 | 1.5841 | 1005.7067 | (467) |
| Electrical energy for heat distribution (space & water) | 17.7766 | 0.0000 | 94.5293 | (472) |
| Overall CO2 factor for heat network | | | 0.5650 | (486) |
| Total CO2 associated with community systems | | | 3470.5755 | (473) |
| Space and water heating | | | 3470.5755 | (476) |
| Space cooling | 80.0662 | 1.4203 | 113.7190 | (477) |
| Pumps, fans and electric keep-hot | 163.0330 | 1.5128 | 246.6363 | (478) |
| Energy for lighting | 118.6565 | 1.5338 | 181.9993 | (479) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -145.5737 | 1.4875 | -216.5460 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -216.5460 | (480) |
| Total Primary energy kWh/year | | | 3796.3840 | (483) |
| Dwelling Primary energy Rate (DPER) | | | 73.9200 | (484) |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 51.3600 | (1b) | x 2.9500 | (2b) = | 151.5120 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 51.3600 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = | 151.5120 | (5) |

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2. Ventilation rate

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| | m3 per hour | |
|---|---|---|
| Number of open chimneys | 0 * 80 = 0.0000 | (6a) |

| | | |
|---|---|---|
| Number of open flues | 0 * 20 = | 0.0000 (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 (6f) |
| Number of intermittent extract fans | 2 * 10 = | 20.0000 (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 (7c) |

| | | Air changes per hour | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 20.0000 / (5) = | 0.1320 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3820 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.3820 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.4871 | 0.4775 | 0.4680 | 0.4202 | 0.4107 | 0.3629 | 0.3629 | 0.3534 | 0.3820 | 0.4107 | 0.4298 | 0.4489 | (22b) |
| Effective ac | 0.6186 | 0.6140 | 0.6095 | 0.5883 | 0.5843 | 0.5658 | 0.5658 | 0.5624 | 0.5730 | 0.5843 | 0.5923 | 0.6007 | (25) |

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## 3. Heat losses and heat loss parameter

---

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| TER Opaque door | | | 1.8900 | 1.0000 | 1.8900 | | | (26) |
| TER Opening Type | | | 10.9500 | 1.1450 | 12.5382 | | | (27) |
| External Walls | 29.7600 | 10.9500 | 18.8100 | 0.1800 | 3.3858 | | | (29a) |
| Wall to Communal Corridor | 14.0900 | 1.8900 | 12.2000 | 0.1800 | 2.1960 | | | (29a) |
| External Roof | 40.9500 | | 40.9500 | 0.1100 | 4.5045 | | | (30) |
| Total net area of external elements Aum(A, m2) | | | 84.8000 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 24.5145 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 34 | | | 15.0100 | 0.0000 | 0.0000 | | | (32) |
| Party Wall to Unit 36 | | | 10.0500 | 0.0000 | 0.0000 | | | (32) |

| | | |
|---|---|---|
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | 250.8509 | (35) |

List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E1 Steel lintel with perforated steel base plate | 7.2600 | 0.0500 | 0.3630 |
| E4 Jamb | 17.6400 | 0.0500 | 0.8820 |
| E7 Party floor between dwellings (in blocks of flats) | 10.0900 | 0.0700 | 0.7063 |
| E18 Party wall between dwellings | 11.8000 | 0.0600 | 0.7080 |
| E25 Staggered party wall between dwellings | 2.9500 | 0.0600 | 0.1770 |
| E24 Eaves (insulation at ceiling level - inverted) | 10.0910 | 0.2400 | 2.4218 |
| E24 Eaves (insulation at ceiling level - inverted) | 8.6180 | 0.2400 | 2.0683 |
| E15 Flat roof with parapet | 10.0910 | 0.5600 | 5.6510 |

| | | |
|---|---|---|
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | 12.9774 | (36) |
| Point Thermal bridges (36a) = | 0.0000 | |
| Total fabric heat loss (33) + (36) + (36a) = | 37.4919 | (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 30.9299 | 30.6996 | 30.4739 | 29.4137 | 29.2153 | 28.2919 | 28.2919 | 28.1209 | 28.6476 | 29.2153 | 29.6166 | 30.0361 | (38) |
| Heat transfer coeff | 68.4218 | 68.1915 | 67.9658 | 66.9055 | 66.7072 | 65.7838 | 65.7838 | 65.6128 | 66.1394 | 66.7072 | 67.1085 | 67.5280 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 66.9046 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.3322 | 1.3277 | 1.3233 | 1.3027 | 1.2988 | 1.2808 | 1.2808 | 1.2775 | 1.2878 | 1.2988 | 1.3066 | 1.3148 | (40) |
| HLP (average) | | | | | | | | | | | | 1.3027 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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## 4. Water heating energy requirements (kWh/year)

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| | | |
|---|---|---|
| Assumed occupancy | 1.7302 | (42) |

Hot water usage for mixer showers

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 53.2291 | 52.4292 | 51.2635 | 49.0332 | 47.3874 | 45.5519 | 44.5086 | 45.6654 | 46.9335 | 48.9043 | 51.1824 | 53.0251 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.0135 | 22.6717 | 22.1904 | 21.3030 | 20.6385 | 19.9016 | 19.5036 | 19.9816 | 20.5020 | 21.2904 | 22.1961 | 22.9357 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.3489 | 31.1725 | 29.9962 | 28.8199 | 27.6436 | 26.4673 | 26.4673 | 27.6436 | 28.8199 | 29.9962 | 31.1725 | 32.3489 | (42c) |

| | | |
|---|---|---|
| Average daily hot water use (litres/day) | 99.8206 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 108.5914 | 106.2734 | 103.4501 | 99.1561 | 95.6694 | 91.9208 | 90.4795 | 93.2906 | 96.2554 | 100.1909 | 104.5511 | 108.3097 | (44) |
| Energy conte | 171.9823 | 151.3319 | 158.9990 | 135.7397 | 128.7894 | 113.0273 | 109.4271 | 115.5132 | 118.6925 | 135.9581 | 148.9522 | 169.5868 | (45) |
| Energy content (annual) | | | | | | | | | | | Total = Sum(45)m = | 1657.9996 | |
| Distribution loss (46)m = 0.15 x (45)m | 25.7973 | 22.6998 | 23.8498 | 20.3610 | 19.3184 | 16.9541 | 16.4141 | 17.3270 | 17.8039 | 20.3937 | 22.3428 | 25.4380 | (46) |

| | | |
|---|---|---|
| Water storage loss: | | |
| Store volume | 150.0000 | (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | 1.3938 | (48) |
| Temperature factor from Table 2b | 0.5400 | (49) |
| Enter (49) or (54) in (55) | 0.7527 | (55) |

Total storage loss

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (56) |

If cylinder contains dedicated solar storage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (57) |
| Primary loss 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |

Total heat required for water heating calculated for each month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 218.5772 | 193.4176 | 205.5939 | 180.8316 | 175.3843 | 158.1192 | 156.0220 | 162.1081 | 163.7844 | 182.5530 | 194.0440 | 216.1817 | (62) |
| WWHRS -24.3341 | -21.5213 | -22.5359 | -18.6606 | -17.3910 | -14.8816 | -13.9491 | -14.8335 | -15.3971 | -18.1514 | -20.5634 | -23.8835 | (63a) |
| PV diverter -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | 194.2431 | 171.8963 | 183.0580 | 162.1710 | 157.9933 | 143.2376 | 142.0729 | 147.2746 | 148.3873 | 164.4015 | 173.4807 | 192.2982 | (64) |
| | | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | 1980.5146 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 1981 | (64) |
| Electric shower(s) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | 94.4600 | 83.9864 | 90.1431 | 81.2069 | 80.0984 | 73.6551 | 73.6604 | 75.6841 | 75.5387 | 82.4820 | 85.6001 | 93.6635 | (65) |

## 5. Internal gains (see Table 5 and 5a)

| Metabolic gains (Table 5), Watts | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 86.5095 | 86.5095 | 86.5095 | 86.5095 | 86.5095 | 86.5095 | 86.5095 | 86.5095 | 86.5095 | 86.5095 | 86.5095 | 86.5095 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 76.1782 | 84.3402 | 76.1782 | 78.7175 | 76.1782 | 78.7175 | 76.1782 | 76.1782 | 78.7175 | 76.1782 | 78.7175 | 76.1782 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 150.7653 | 152.3298 | 148.3874 | 139.9944 | 129.3998 | 119.4424 | 112.7903 | 111.2258 | 115.1682 | 123.5612 | 134.1557 | 144.1132 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 31.6509 | 31.6509 | 31.6509 | 31.6509 | 31.6509 | 31.6509 | 31.6509 | 31.6509 | 31.6509 | 31.6509 | 31.6509 | 31.6509 | (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.0000 | 3.0000 | 3.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | -69.2076 | -69.2076 | -69.2076 | -69.2076 | -69.2076 | -69.2076 | -69.2076 | -69.2076 | -69.2076 | -69.2076 | -69.2076 | -69.2076 | (71) |
| Water heating gains (Table 5) | 126.9624 | 124.9798 | 121.1601 | 112.7874 | 107.6591 | 102.2987 | 99.0060 | 101.7259 | 104.9149 | 110.8629 | 118.8890 | 125.8918 | (72) |
| Total internal gains | 405.8588 | 413.6026 | 397.6785 | 383.4522 | 365.1901 | 349.4115 | 336.9273 | 338.0828 | 347.7535 | 362.5551 | 383.7151 | 398.1361 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Southwest | 10.9500 | 36.7938 | 0.6300 | 0.7000 | 0.7700 | 123.1292 | (79) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 123.1292 | 209.7345 | 286.9679 | 355.5672 | 398.2649 | 395.3848 | 381.1932 | 349.3388 | 310.7256 | 231.8013 | 147.4804 | 105.3729 | (83) |
| Total gains | 528.9880 | 623.3372 | 684.6465 | 739.0194 | 763.4550 | 744.7963 | 718.1205 | 687.4216 | 658.4791 | 594.3565 | 531.1955 | 503.5090 | (84) |

## 7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a) | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 52.3051 | 52.4817 | 52.6560 | 53.4904 | 53.6495 | 54.4026 | 54.4026 | 54.5444 | 54.1100 | 53.6495 | 53.3287 | 52.9974 | |
| alpha | 4.4870 | 4.4988 | 4.5104 | 4.5660 | 4.5766 | 4.6268 | 4.6268 | 4.6363 | 4.6073 | 4.5766 | 4.5552 | 4.5332 | |
| util living area | 0.9828 | 0.9646 | 0.9318 | 0.8556 | 0.7267 | 0.5470 | 0.3994 | 0.4336 | 0.6480 | 0.8778 | 0.9654 | 0.9858 | (86) |
| MIT | 19.7452 | 19.9985 | 20.2986 | 20.6410 | 20.8671 | 20.9723 | 20.9947 | 20.9923 | 20.9398 | 20.6514 | 20.1499 | 19.7104 | (87) |
| Th 2 | 19.8157 | 19.8192 | 19.8226 | 19.8387 | 19.8418 | 19.8559 | 19.8559 | 19.8585 | 19.8504 | 19.8418 | 19.8356 | 19.8293 | (88) |
| util rest of house | 0.9775 | 0.9542 | 0.9120 | 0.8163 | 0.6606 | 0.4570 | 0.2975 | 0.3288 | 0.5572 | 0.8354 | 0.9533 | 0.9814 | (89) |
| MIT 2 | 18.4078 | 18.7257 | 19.0948 | 19.5046 | 19.7409 | 19.8418 | 19.8544 | 19.8562 | 19.8154 | 19.5297 | 18.9311 | 18.3737 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.6145 | (91) |
| MIT | 19.2296 | 19.5078 | 19.8345 | 20.2029 | 20.4329 | 20.5365 | 20.5551 | 20.5543 | 20.5063 | 20.2189 | 19.6800 | 19.1951 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.2296 | 19.5078 | 19.8345 | 20.2029 | 20.4329 | 20.5365 | 20.5551 | 20.5543 | 20.5063 | 20.2189 | 19.6800 | 19.1951 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9741 | 0.9508 | 0.9123 | 0.8296 | 0.6957 | 0.5114 | 0.3602 | 0.3932 | 0.6106 | 0.8506 | 0.9514 | 0.9784 | (94) |
| Useful gains | 515.3058 | 592.6996 | 624.5805 | 613.1258 | 531.1298 | 380.9023 | 258.6647 | 270.3074 | 402.0691 | 505.5603 | 505.3555 | 492.6177 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | 1021.5116 | 996.1304 | 906.2916 | 756.2253 | 582.5468 | 390.5244 | 260.1826 | 272.5771 | 423.7104 | 641.6521 | 844.2274 | 1012.5873 | (97) |
| Space heating kWh | 376.6171 | 271.1055 | 209.5930 | 103.0316 | 38.2542 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 101.2523 | 243.9878 | 386.8574 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 1730.6990 | |
| Solar heating kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | 376.6171 | 271.1055 | 209.5930 | 103.0316 | 38.2542 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 101.2523 | 243.9878 | 386.8574 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 1730.6990 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 33.6974 | (99) |

## 9a. Energy requirements - Individual heating systems, including micro-CHP

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | 0.0000 | (201) |
| Fraction of space heat from main system(s) | | | | | | | | | | | | 1.0000 | (202) |
| Efficiency of main space heating system 1 (in %) | | | | | | | | | | | | 92.3000 | (206) |
| Efficiency of main space heating system 2 (in %) | | | | | | | | | | | | 0.0000 | (207) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 | (208) |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| Space heating requirement | 376.6171 | 271.1055 | 209.5930 | 103.0316 | 38.2542 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 101.2523 | 243.9878 | 386.8574 | (98) |
| Space heating efficiency (main heating system 1) | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.3000 | 92.3000 | 92.3000 | (210) |
| Space heating fuel (main heating system) | | | | | | | | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 408.0358 | 293.7221 | 227.0781 | 111.6269 | 41.4455 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 109.6992 | 264.3421 | 419.1304 (211) |
| Space heating efficiency (main heating system 2) | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (212) |
| Space heating fuel (main heating system 2) | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (213) |
| Space heating fuel (secondary) | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (215) |
| Water heating | | | | | | | | | | | | |
| Water heating requirement | | | | | | | | | | | | |
| | 194.2431 | 171.8963 | 183.0580 | 162.1710 | 157.9933 | 143.2376 | 142.0729 | 147.2746 | 148.3873 | 164.4015 | 173.4807 | 192.2982 (64) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 (216) |
| (217)m | 85.5182 | 85.0768 | 84.3641 | 83.0709 | 81.4083 | 79.8000 | 79.8000 | 79.8000 | 79.8000 | 83.0065 | 84.8245 | 85.5947 (217) |
| Fuel for water heating, kWh/month | | | | | | | | | | | | |
| | 227.1366 | 202.0483 | 216.9856 | 195.2199 | 194.0751 | 179.4957 | 178.0362 | 184.5547 | 185.9490 | 198.0586 | 204.5171 | 224.6613 (219) |
| Space cooling fuel requirement | | | | | | | | | | | | |
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (221) |
| Pumps and Fa | 7.3041 | 6.5973 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 (231) |
| Lighting | 15.8283 | 12.6981 | 11.4332 | 8.3765 | 6.4702 | 5.2862 | 5.9023 | 7.6721 | 9.9653 | 13.0750 | 14.7682 | 16.2683 (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (233a)m | -11.4881 | -17.2874 | -26.5087 | -31.8712 | -36.2229 | -34.5128 | -34.1091 | -31.2779 | -26.6147 | -20.6655 | -13.0163 | -9.8101 (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | |
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (233b)m | -3.5521 | -7.6842 | -15.6722 | -24.1320 | -32.4901 | -32.8441 | -32.4421 | -27.1880 | -19.5742 | -11.1641 | -4.7990 | -2.7924 (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | |
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235d) |

| | |
|---|---|
| Annual totals kWh/year | |
| Space heating fuel - main system 1 | 1875.0801 (211) |
| Space heating fuel - main system 2 | 0.0000 (213) |
| Space heating fuel - secondary | 0.0000 (215) |
| Efficiency of water heater | 79.8000 |
| Water heating fuel used | 2390.7383 (219) |
| Space cooling fuel | 0.0000 (221) |
| Electricity for pumps and fans: | |
| Total electricity for the above, kWh/year | 86.0000 (231) |
| Electricity for lighting (calculated in Appendix L) | 127.7437 (232) |
| Energy saving/generation technologies (Appendices M ,N and Q) | |
| PV generation | -507.7193 (233) |
| Wind generation | 0.0000 (234) |
| Hydro-electric generation (Appendix N) | 0.0000 (235a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 (235) |
| Appendix Q - special features | |
| Energy saved or generated | -0.0000 (236) |
| Energy used | 0.0000 (237) |
| Total delivered energy for all uses | 3971.8428 (238) |

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 1875.0801 | 0.2100 | 393.7668 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2390.7383 | 0.2100 | 502.0550 | (264) |
| Space and water heating | | | 895.8219 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 127.7437 | 0.1443 | 18.4374 | (268) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -293.3848 | 0.1332 | -39.0862 | |
| PV Unit electricity exported | -214.3346 | 0.1252 | -26.8318 | |
| Total | | | -65.9180 | (269) |
| Total CO2, kg/year | | | 860.2705 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 16.7500 | (273) |

13a. Primary energy - Individual heating systems including micro-CHP

| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 1875.0801 | 1.1300 | 2118.8406 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2390.7383 | 1.1300 | 2701.5342 | (278) |
| Space and water heating | | | 4820.3748 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 127.7437 | 1.5338 | 195.9376 | (282) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -293.3848 | 1.4923 | -437.8178 | |
| PV Unit electricity exported | -214.3346 | 0.4595 | -98.4842 | |
| Total | | | -536.3020 | (283) |
| Total Primary energy kWh/year | | | 4610.1112 | (286) |
| Target Primary Energy Rate (TPER) | | | 89.7600 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Property Reference** | Unit 36 | **Issued on Date** | 17/05/2025 |
| **Assessment Reference** | 00001 | **Prop Type Ref** | Unit 36 |
| **Property** | | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 75 C | **DER** | 6.67 | **TER** | 15.94 |
| **Environmental** | 94 A | **% DER < TER** | | | 58.16 |
| **$CO_2$ Emissions (t/year)** | 0.51 | **DFEE** | 47.17 | **TFEE** | 51.00 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 7.50 |
| **% DPER < TPER** | 17.61 | **DPER** | 69.96 | **TPER** | 84.92 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Robert Arnold | **Assessor ID** | BA04-0001 |
| **Client** | | | |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 87.0900 | (1b) | x 2.9500 | (2b) = | 256.9155 | (1b) - (3b) (4) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 87.0900 | | | | | |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = | 256.9155 | (5) |

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2. Ventilation rate

---

| | | m3 per hour | |
|---|---|---|---|
| Number of open chimneys | | 0 * 80 = | 0.0000 (6a) |
| Number of open flues | | 0 * 20 = | 0.0000 (6b) |
| Number of chimneys / flues attached to closed fire | | 0 * 10 = | 0.0000 (6c) |
| Number of flues attached to solid fuel boiler | | 0 * 20 = | 0.0000 (6d) |
| Number of flues attached to other heater | | 0 * 35 = | 0.0000 (6e) |
| Number of blocked chimneys | | 0 * 20 = | 0.0000 (6f) |
| Number of intermittent extract fans | | 0 * 10 = | 0.0000 (7a) |
| Number of passive vents | | 0 * 10 = | 0.0000 (7b) |
| Number of flueless gas fires | | 0 * 40 = | 0.0000 (7c) |

| | | Air changes per hour | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 0.0000 | / (5) = | 0.0000 (8) |
| Pressure test | | | Yes |
| Pressure Test Method | | | Blower Door |
| Measured/design AP50 | | | 3.0000 (17) |
| Infiltration rate | | | 0.1500 (18) |
| Number of sides sheltered | | | 0 (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] | = | 1.0000 (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) | = | 0.1500 (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.1912 | 0.1875 | 0.1837 | 0.1650 | 0.1612 | 0.1425 | 0.1425 | 0.1388 | 0.1500 | 0.1612 | 0.1687 | 0.1762 | (22b) |

Balanced mechanical ventilation with heat recovery

| | |
|---|---|
| If mechanical ventilation | 0.5000 (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | 0.5000 (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | 80.1000 (23c) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective ac | 0.2907 | 0.2870 | 0.2833 | 0.2645 | 0.2607 | 0.2420 | 0.2420 | 0.2382 | 0.2495 | 0.2607 | 0.2682 | 0.2757 | (25) |

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3. Heat losses and heat loss parameter

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| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| Window | | | 18.7100 | 1.0536 | 19.7136 | | | (27) |
| Front Door | | | 1.8900 | 1.4000 | 2.6460 | | | (26) |
| Glass Door | | | 2.2900 | 1.3258 | 3.0360 | | | (27) |
| External Walls | 74.9900 | 21.0000 | 53.9900 | 0.1500 | 8.0985 | 150.0000 | 8098.5000 | (29a) |
| Wall to Communal Corridor | 10.9900 | 1.8900 | 9.1000 | 0.1400 | 1.2740 | 150.0000 | 1365.0000 | (29a) |
| Wall to Stairs | 25.4100 | | 25.4100 | 0.1100 | 2.7951 | 150.0000 | 3811.5000 | (29a) |
| External Roof | 87.0900 | | 87.0900 | 0.1000 | 8.7090 | 9.0000 | 783.8100 | (30) |
| Total net area of external elements Aum(A, m2) | | | 198.4800 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 46.2722 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 35 | | | 31.7200 | 0.0000 | 0.0000 | 110.0000 | 3489.2000 | (32) |
| Party Wall to Unit 38 | | | 8.4500 | 0.0000 | 0.0000 | 110.0000 | 929.5000 | (32) |
| Party Floor | | | 87.0900 | | | 80.0000 | 6967.2000 | (32d) |
| Internal Walls | | | 219.9100 | | | 9.0000 | 1979.1900 | (32c) |

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 27423.9000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 314.8915 (35)
List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E1 Steel lintel with perforated steel base plate | 9.2900 | 0.0500 | 0.4645 |
| E4 Jamb | 27.1200 | 0.0500 | 1.3560 |
| E7 Party floor between dwellings (in blocks of flats) | 10.5775 | 0.0350 | 0.3702 |
| E15 Flat roof with parapet | 25.4200 | 0.5600 | 14.2352 |
| E16 Corner (normal) | 5.9000 | 0.0900 | 0.5310 |
| E18 Party wall between dwellings | 2.9500 | 0.0300 | 0.0885 |
| E17 Corner (inverted - internal area greater than external area) | 2.9500 | -0.0900 | -0.2655 |
| E25 Staggered party wall between dwellings | 2.9500 | 0.0600 | 0.1770 |
| E24 Eaves (insulation at ceiling level - inverted) | 14.8435 | 0.1200 | 1.7812 |
| E24 Eaves (insulation at ceiling level - inverted) | 8.6150 | 0.1200 | 1.0338 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 19.7719 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 66.0441 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 24.6504 | 24.3325 | 24.0145 | 22.4249 | 22.1069 | 20.5173 | 20.5173 | 20.1993 | 21.1531 | 22.1069 | 22.7428 | 23.3787 | (38) |
| Heat transfer coeff | 90.6945 | 90.3766 | 90.0587 | 88.4690 | 88.1511 | 86.5614 | 86.5614 | 86.2435 | 87.1973 | 88.1511 | 88.7869 | 89.4228 | (39) |

Average = Sum(39)m / 12 = 88.3895

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.0414 | 1.0377 | 1.0341 | 1.0158 | 1.0122 | 0.9939 | 0.9939 | 0.9903 | 1.0012 | 1.0122 | 1.0195 | 1.0268 | (40) |
| HLP (average) | | | | | | | | | | | | 1.0149 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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## 4. Water heating energy requirements (kWh/year)

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Assumed occupancy 2.5838 (42)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hot water usage for mixer showers | 65.8345 | 64.8265 | 63.3411 | 61.0561 | 59.0087 | 56.1445 | 53.8791 | 56.5275 | 57.8595 | 60.6964 | 63.6508 | 65.7751 | (42a) |
| Hot water usage for baths | 28.5178 | 28.0873 | 27.4749 | 26.5577 | 25.7312 | 24.5933 | 23.7301 | 24.7857 | 25.3397 | 26.4671 | 27.6393 | 28.4952 | (42b) |
| Hot water usage for other uses | 41.0903 | 39.5961 | 38.1019 | 36.6077 | 35.1135 | 33.6193 | 33.6193 | 35.1135 | 36.6077 | 38.1019 | 39.5961 | 41.0903 | (42c) |

Average daily hot water use (litres/day) 124.4918 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 135.4425 | 132.5099 | 128.9179 | 124.2215 | 119.8534 | 114.3571 | 111.2285 | 116.4267 | 119.8069 | 125.2654 | 130.8861 | 135.3605 | (44) |
| Energy conte | 199.3948 | 175.3374 | 184.2210 | 162.2643 | 154.4432 | 132.2502 | 122.9107 | 137.0363 | 138.9700 | 161.4171 | 176.8970 | 198.7868 | (45) |

Energy content (annual) Total = Sum(45)m = 1943.9289

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Distribution loss (46)m = 0.15 x (45)m | 29.9092 | 26.3006 | 27.6332 | 24.3396 | 23.1665 | 19.8375 | 18.4366 | 20.5554 | 20.8455 | 24.2126 | 26.5345 | 29.8180 | (46) |

Water storage loss:
Store volume 110.0000 (47)
b) If manufacturer declared loss factor is not known :
Hot water storage loss factor from Table 2 (kWh/litre/day) 0.0152 (51)
Volume factor from Table 2a 1.0294 (52)
Temperature factor from Table 2b 0.6000 (53)
Enter (49) or (54) in (55) 1.0327 (55)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total storage loss | 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (56) |
| If cylinder contains dedicated solar storage | 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (57) |
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | 254.6716 | 225.2648 | 239.4978 | 215.7580 | 209.7200 | 185.7439 | 178.1875 | 192.3131 | 192.4637 | 216.6939 | 230.3907 | 254.0636 | (62) |
| WWHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | 254.6716 | 225.2648 | 239.4978 | 215.7580 | 209.7200 | 185.7439 | 178.1875 | 192.3131 | 192.4637 | 216.6939 | 230.3907 | 254.0636 | (64) |

Total per year (kWh/year) = Sum(64)m = 2594.7687 (64)
12Total per year (kWh/year) 2595 (64)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Electric shower(s) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Heat gains from water heating, kWh/month | 110.5202 | 98.2416 | 105.4749 | 96.7478 | 95.5738 | 86.7681 | 85.0893 | 89.7860 | 89.0025 | 97.8926 | 101.6132 | 110.3181 | (65) |

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## 5. Internal gains (see Table 5 and 5a)

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Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 129.1879 | 129.1879 | 129.1879 | 129.1879 | 129.1879 | 129.1879 | 129.1879 | 129.1879 | 129.1879 | 129.1879 | 129.1879 | 129.1879 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 117.8350 | 130.4602 | 117.8350 | 121.7628 | 117.8350 | 121.7628 | 117.8350 | 117.8350 | 121.7628 | 117.8350 | 121.7628 | 117.8350 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 233.6211 | 236.0453 | 229.9363 | 216.9308 | 200.5138 | 185.0841 | 174.7761 | 172.3519 | 178.4609 | 191.4664 | 207.8834 | 223.3131 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 35.9188 | 35.9188 | 35.9188 | 35.9188 | 35.9188 | 35.9188 | 35.9188 | 35.9188 | 35.9188 | 35.9188 | 35.9188 | 35.9188 | (69) |
| Pumps, fans | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | -103.3503 | -103.3503 | -103.3503 | -103.3503 | -103.3503 | -103.3503 | -103.3503 | -103.3503 | -103.3503 | -103.3503 | -103.3503 | -103.3503 | (71) |
| Water heating gains (Table 5) | 148.5487 | 146.1929 | 141.7674 | 134.3720 | 128.4594 | 120.5113 | 114.3673 | 120.6801 | 123.6145 | 131.5761 | 141.1294 | 148.2770 | (72) |
| Total internal gains | 561.7611 | 574.4548 | 551.2950 | 534.8220 | 508.5646 | 489.1146 | 468.7348 | 472.6234 | 485.5947 | 502.6339 | 532.5320 | 551.1814 | (73) |

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## 6. Solar gains

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| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W |
|---|---|---|---|---|---|---|

| | | | | | | |
|---|---|---|---|---|---|---|
| Northeast | 6.6600 | 11.2829 | 0.4500 | 0.7000 | 0.7700 | 16.4036 (75) |
| Southeast | 9.4800 | 36.7938 | 0.4500 | 0.7000 | 0.7700 | 76.1425 (77) |
| Southwest | 2.5700 | 36.7938 | 0.4500 | 0.7000 | 0.7700 | 20.6420 (79) |
| Southeast | 2.2900 | 36.7938 | 0.4500 | 0.7000 | 0.7700 | 18.3931 (77) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 131.5812 | 229.5801 | 328.5941 | 431.4022 | 505.3481 | 511.4331 | 489.0230 | 432.3670 | 363.9630 | 257.6371 | 158.5962 | 111.9641 (83) |
| Total gains | 693.3423 | 804.0349 | 879.8891 | 966.2242 | 1013.9128 | 1000.5478 | 957.7578 | 904.9904 | 849.5577 | 760.2710 | 691.1283 | 663.1455 (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| tau | 83.9935 | 84.2890 | 84.5865 | 86.1064 | 86.4170 | 88.0040 | 88.0040 | 88.3284 | 87.3623 | 86.4170 | 85.7981 | 85.1880 | |
| alpha | 6.5996 | 6.6193 | 6.6391 | 6.7404 | 6.7611 | 6.8669 | 6.8669 | 6.8886 | 6.8242 | 6.7611 | 6.7199 | 6.6792 | |
| util living area | 0.9969 | 0.9911 | 0.9751 | 0.9108 | 0.7630 | 0.5494 | 0.3972 | 0.4375 | 0.6872 | 0.9371 | 0.9910 | 0.9976 | (86) |
| MIT | 20.1450 | 20.3162 | 20.5344 | 20.8015 | 20.9518 | 20.9955 | 20.9996 | 20.9992 | 20.9813 | 20.7869 | 20.4277 | 20.1251 | (87) |
| Th 2 | 20.0490 | 20.0520 | 20.0550 | 20.0702 | 20.0732 | 20.0884 | 20.0884 | 20.0914 | 20.0823 | 20.0732 | 20.0671 | 20.0611 | (88) |
| util rest of house | 0.9956 | 0.9876 | 0.9654 | 0.8804 | 0.7027 | 0.4733 | 0.3152 | 0.3516 | 0.6053 | 0.9082 | 0.9868 | 0.9967 | (89) |
| MIT 2 | 19.0656 | 19.2850 | 19.5598 | 19.8862 | 20.0389 | 20.0864 | 20.0883 | 20.0912 | 20.0724 | 19.8797 | 19.4397 | 19.0496 | (90) |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.3483 | (91) |
| MIT | 19.4415 | 19.6441 | 19.8992 | 20.2049 | 20.3568 | 20.4030 | 20.4057 | 20.4074 | 20.3890 | 20.1956 | 19.7838 | 19.4242 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.4415 | 19.6441 | 19.8992 | 20.2049 | 20.3568 | 20.4030 | 20.4057 | 20.4074 | 20.3890 | 20.1956 | 19.7838 | 19.4242 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9945 | 0.9857 | 0.9635 | 0.8853 | 0.7220 | 0.4998 | 0.3438 | 0.3816 | 0.6336 | 0.9126 | 0.9851 | 0.9958 | (94) |
| Useful gains | 689.5466 | 792.5344 | 847.7406 | 855.4206 | 732.0472 | 500.1010 | 329.2810 | 345.3339 | 538.2465 | 693.8532 | 680.8544 | 660.3467 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | 1373.2531 | 1332.5253 | 1206.7121 | 1000.1370 | 763.1072 | 502.3145 | 329.4229 | 345.6158 | 548.3794 | 845.8640 | 1126.1557 | 1361.3874 | (97) |
| Space heating kWh | 508.6776 | 362.8739 | 267.0748 | 104.1958 | 23.1086 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 113.0961 | 320.6169 | 521.5743 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 2221.2179 | |
| Solar heating kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | 508.6776 | 362.8739 | 267.0748 | 104.1958 | 23.1086 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 113.0961 | 320.6169 | 521.5743 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 2221.2179 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 25.5049 | (99) |

## 8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ext. temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | |
| Heat loss rate W | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 813.6771 | 640.5543 | 655.4503 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (100) |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.9653 | 0.9875 | 0.9808 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (101) |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 785.4600 | 632.5480 | 642.8831 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (102) |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 1109.8484 | 1062.9755 | 1002.8674 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 233.5596 | 320.2381 | 267.8283 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (104) |
| Cooled fraction | | | | | | | | | fC = cooled area / (4) = | | | 0.9990 | (105) |
| Intermittency factor (Table 10b) | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | (106) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 58.3296 | 79.9768 | 66.8879 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) |
| Space cooling requirement | | | | | | | | | | | | 205.1942 | (107) |

## 9b. Energy requirements

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | 0.0000 | (301) |
| Fraction of space heat from community system | | | | | | | | | | | | 1.0000 | (302) |
| Fraction of heat from community Heat pump-Space and Water | | | | | | | | | | | | 1.0000 | (303a) |
| Factor for control and charging method (Table 4c(3)) for space heating | | | | | | | | | | | | 1.0000 | (305) |
| Factor for charging method (Table 4c(3)) for water heating | | | | | | | | | | | | 1.0000 | (305a) |
| Distribution loss factor (Table 12c) for community heating system | | | | | | | | | | | | 2.0000 | (306) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 | (208) |
| Space heating: | | | | | | | | | | | | | |
| Space heating requirement | 508.6776 | 362.8739 | 267.0748 | 104.1958 | 23.1086 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 113.0961 | 320.6169 | 521.5743 | (98) |
| Space heat from Heat pump = (98) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 307a | 1017.3552 | 725.7477 | 534.1495 | 208.3916 | 46.2173 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 226.1922 | 641.2338 | 1043.1485 | |
| Space heating requirement | 1017.3552 | 725.7477 | 534.1495 | 208.3916 | 46.2173 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 226.1922 | 641.2338 | 1043.1485 | (307) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | | | | | | | | | | | 0.0000 | (308) |
| Space heating fuel for secondary/supplementary system | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (309) |
| Water heating | | | | | | | | | | | | | |
| Annual water heating requirement | 254.6716 | 225.2648 | 239.4978 | 215.7580 | 209.7200 | 185.7439 | 178.1875 | 192.3131 | 192.4637 | 216.6939 | 230.3907 | 254.0636 | (64) |
| Water heat from Heat pump = (64) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 310a | 509.3431 | 450.5296 | 478.9956 | 431.5160 | 419.4401 | 371.4878 | 356.3751 | 384.6263 | 384.9274 | 433.3879 | 460.7813 | 508.1273 | |
| Water heating fuel | 509.3431 | 450.5296 | 478.9956 | 431.5160 | 419.4401 | 371.4878 | 356.3751 | 384.6263 | 384.9274 | 433.3879 | 460.7813 | 508.1273 | (310) |
| Cooling System Energy Efficiency Ratio | | | | | | | | | | | | 2.6000 | (314) |
| Space coolin | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 22.4344 | 30.7603 | 25.7261 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (315) |
| Pumps and Fa | 22.7341 | 20.5340 | 22.7341 | 22.0007 | 22.7341 | 22.0007 | 22.7341 | 22.7341 | 22.0007 | 22.7341 | 22.0007 | 22.7341 | (331) |
| Lighting | 26.7624 | 21.4698 | 19.3312 | 14.1629 | 10.9398 | 8.9379 | 9.9796 | 12.9719 | 16.8492 | 22.1071 | 24.9699 | 27.5062 | (332) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (333a)m | -4.8505 | -7.9137 | -13.2457 | -17.2934 | -20.7917 | -20.2241 | -19.9350 | -17.6638 | -14.1026 | -9.9272 | -5.6753 | -4.0655 (333a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (334a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (334a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (335a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (335a) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (333b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (333b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (334b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (334b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (335b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (335b) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - community heating | 4442.4358 | (307) |
| Space heating fuel - secondary | 0.0000 | (309) |
| Water heating fuel - community heating | 5189.5374 | (310) |
| Efficiency of water heater | 0.0000 | (311) |
| Electricity used for heat distribution | 44.4244 | (313) |
| Space cooling fuel | 78.9209 | (321) |
| | | |
| Electricity for pumps and fans: | | |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8540) | | |
| mechanical ventilation fans (SFP = 0.8540) | 267.6751 | (330a) |
| Total electricity for the above, kWh/year | 267.6751 | (331) |
| Electricity for lighting (calculated in Appendix L) | 215.9881 | (332) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -155.6885 | (333) |
| Wind generation | 0.0000 | (334) |
| Hydro-electric generation (Appendix N) | 0.0000 | (335a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (335) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (336) |
| Energy used | 0.0000 | (337) |
| Total delivered energy for all uses | 10038.8689 | (338) |

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12b. Carbon dioxide emissions - Community heating scheme

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (367) |
| Space and Water heating from Heat pump | 3439.9905 | 0.1569 | 248.9985 | (367) |
| Electrical energy for heat distribution (space & water) | 44.4244 | 0.0000 | 14.2818 | (372) |
| Overall CO2 factor for heat network | | | 0.0544 | (386) |
| Total CO2 associated with community systems | | | 524.3467 | (373) |
| Space and water heating | | | 524.3467 | (376) |
| Space cooling | 78.9209 | 0.1139 | 8.9879 | (377) |
| Pumps, fans and electric keep-hot | 267.6751 | 0.1387 | 37.1298 | (378) |
| Energy for lighting | 215.9881 | 0.1443 | 31.1738 | (379) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -155.6885 | 0.1317 | -20.5092 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -20.5092 | (380) |
| Total CO2, kg/year | | | 581.1289 | (383) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 6.6700 | (384) |

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13b. Primary energy - Community heating scheme

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| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (467a) |
| Space and Water heating from Heat pump | 3439.9905 | 1.5810 | 2508.3841 | (467) |
| Electrical energy for heat distribution (space & water) | 44.4244 | 0.0000 | 149.1592 | (472) |
| Overall CO2 factor for heat network | | | 0.5686 | (486) |
| Total CO2 associated with community systems | | | 5476.2724 | (473) |
| Space and water heating | | | 5476.2724 | (476) |
| Space cooling | 78.9209 | 1.4198 | 112.0511 | (477) |
| Pumps, fans and electric keep-hot | 267.6751 | 1.5128 | 404.9389 | (478) |
| Energy for lighting | 215.9881 | 1.5338 | 331.2898 | (479) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -155.6885 | 1.4867 | -231.4610 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -231.4610 | (480) |
| Total Primary energy kWh/year | | | 6093.0911 | (483) |
| Dwelling Primary energy Rate (DPER) | | | 69.9600 | (484) |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

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| | | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | |
| Ground floor | | 87.0900 | (1b) | x 2.9500 | (2b) = | 256.9155 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 87.0900 | | | | | | (4) |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | | 256.9155 | (5) |

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2. Ventilation rate

| | | | |
|---|---|---|---|
| | | m3 per hour | |
| Number of open chimneys | 0 * 80 = | 0.0000 | (6a) |
| Number of open flues | 0 * 20 = | 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | 3 * 10 = | 30.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |
| | | Air changes per hour | |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 30.0000 / (5) = | 0.1168 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3668 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.3668 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.4676 | 0.4585 | 0.4493 | 0.4034 | 0.3943 | 0.3484 | 0.3484 | 0.3393 | 0.3668 | 0.3943 | 0.4126 | 0.4310 | (22b) |
| Effective ac | 0.6093 | 0.6051 | 0.6009 | 0.5814 | 0.5777 | 0.5607 | 0.5607 | 0.5575 | 0.5673 | 0.5777 | 0.5851 | 0.5929 | (25) |

## 3. Heat losses and heat loss parameter

| Element | Gross | Openings | NetArea | U-value | A x U | K-value | A x K | |
|---|---|---|---|---|---|---|---|---|
| | m2 | m2 | m2 | W/m2K | W/K | kJ/m2K | kJ/K | |
| Main dwelling | | | | | | | | |
| TER Opaque door | | | 1.8900 | 1.0000 | 1.8900 | | | (26) |
| TER Opening Type | | | 19.8700 | 1.1450 | 22.7519 | | | (27) |
| External Walls | 74.9900 | 19.8700 | 55.1200 | 0.1800 | 9.9216 | | | (29a) |
| Wall to Communal Corridor | 10.9900 | 1.8900 | 9.1000 | 0.1800 | 1.6380 | | | (29a) |
| Wall to Stairs | 25.4100 | | 25.4100 | 0.1800 | 4.5738 | | | (29a) |
| External Roof | 87.0900 | | 87.0900 | 0.1100 | 9.5799 | | | (30) |
| Total net area of external elements Aum(A, m2) | | | 198.4800 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 50.3552 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 35 | | | 31.7200 | 0.0000 | 0.0000 | | | (32) |
| Party Wall to Unit 38 | | | 8.4500 | 0.0000 | 0.0000 | | | (32) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 314.8915 (35)

List of Thermal Bridges

| K1 Element | Length | Psi-value | Total |
|---|---|---|---|
| E1 Steel lintel with perforated steel base plate | 9.2900 | 0.0500 | 0.4645 |
| E4 Jamb | 27.1200 | 0.0500 | 1.3560 |
| E7 Party floor between dwellings (in blocks of flats) | 10.5775 | 0.0700 | 0.7404 |
| E15 Flat roof with parapet | 25.4200 | 0.5600 | 14.2352 |
| E16 Corner (normal) | 5.9000 | 0.0900 | 0.5310 |
| E18 Party wall between dwellings | 2.9500 | 0.0600 | 0.1770 |
| E17 Corner (inverted - internal area greater than external area) | 2.9500 | -0.0900 | -0.2655 |
| E25 Staggered party wall between dwellings | 2.9500 | 0.0600 | 0.1770 |
| E24 Eaves (insulation at ceiling level - inverted) | 14.8435 | 0.2400 | 3.5624 |
| E24 Eaves (insulation at ceiling level - inverted) | 8.6150 | 0.2400 | 2.0676 |

| | | |
|---|---|---|
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | 23.0457 | (36) |
| Point Thermal bridges | (36a) = 0.0000 | |
| Total fabric heat loss | (33) + (36) + (36a) = 73.4009 | (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 51.6611 | 51.3011 | 50.9483 | 49.2910 | 48.9810 | 47.5375 | 47.5375 | 47.2702 | 48.0935 | 48.9810 | 49.6082 | 50.2640 | (38) |
| Heat transfer coeff | 125.0620 | 124.7020 | 124.3492 | 122.6919 | 122.3818 | 120.9384 | 120.9384 | 120.6711 | 121.4944 | 122.3818 | 123.0091 | 123.6649 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 122.6904 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.4360 | 1.4319 | 1.4278 | 1.4088 | 1.4052 | 1.3887 | 1.3887 | 1.3856 | 1.3950 | 1.4052 | 1.4124 | 1.4200 | (40) |
| HLP (average) | | | | | | | | | | | | 1.4088 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

## 4. Water heating energy requirements (kWh/year)

| | | |
|---|---|---|
| Assumed occupancy | 2.5838 | (42) |

Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 67.5409 | 66.5259 | 65.0468 | 62.2169 | 60.1285 | 57.7995 | 56.4757 | 57.9436 | 59.5526 | 62.0532 | 64.9439 | 67.2821 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 29.1680 | 28.7348 | 28.1248 | 27.0000 | 26.1578 | 25.2240 | 24.7195 | 25.3253 | 25.9848 | 26.9841 | 28.1320 | 29.0694 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 41.0903 | 39.5961 | 38.1019 | 36.6077 | 35.1135 | 33.6193 | 33.6193 | 35.1135 | 36.6077 | 38.1019 | 39.5961 | 41.0903 | (42c) |

| | | |
|---|---|---|
| Average daily hot water use (litres/day) | 126.6685 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 137.7991 | 134.8567 | 131.2735 | 125.8246 | 121.3998 | 116.6427 | 114.8145 | 118.3823 | 122.1451 | 127.1392 | 132.6720 | 137.4417 | (44) |
| Energy conte | 218.2401 | 192.0342 | 201.7624 | 172.2476 | 163.4274 | 143.4259 | 138.8582 | 146.5821 | 150.6172 | 172.5267 | 189.0156 | 215.2006 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 2103.9380 | |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | | |
| | 32.7360 | 28.8051 | 30.2644 | 25.8371 | 24.5141 | 21.5139 | 20.8287 | 21.9873 | 22.5926 | 25.8790 | 28.3523 | 32.2801 | (46) |
| Water storage loss: | | | | | | | | | | | | | |
| Store volume | | | | | | | | | | | | 150.0000 | (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | | | | | | | | | | | | 1.3938 | (48) |
| Temperature factor from Table 2b | | | | | | | | | | | | 0.5400 | (49) |
| Enter (49) or (54) in (55) | | | | | | | | | | | | 0.7527 | (55) |
| Total storage loss | | | | | | | | | | | | | |
| | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (56) |
| If cylinder contains dedicated solar storage | | | | | | | | | | | | | |
| | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (57) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | | | | | | | | | | | | | |
| | 264.8350 | 234.1199 | 248.3573 | 217.3394 | 210.0223 | 188.5177 | 185.4531 | 193.1770 | 195.7090 | 219.1216 | 234.1075 | 261.7955 | (62) |
| WWHRS | -30.8769 | -27.3078 | -28.5951 | -23.6779 | -22.0669 | -18.8828 | -17.6996 | -18.8218 | -19.5369 | -23.0319 | -26.0923 | -30.3051 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | | | | | | | | | | | | | |
| | 233.9582 | 206.8122 | 219.7622 | 193.6616 | 187.9554 | 169.6349 | 167.7535 | 174.3552 | 176.1721 | 196.0898 | 208.0152 | 231.4904 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2365.6605 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2366 | (64) |
| Electric shower(s) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | | | | | |
| Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | | | | | | | | | | | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | | | | | | | | | | | | | |
| | 109.8408 | 97.5200 | 104.3619 | 93.3458 | 91.6155 | 83.7626 | 83.4463 | 86.0145 | 86.1537 | 94.6411 | 98.9212 | 108.8301 | (65) |

## 5. Internal gains (see Table 5 and 5a)

| Metabolic gains (Table 5), Watts | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 129.1879 | 129.1879 | 129.1879 | 129.1879 | 129.1879 | 129.1879 | 129.1879 | 129.1879 | 129.1879 | 129.1879 | 129.1879 | 129.1879 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 117.8111 | 130.4337 | 117.8111 | 121.7382 | 117.8111 | 121.7382 | 117.8111 | 117.8111 | 121.7382 | 117.8111 | 121.7382 | 117.8111 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 233.6211 | 236.0453 | 229.9363 | 216.9308 | 200.5138 | 185.0841 | 174.7761 | 172.3519 | 178.4609 | 191.4664 | 207.8834 | 223.3131 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 35.9188 | 35.9188 | 35.9188 | 35.9188 | 35.9188 | 35.9188 | 35.9188 | 35.9188 | 35.9188 | 35.9188 | 35.9188 | 35.9188 | (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.0000 | 3.0000 | 3.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | | | | | | | | | | | | | |
| | -103.3503 | -103.3503 | -103.3503 | -103.3503 | -103.3503 | -103.3503 | -103.3503 | -103.3503 | -103.3503 | -103.3503 | -103.3503 | -103.3503 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 147.6354 | 145.1190 | 140.2714 | 129.6469 | 123.1392 | 116.3369 | 112.1590 | 115.6108 | 119.6579 | 127.2057 | 137.3905 | 146.2770 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 563.8240 | 576.3544 | 552.7752 | 533.0723 | 506.2205 | 484.9156 | 466.5026 | 467.5302 | 481.6134 | 501.2396 | 531.7685 | 552.1576 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Northeast | 6.3000 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 21.7237 | (75) |
| Southeast | 11.1400 | 36.7938 | 0.6300 | 0.7000 | 0.7700 | 125.2657 | (77) |
| Southwest | 2.4300 | 36.7938 | 0.6300 | 0.7000 | 0.7700 | 27.3246 | (79) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 174.3140 | 304.1369 | 435.2997 | 571.4832 | 669.4316 | 677.4888 | 647.8038 | 572.7580 | 482.1508 | 341.3038 | 210.1020 | 148.3261 | (83) |
| Total gains | 738.1380 | 880.4913 | 988.0749 | 1104.5555 | 1175.6521 | 1162.4043 | 1114.3065 | 1040.2882 | 963.7642 | 842.5434 | 741.8705 | 700.4837 | (84) |

## 7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 60.9118 | 61.0876 | 61.2610 | 62.0885 | 62.2458 | 62.9887 | 62.9887 | 63.1282 | 62.7004 | 62.2458 | 61.9283 | 61.5999 | |
| alpha | 5.0608 | 5.0725 | 5.0841 | 5.1392 | 5.1497 | 5.1992 | 5.1992 | 5.2085 | 5.1800 | 5.1497 | 5.1286 | 5.1067 | |
| util living area | | | | | | | | | | | | | |
| | 0.9966 | 0.9914 | 0.9782 | 0.9331 | 0.8235 | 0.6367 | 0.4721 | 0.5240 | 0.7746 | 0.9561 | 0.9921 | 0.9974 | (86) |
| MIT | 19.6755 | 19.8884 | 20.1801 | 20.5539 | 20.8328 | 20.9665 | 20.9941 | 20.9901 | 20.9097 | 20.5406 | 20.0434 | 19.6469 | (87) |
| Th 2 | 19.7358 | 19.7390 | 19.7421 | 19.7566 | 19.7593 | 19.7720 | 19.7720 | 19.7744 | 19.7671 | 19.7593 | 19.7538 | 19.7481 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9952 | 0.9878 | 0.9688 | 0.9045 | 0.7561 | 0.5280 | 0.3434 | 0.3896 | 0.6736 | 0.9310 | 0.9882 | 0.9963 | (89) |
| MIT 2 | 18.2336 | 18.5062 | 18.8750 | 19.3367 | 19.6364 | 19.7571 | 19.7708 | 19.7720 | 19.7174 | 19.3347 | 18.7158 | 18.2058 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.3483 | (91) |
| MIT | 18.7358 | 18.9876 | 19.3295 | 19.7606 | 20.0531 | 20.1783 | 20.1968 | 20.1962 | 20.1326 | 19.7546 | 19.1782 | 18.7077 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 18.7358 | 18.9876 | 19.3295 | 19.7606 | 20.0531 | 20.1783 | 20.1968 | 20.1962 | 20.1326 | 19.7546 | 19.1782 | 18.7077 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9936 | 0.9848 | 0.9648 | 0.9046 | 0.7738 | 0.5655 | 0.3886 | 0.4369 | 0.7064 | 0.9309 | 0.9856 | 0.9950 | (94) |
| Useful gains | 733.3955 | 867.0769 | 953.2639 | 999.2177 | 909.6939 | 657.3138 | 432.9934 | 454.4959 | 680.8295 | 784.2923 | 731.1737 | 696.9681 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | | | | | | | | | | | | | |
| | 1805.3671 | 1756.7462 | 1595.3386 | 1332.5080 | 1022.2686 | 674.6341 | 434.9924 | 458.0957 | 732.9274 | 1120.3607 | 1485.7256 | 1794.0918 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 797.5469 | 597.8578 | 477.7036 | 239.9690 | 83.7555 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 250.0349 | 543.2773 | 816.2600 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 3806.4051 | |
| Solar heating kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | | | | | | | | | | | | | |
| | 797.5469 | 597.8578 | 477.7036 | 239.9690 | 83.7555 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 250.0349 | 543.2773 | 816.2600 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 3806.4051 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 43.7066 | (99) |

## 9a. Energy requirements - Individual heating systems, including micro-CHP

| | | |
|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | 0.0000 | (201) |
| Fraction of space heat from main system(s) | 1.0000 | (202) |
| Efficiency of main space heating system 1 (in %) | 92.3000 | (206) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Efficiency of main space heating system 2 (in %) | | | | | | | | | | | | 0.0000 | (207) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 | (208) |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| Space heating requirement | | | | | | | | | | | | | |
| | 797.5469 | 597.8578 | 477.7036 | 239.9690 | 83.7555 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 250.0349 | 543.2773 | 816.2600 | (98) |
| Space heating efficiency (main heating system 1) | | | | | | | | | | | | | |
| | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.3000 | 92.3000 | 92.3000 | (210) |
| Space heating fuel (main heating system) | | | | | | | | | | | | | |
| | 864.0811 | 647.7332 | 517.5554 | 259.9881 | 90.7427 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 270.8937 | 588.5995 | 884.3554 | (211) |
| Space heating efficiency (main heating system 2) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (212) |
| Space heating fuel (main heating system 2) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (213) |
| Space heating fuel (secondary) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (215) |
| Water heating | | | | | | | | | | | | | |
| Water heating requirement | | | | | | | | | | | | | |
| | 233.9582 | 206.8122 | 219.7622 | 193.6616 | 187.9554 | 169.6349 | 167.7535 | 174.3552 | 176.1721 | 196.0898 | 208.0152 | 231.4904 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 | (216) |
| (217)m | 86.5851 | 86.2985 | 85.7527 | 84.5417 | 82.3735 | 79.8000 | 79.8000 | 79.8000 | 79.8000 | 84.6059 | 86.1110 | 86.6411 | (217) |
| Fuel for water heating, kWh/month | | | | | | | | | | | | | |
| | 270.2060 | 239.6475 | 256.2745 | 229.0722 | 228.1746 | 212.5750 | 210.2174 | 218.4902 | 220.7670 | 231.7684 | 241.5662 | 267.1832 | (219) |
| Space cooling fuel requirement | | | | | | | | | | | | | |
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (221) |
| Pumps and Fa | 7.3041 | 6.5973 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | (231) |
| Lighting | 24.4788 | 19.6378 | 17.6817 | 12.9544 | 10.0063 | 8.1752 | 9.1281 | 11.8650 | 15.4115 | 20.2208 | 22.8393 | 25.1592 | (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233a)m | -19.1391 | -28.6158 | -43.5891 | -52.0272 | -58.7634 | -55.8161 | -55.1233 | -50.7038 | -43.4017 | -34.0110 | -21.6090 | -16.3611 | (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233b)m | -6.3643 | -13.7282 | -27.9360 | -42.9363 | -57.7516 | -58.3995 | -57.7259 | -48.4356 | -34.9198 | -19.9617 | -8.6000 | -5.0087 | (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235d) |
| Annual totals kWh/year | | | | | | | | | | | | | |
| Space heating fuel - main system 1 | | | | | | | | | | | | 4123.9491 | (211) |
| Space heating fuel - main system 2 | | | | | | | | | | | | 0.0000 | (213) |
| Space heating fuel - secondary | | | | | | | | | | | | 0.0000 | (215) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 | |
| Water heating fuel used | | | | | | | | | | | | 2825.9423 | (219) |
| Space cooling fuel | | | | | | | | | | | | 0.0000 | (221) |
| Electricity for pumps and fans: | | | | | | | | | | | | | |
| Total electricity for the above, kWh/year | | | | | | | | | | | | 86.0000 | (231) |
| Electricity for lighting (calculated in Appendix L) | | | | | | | | | | | | 197.5581 | (232) |
| Energy saving/generation technologies (Appendices M ,N and Q) | | | | | | | | | | | | | |
| PV generation | | | | | | | | | | | | -860.9283 | (233) |
| Wind generation | | | | | | | | | | | | 0.0000 | (234) |
| Hydro-electric generation (Appendix N) | | | | | | | | | | | | 0.0000 | (235a) |
| Electricity generated - Micro CHP (Appendix N) | | | | | | | | | | | | 0.0000 | (235) |
| Appendix Q - special features | | | | | | | | | | | | | |
| Energy saved or generated | | | | | | | | | | | | -0.0000 | (236) |
| Energy used | | | | | | | | | | | | 0.0000 | (237) |
| Total delivered energy for all uses | | | | | | | | | | | | 6372.5212 | (238) |

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 4123.9491 | 0.2100 | 866.0293 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2825.9423 | 0.2100 | 593.4479 | (264) |
| Space and water heating | | | 1459.4772 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 197.5581 | 0.1443 | 28.5137 | (268) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -479.1607 | 0.1334 | -63.9098 | |
| PV Unit electricity exported | -381.7676 | 0.1252 | -47.8054 | |
| Total | | | -111.7152 | (269) |
| Total CO2, kg/year | | | 1388.2050 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 15.9400 | (273) |

13a. Primary energy - Individual heating systems including micro-CHP

| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 4123.9491 | 1.1300 | 4660.0625 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2825.9423 | 1.1300 | 3193.3147 | (278) |
| Space and water heating | | | 7853.3773 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 197.5581 | 1.5338 | 303.0213 | (282) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -479.1607 | 1.4929 | -715.3275 | |
| PV Unit electricity exported | -381.7676 | 0.4596 | -175.4661 | |
| Total | | | -890.7935 | (283) |
| Total Primary energy kWh/year | | | 7395.7058 | (286) |
| Target Primary Energy Rate (TPER) | | | 84.9200 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Property Reference** | Unit 37 | **Issued on Date** | 17/05/2025 |
| **Assessment Reference** | 00001 | **Prop Type Ref** | Unit 37 |
| **Property** | | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 76 C | **DER** | 7.24 | **TER** | 18.25 |
| **Environmental** | 95 A | **% DER < TER** | | | 60.33 |
| **$CO_2$ Emissions (t/year)** | 0.33 | **DFEE** | 45.00 | **TFEE** | 49.41 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 8.92 |
| **% DPER < TPER** | 21.85 | **DPER** | 76.49 | **TPER** | 97.88 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Robert Arnold | **Assessor ID** | BA04-0001 |
| **Client** | | | |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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## 1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 50.5800 | (1b) | x 2.9500 | (2b) = | 149.2110 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 50.5800 | | | | | (4) |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | 149.2110 | (5) |

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## 2. Ventilation rate

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| | | m3 per hour | |
|---|---|---|---|
| Number of open chimneys | | 0 * 80 = | 0.0000 (6a) |
| Number of open flues | | 0 * 20 = | 0.0000 (6b) |
| Number of chimneys / flues attached to closed fire | | 0 * 10 = | 0.0000 (6c) |
| Number of flues attached to solid fuel boiler | | 0 * 20 = | 0.0000 (6d) |
| Number of flues attached to other heater | | 0 * 35 = | 0.0000 (6e) |
| Number of blocked chimneys | | 0 * 20 = | 0.0000 (6f) |
| Number of intermittent extract fans | | 0 * 10 = | 0.0000 (7a) |
| Number of passive vents | | 0 * 10 = | 0.0000 (7b) |
| Number of flueless gas fires | | 0 * 40 = | 0.0000 (7c) |
| | | Air changes per hour | |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | | 0.0000 / (5) = | 0.0000 (8) |
| Pressure test | | | Yes |
| Pressure Test Method | | | Blower Door |
| Measured/design AP50 | | | 3.0000 (17) |
| Infiltration rate | | | 0.1500 (18) |
| Number of sides sheltered | | | 0 (19) |
| Shelter factor | | (20) = 1 - [0.075 x (19)] = | 1.0000 (20) |
| Infiltration rate adjusted to include shelter factor | | (21) = (18) x (20) = | 0.1500 (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.1912 | 0.1875 | 0.1837 | 0.1650 | 0.1612 | 0.1425 | 0.1425 | 0.1388 | 0.1500 | 0.1612 | 0.1687 | 0.1762 | (22b) |
| Balanced mechanical ventilation with heat recovery | | | | | | | | | | | | | |
| If mechanical ventilation | | | | | | | | | | | | 0.5000 | (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | | | | | | | | | | | | 0.5000 | (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | | | | | | | | | | | | 80.1000 | (23c) |
| Effective ac | 0.2907 | 0.2870 | 0.2833 | 0.2645 | 0.2607 | 0.2420 | 0.2420 | 0.2382 | 0.2495 | 0.2607 | 0.2682 | 0.2757 | (25) |

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## 3. Heat losses and heat loss parameter

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| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| Windows | | | 11.0000 | 1.0536 | 11.5900 | | | (27) |
| Front Door | | | 1.8900 | 1.4000 | 2.6460 | | | (26) |
| Glass Door | | | 2.2900 | 1.3258 | 3.0360 | | | (27) |
| External Walls | 29.4000 | 13.2900 | 16.1100 | 0.1500 | 2.4165 | 150.0000 | 2416.5000 | (29a) |
| Wall to Communal Corridor | 29.4000 | 1.8900 | 27.5100 | 0.1300 | 3.5763 | 150.0000 | 4126.5000 | (29a) |
| External Roof | 14.4200 | | 14.4200 | 0.1000 | 1.4420 | 9.0000 | 129.7800 | (30) |
| Total net area of external elements Aum(A, m2) | | | 73.2200 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 24.7068 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 34 | | | 14.9700 | 0.0000 | 0.0000 | 70.0000 | 1047.9000 | (32) |
| Party Wall to Unit 39 | | | 14.9700 | 0.0000 | 0.0000 | 70.0000 | 1047.9000 | (32) |
| Party Floor | | | 50.5800 | | | 80.0000 | 4046.4000 | (32d) |
| Party Ceiling | | | 31.2100 | | | 100.0000 | 3121.0000 | (32b) |
| Internal Walls | | | 98.5600 | | | 9.0000 | 887.0400 | (32c) |

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 16823.0200 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 332.6022 (35)
List of Thermal Bridges

| | Length | Psi-value | Total | |
|---|---|---|---|---|
| K1 Element | | | | |
| E1 Steel lintel with perforated steel base plate | 5.8800 | 0.0500 | 0.2940 | |
| E4 Jamb | 13.5600 | 0.0500 | 0.6780 | |
| E7 Party floor between dwellings (in blocks of flats) | 1.1130 | 0.0350 | 0.0390 | |
| E18 Party wall between dwellings | 5.9000 | 0.0300 | 0.1770 | |
| E24 Eaves (insulation at ceiling level - inverted) | 8.8550 | 0.1200 | 1.0626 | |
| E24 Eaves (insulation at ceiling level - inverted) | 9.9680 | 0.1200 | 1.1962 | |
| E7 Party floor between dwellings (in blocks of flats) | 9.9680 | 0.0350 | 0.3489 | |
| E15 Flat roof with parapet | 8.8550 | 0.5600 | 4.9588 | |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 8.7544 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 33.4612 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 14.3164 | 14.1318 | 13.9471 | 13.0239 | 12.8392 | 11.9160 | 11.9160 | 11.7313 | 12.2853 | 12.8392 | 13.2085 | 13.5778 | (38) |
| Heat transfer coeff | 47.7776 | 47.5930 | 47.4083 | 46.4851 | 46.3005 | 45.3772 | 45.3772 | 45.1926 | 45.7465 | 46.3005 | 46.6697 | 47.0390 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 46.4389 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 0.9446 | 0.9409 | 0.9373 | 0.9190 | 0.9154 | 0.8971 | 0.8971 | 0.8935 | 0.9044 | 0.9154 | 0.9227 | 0.9300 | (40) |
| HLP (average) | | | | | | | | | | | | 0.9181 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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4. Water heating energy requirements (kWh/year)

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Assumed occupancy 1.7072 (42)
Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 51.5083 | 50.7197 | 49.5576 | 47.7698 | 46.1680 | 43.9270 | 42.1545 | 44.2266 | 45.2688 | 47.4884 | 49.7999 | 51.4619 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 22.3383 | 22.0011 | 21.5214 | 20.8030 | 20.1555 | 19.2642 | 18.5880 | 19.4149 | 19.8489 | 20.7320 | 21.6502 | 22.3206 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.1133 | 30.9456 | 29.7778 | 28.6100 | 27.4423 | 26.2745 | 26.2745 | 27.4423 | 28.6100 | 29.7778 | 30.9456 | 32.1133 | (42c) |

Average daily hot water use (litres/day) 97.3935 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 105.9599 | 103.6664 | 100.8567 | 97.1828 | 93.7657 | 89.4657 | 87.0171 | 91.0838 | 93.7277 | 97.9982 | 102.3956 | 105.8958 | (44) |
| Energy conte | 155.9913 | 137.1716 | 144.1222 | 126.9450 | 120.8266 | 103.4642 | 96.1565 | 107.2073 | 108.7195 | 126.2805 | 138.3910 | 155.5157 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1520.7914 | |
| Distribution loss (46)m = 0.15 x (45)m | 23.3987 | 20.5757 | 21.6183 | 19.0417 | 18.1240 | 15.5196 | 14.4235 | 16.0811 | 16.3079 | 18.9421 | 20.7587 | 23.3274 | (46) |

Water storage loss:
Store volume 110.0000 (47)
b) If manufacturer declared loss factor is not known :
Hot water storage loss factor from Table 2 (kWh/litre/day) 0.0152 (51)
Volume factor from Table 2a 1.0294 (52)
Temperature factor from Table 2b 0.6000 (53)
Enter (49) or (54) in (55) 1.0327 (55)
Total storage loss

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (56) |

If cylinder contains dedicated solar storage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (57) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |

Total heat required for water heating calculated for each month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 211.2681 | 187.0990 | 199.3990 | 180.4387 | 176.1034 | 156.9578 | 151.4333 | 162.4841 | 162.2131 | 181.5573 | 191.8847 | 210.7925 | (62) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WWHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |

Output from w/h

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 211.2681 | 187.0990 | 199.3990 | 180.4387 | 176.1034 | 156.9578 | 151.4333 | 162.4841 | 162.2131 | 181.5573 | 191.8847 | 210.7925 | (64) |

Total per year (kWh/year) = Sum(64)m = 2171.6312 (64)
12Total per year (kWh/year) 2172 (64)
Electric shower(s)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)
Heat gains from water heating, kWh/month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 96.0886 | 85.5515 | 92.1421 | 85.0042 | 84.3963 | 77.1968 | 76.1935 | 79.8679 | 78.9442 | 86.2097 | 88.8100 | 95.9304 | (65) |

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5. Internal gains (see Table 5 and 5a)

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Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 85.3594 | 85.3594 | 85.3594 | 85.3594 | 85.3594 | 85.3594 | 85.3594 | 85.3594 | 85.3594 | 85.3594 | 85.3594 | 85.3594 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 75.0224 | 83.0605 | 75.0224 | 77.5231 | 75.0224 | 77.5231 | 75.0224 | 75.0224 | 77.5231 | 75.0224 | 77.5231 | 75.0224 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 148.7402 | 150.2837 | 146.3942 | 138.1140 | 127.6617 | 117.8381 | 111.2753 | 109.7318 | 113.6213 | 121.9015 | 132.3538 | 142.1774 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 31.5359 | 31.5359 | 31.5359 | 31.5359 | 31.5359 | 31.5359 | 31.5359 | 31.5359 | 31.5359 | 31.5359 | 31.5359 | 31.5359 | (69) |
| Pumps, fans | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | -68.2875 | -68.2875 | -68.2875 | -68.2875 | -68.2875 | -68.2875 | -68.2875 | -68.2875 | -68.2875 | -68.2875 | -68.2875 | -68.2875 | (71) |
| Water heating gains (Table 5) | 129.1513 | 127.3088 | 123.8469 | 118.0613 | 113.4359 | 107.2177 | 102.4106 | 107.3493 | 109.6447 | 115.8733 | 123.3472 | 128.9387 | (72) |
| Total internal gains | 401.5217 | 409.2608 | 393.8713 | 382.3063 | 364.7278 | 351.1867 | 337.3160 | 340.7113 | 349.3969 | 361.4049 | 381.8318 | 394.7463 | (73) |

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6. Solar gains

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| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Northwest | 11.0000 | 11.2829 | 0.4500 | 0.7000 | 0.7700 | 27.0931 | (81) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northwest | | | 2.2900 | | 11.2829 | | 0.4500 | | 0.7000 | | 0.7700 | | 5.6403 (81) |
| Solar gains | 32.7334 | 66.6298 | 120.0457 | 197.1495 | 265.0076 | 282.5261 | 264.2974 | 210.7010 | 146.2775 | 81.4269 | 41.1871 | 26.7317 (83) | |
| Total gains | 434.2551 | 475.8905 | 513.9170 | 579.4557 | 629.7354 | 633.7129 | 601.6134 | 551.4122 | 495.6744 | 442.8318 | 423.0189 | 421.4781 (84) | |

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| tau | 97.8085 | 98.1880 | 98.5704 | 100.5281 | 100.9291 | 102.9826 | 102.9826 | 103.4033 | 102.1512 | 100.9291 | 100.1304 | 99.3443 | |
| alpha | 7.5206 | 7.5459 | 7.5714 | 7.7019 | 7.7286 | 7.8655 | 7.8655 | 7.8936 | 7.8101 | 7.7286 | 7.6754 | 7.6230 | |
| util living area | 0.9953 | 0.9894 | 0.9696 | 0.8715 | 0.6719 | 0.4577 | 0.3318 | 0.3769 | 0.6299 | 0.9189 | 0.9866 | 0.9961 | (86) |
| MIT | 20.3667 | 20.4882 | 20.6721 | 20.9001 | 20.9870 | 20.9994 | 21.0000 | 20.9999 | 20.9940 | 20.8702 | 20.5980 | 20.3571 | (87) |
| Th 2 | 20.1298 | 20.1328 | 20.1359 | 20.1513 | 20.1544 | 20.1699 | 20.1699 | 20.1730 | 20.1637 | 20.1544 | 20.1483 | 20.1421 | (88) |
| util rest of house | 0.9934 | 0.9853 | 0.9580 | 0.8349 | 0.6155 | 0.3987 | 0.2693 | 0.3092 | 0.5570 | 0.8850 | 0.9805 | 0.9945 | (89) |
| MIT 2 | 19.4077 | 19.5634 | 19.7931 | 20.0639 | 20.1459 | 20.1697 | 20.1699 | 20.1730 | 20.1608 | 20.0418 | 19.7154 | 19.4055 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.6103 | (91) |
| MIT | 19.9930 | 20.1278 | 20.3296 | 20.5742 | 20.6592 | 20.6761 | 20.6765 | 20.6777 | 20.6693 | 20.5474 | 20.2541 | 19.9863 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.9930 | 20.1278 | 20.3296 | 20.5742 | 20.6592 | 20.6761 | 20.6765 | 20.6777 | 20.6693 | 20.5474 | 20.2541 | 19.9863 | (93) |

8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9930 | 0.9852 | 0.9610 | 0.8540 | 0.6496 | 0.4347 | 0.3075 | 0.3505 | 0.6014 | 0.9020 | 0.9814 | 0.9942 | (94) |
| Useful gains | 431.2196 | 468.8610 | 493.8571 | 494.8737 | 409.0454 | 275.4918 | 184.9688 | 193.2872 | 298.1182 | 399.4520 | 415.1638 | 419.0290 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | 749.7746 | 724.7365 | 655.6370 | 542.6774 | 414.8167 | 275.7156 | 184.9808 | 193.3192 | 300.5231 | 460.5692 | 613.8969 | 742.5728 | (97) |
| Space heating kWh | 237.0049 | 171.9484 | 120.3642 | 34.4187 | 4.2938 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 45.4712 | 143.0879 | 240.7165 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 997.3056 | |
| Solar heating kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | 237.0049 | 171.9484 | 120.3642 | 34.4187 | 4.2938 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 45.4712 | 143.0879 | 240.7165 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 997.3056 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 19.7174 | (99) |

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ext. temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | |
| Heat loss rate W | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 426.5458 | 335.7913 | 343.4635 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (100) |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.9920 | 0.9977 | 0.9951 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (101) |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 423.1220 | 335.0168 | 341.7793 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (102) |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 700.1338 | 664.6856 | 606.5283 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 199.4485 | 245.2736 | 196.9733 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (104) |
| Cooled fraction | | | | | | | | | | fC = cooled area / (4) = | | 0.9885 | (105) |
| Intermittency factor (Table 10b) | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | (106) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 49.2903 | 60.6153 | 48.6786 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) |
| Space cooling requirement | | | | | | | | | | | | 158.5843 | (107) |

9b. Energy requirements

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | 0.0000 | (301) |
| Fraction of space heat from community system | | | | | | | | | | | | 1.0000 | (302) |
| Fraction of heat from community Heat pump-Space and Water | | | | | | | | | | | | 1.0000 | (303a) |
| Factor for control and charging method (Table 4c(3)) for space heating | | | | | | | | | | | | 1.0000 | (305) |
| Factor for charging method (Table 4c(3)) for water heating | | | | | | | | | | | | 1.0000 | (305a) |
| Distribution loss factor (Table 12c) for community heating system | | | | | | | | | | | | 2.0000 | (306) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 | (208) |
| Space heating: | | | | | | | | | | | | | |
| Space heating requirement | 237.0049 | 171.9484 | 120.3642 | 34.4187 | 4.2938 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 45.4712 | 143.0879 | 240.7165 | (98) |
| Space heat from Heat pump = (98) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 307a | 474.0098 | 343.8967 | 240.7285 | 68.8373 | 8.5876 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 90.9425 | 286.1757 | 481.4331 | |
| Space heating requirement | 474.0098 | 343.8967 | 240.7285 | 68.8373 | 8.5876 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 90.9425 | 286.1757 | 481.4331 | (307) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | | | | | | | | | | | 0.0000 | (308) |
| Space heating fuel for secondary/supplementary system | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (309) |
| Water heating | | | | | | | | | | | | | |
| Annual water heating requirement | 211.2681 | 187.0990 | 199.3990 | 180.4387 | 176.1034 | 156.9578 | 151.4333 | 162.4841 | 162.2131 | 181.5573 | 191.8847 | 210.7925 | (64) |
| Water heat from Heat pump = (64) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 310a | 422.5363 | 374.1980 | 398.7980 | 360.8773 | 352.2069 | 313.9157 | 302.8666 | 324.9683 | 324.4263 | 363.1147 | 383.7694 | 421.5850 | |
| Water heating fuel | 422.5363 | 374.1980 | 398.7980 | 360.8773 | 352.2069 | 313.9157 | 302.8666 | 324.9683 | 324.4263 | 363.1147 | 383.7694 | 421.5850 | (310) |
| Cooling System Energy Efficiency Ratio | | | | | | | | | | | | 2.6000 | (314) |
| Space coolin | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 18.9578 | 23.3136 | 18.7226 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (315) |
| Pumps and Fa | 13.2034 | 11.9257 | 13.2034 | 12.7775 | 13.2034 | 12.7775 | 13.2034 | 13.2034 | 12.7775 | 13.2034 | 12.7775 | 13.2034 | (331) |
| Lighting | 14.5049 | 11.6364 | 10.4772 | 7.6761 | 5.9292 | 4.8442 | 5.4088 | 7.0306 | 9.1321 | 11.9818 | 13.5334 | 14.9080 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333a)m | -4.6937 | -7.5620 | -12.4949 | -16.0972 | -19.1600 | -18.5714 | -18.3108 | -16.3185 | -13.1593 | -9.4100 | -5.4618 | -3.9438 | (333a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334a) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335a) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (333b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335b) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - community heating | 1994.6112 | (307) |
| Space heating fuel - secondary | 0.0000 | (309) |
| Water heating fuel - community heating | 4343.2624 | (310) |
| Efficiency of water heater | 0.0000 | (311) |
| Electricity used for heat distribution | 19.9461 | (313) |
| Space cooling fuel | 60.9939 | (321) |
| | | |
| Electricity for pumps and fans: | | |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8540) | | |
| mechanical ventilation fans (SFP = 0.8540) | 155.4600 | (330a) |
| Total electricity for the above, kWh/year | 155.4600 | (331) |
| Electricity for lighting (calculated in Appendix L) | 117.0627 | (332) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -145.1834 | (333) |
| Wind generation | 0.0000 | (334) |
| Hydro-electric generation (Appendix N) | 0.0000 | (335a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (335) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (336) |
| Energy used | 0.0000 | (337) |
| Total delivered energy for all uses | 6526.2068 | (338) |

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12b. Carbon dioxide emissions - Community heating scheme

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (367) |
| Space and Water heating from Heat pump | 2263.5263 | 0.1575 | 112.1965 | (367) |
| Electrical energy for heat distribution (space & water) | 19.9461 | 0.0000 | 9.2532 | (372) |
| Overall CO2 factor for heat network | | | 0.0536 | (386) |
| Total CO2 associated with community systems | | | 339.7260 | (373) |
| Space and water heating | | | 339.7260 | (376) |
| Space cooling | 60.9939 | 0.1141 | 6.9597 | (377) |
| Pumps, fans and electric keep-hot | 155.4600 | 0.1387 | 21.5642 | (378) |
| Energy for lighting | 117.0627 | 0.1443 | 16.8958 | (379) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -145.1834 | 0.1320 | -19.1592 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -19.1592 | (380) |
| Total CO2, kg/year | | | 365.9864 | (383) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 7.2400 | (384) |

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13b. Primary energy - Community heating scheme

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| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (467a) |
| Space and Water heating from Heat pump | 2263.5263 | 1.5831 | 1127.7151 | (467) |
| Electrical energy for heat distribution (space & water) | 19.9461 | 0.0000 | 97.6072 | (472) |
| Overall CO2 factor for heat network | | | 0.5654 | (486) |
| Total CO2 associated with community systems | | | 3583.5786 | (473) |
| Space and water heating | | | 3583.5786 | (476) |
| Space cooling | 60.9939 | 1.4206 | 86.6453 | (477) |
| Pumps, fans and electric keep-hot | 155.4600 | 1.5128 | 235.1798 | (478) |
| Energy for lighting | 117.0627 | 1.5338 | 179.5546 | (479) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -145.1834 | 1.4876 | -215.9707 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -215.9707 | (480) |
| Total Primary energy kWh/year | | | 3868.9876 | (483) |
| Dwelling Primary energy Rate (DPER) | | | 76.4900 | (484) |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

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| | | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | |
| Ground floor | | 50.5800 | (1b) | x 2.9500 | (2b) = | 149.2110 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 50.5800 | | | | | | (4) |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | | 149.2110 | (5) |

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2. Ventilation rate

---

| | m3 per hour | |
|---|---|---|
| Number of open chimneys | 0 * 80 = 0.0000 | (6a) |

| | | |
|---|---|---|
| Number of open flues | 0 * 20 = | 0.0000 (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 (6f) |
| Number of intermittent extract fans | 2 * 10 = | 20.0000 (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 (7c) |

| | | Air changes per hour | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 20.0000 / (5) = | 0.1340 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3840 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.3840 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.4896 | 0.4800 | 0.4704 | 0.4224 | 0.4128 | 0.3648 | 0.3648 | 0.3552 | 0.3840 | 0.4128 | 0.4320 | 0.4512 | (22b) |
| Effective ac | 0.6199 | 0.6152 | 0.6107 | 0.5892 | 0.5852 | 0.5666 | 0.5666 | 0.5631 | 0.5737 | 0.5852 | 0.5933 | 0.6018 | (25) |

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## 3. Heat losses and heat loss parameter

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| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| TER Opaque door | | | 1.8900 | 1.0000 | 1.8900 | | | (26) |
| TER Opening Type | | | 10.7500 | 1.1450 | 12.3092 | | | (27) |
| External Walls | 29.4000 | 10.7500 | 18.6500 | 0.1800 | 3.3570 | | | (29a) |
| Wall to Communal Corridor | 29.4000 | 1.8900 | 27.5100 | 0.1800 | 4.9518 | | | (29a) |
| External Roof | 14.4200 | | 14.4200 | 0.1100 | 1.5862 | | | (30) |
| Total net area of external elements Aum(A, m2) | | | 73.2200 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 24.0942 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 34 | | | 14.9700 | 0.0000 | 0.0000 | | | (32) |
| Party Wall to Unit 39 | | | 14.9700 | 0.0000 | 0.0000 | | | (32) |

| | | |
|---|---|---|
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | 320.2614 | (35) |

List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E1 Steel lintel with perforated steel base plate | 5.8800 | 0.0500 | 0.2940 |
| E4 Jamb | 13.5600 | 0.0500 | 0.6780 |
| E7 Party floor between dwellings (in blocks of flats) | 1.1130 | 0.0700 | 0.0779 |
| E18 Party wall between dwellings | 5.9000 | 0.0600 | 0.3540 |
| E24 Eaves (insulation at ceiling level - inverted) | 8.8550 | 0.2400 | 2.1252 |
| E24 Eaves (insulation at ceiling level - inverted) | 9.9680 | 0.2400 | 2.3923 |
| E7 Party floor between dwellings (in blocks of flats) | 9.9680 | 0.0700 | 0.6978 |
| E15 Flat roof with parapet | 8.8550 | 0.5600 | 4.9588 |

| | | |
|---|---|---|
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | 11.5780 | (36) |
| Point Thermal bridges | (36a) = 0.0000 | |
| Total fabric heat loss | (33) + (36) + (36a) = 35.6722 | (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 30.5226 | 30.2934 | 30.0687 | 29.0134 | 28.8160 | 27.8969 | 27.8969 | 27.7266 | 28.2509 | 28.8160 | 29.2154 | 29.6330 | (38) |
| Heat transfer coeff | 66.1947 | 65.9655 | 65.7408 | 64.6856 | 64.4881 | 63.5690 | 63.5690 | 63.3988 | 63.9230 | 64.4881 | 64.8875 | 65.3051 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 64.6846 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.3087 | 1.3042 | 1.2997 | 1.2789 | 1.2750 | 1.2568 | 1.2568 | 1.2534 | 1.2638 | 1.2750 | 1.2829 | 1.2911 | (40) |
| HLP (average) | | | | | | | | | | | | 1.2789 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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## 4. Water heating energy requirements (kWh/year)

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| | | |
|---|---|---|
| Assumed occupancy | 1.7072 | (42) |

Hot water usage for mixer showers

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 52.8434 | 52.0493 | 50.8921 | 48.6780 | 47.0440 | 45.2218 | 44.1861 | 45.3346 | 46.5935 | 48.5499 | 50.8116 | 52.6409 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 22.8476 | 22.5083 | 22.0305 | 21.1494 | 20.4897 | 19.7582 | 19.3631 | 19.8376 | 20.3542 | 21.1370 | 22.0361 | 22.7704 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 32.1133 | 30.9456 | 29.7778 | 28.6100 | 27.4423 | 26.2745 | 26.2745 | 27.4423 | 28.6100 | 29.7778 | 30.9456 | 32.1133 | (42c) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 99.0971 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 107.8043 | 105.5031 | 102.7003 | 98.4374 | 94.9760 | 91.2546 | 89.8237 | 92.6144 | 95.5577 | 99.4647 | 103.7933 | 107.5246 | (44) |
| Energy conte | 170.7357 | 150.2351 | 157.8466 | 134.7559 | 127.8560 | 112.2081 | 108.6340 | 114.6760 | 117.8322 | 134.9726 | 147.8726 | 168.3576 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1645.9824 | |

Distribution loss (46)m = 0.15 x (45)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 25.6104 | 22.5353 | 23.6770 | 20.2134 | 19.1784 | 16.8312 | 16.2951 | 17.2014 | 17.6748 | 20.2459 | 22.1809 | 25.2536 | (46) |

| | |
|---|---|
| Water storage loss: | |
| Store volume | 150.0000 (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | 1.3938 (48) |
| Temperature factor from Table 2b | 0.5400 (49) |
| Enter (49) or (54) in (55) | 0.7527 (55) |

Total storage loss

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (56) |

If cylinder contains dedicated solar storage

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (57) |
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |

Total heat required for water heating calculated for each month

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 217.3306 | 192.3208 | 204.4415 | 179.8478 | 174.4509 | 157.3000 | 155.2289 | 161.2709 | 162.9241 | 181.5675 | 192.9644 | 214.9525 | (62) |
| WWHRS | -24.1578 | -21.3654 | -22.3726 | -18.5254 | -17.2650 | -14.7738 | -13.8481 | -14.7260 | -15.2855 | -18.0199 | -20.4144 | -23.7104 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | 193.1728 | 170.9554 | 182.0689 | 161.3224 | 157.1859 | 142.5262 | 141.3808 | 146.5449 | 147.6386 | 163.5476 | 172.5500 | 191.2421 | (64) |
| | | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | 1970.1356 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 1970 | (64) |
| Electric shower(s) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | 94.0456 | 83.6217 | 89.7599 | 80.8798 | 79.7880 | 73.3827 | 73.3967 | 75.4057 | 75.2527 | 82.1543 | 85.2411 | 93.2548 | (65) |

## 5. Internal gains (see Table 5 and 5a)

| Metabolic gains (Table 5), Watts | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 85.3594 | 85.3594 | 85.3594 | 85.3594 | 85.3594 | 85.3594 | 85.3594 | 85.3594 | 85.3594 | 85.3594 | 85.3594 | 85.3594 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 75.1690 | 83.2228 | 75.1690 | 77.6747 | 75.1690 | 77.6747 | 75.1690 | 75.1690 | 77.6747 | 75.1690 | 77.6747 | 75.1690 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 148.7402 | 150.2837 | 146.3942 | 138.1140 | 127.6617 | 117.8381 | 111.2753 | 109.7318 | 113.6213 | 121.9015 | 132.3538 | 142.1774 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 31.5359 | 31.5359 | 31.5359 | 31.5359 | 31.5359 | 31.5359 | 31.5359 | 31.5359 | 31.5359 | 31.5359 | 31.5359 | 31.5359 | (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.0000 | 3.0000 | 3.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | -68.2875 | -68.2875 | -68.2875 | -68.2875 | -68.2875 | -68.2875 | -68.2875 | -68.2875 | -68.2875 | -68.2875 | -68.2875 | -68.2875 | (71) |
| Water heating gains (Table 5) | 126.4053 | 124.4371 | 120.6450 | 112.3331 | 107.2420 | 101.9204 | 98.6515 | 101.3517 | 104.5176 | 110.4225 | 118.3904 | 125.3425 | (72) |
| Total internal gains | 401.9224 | 409.5515 | 393.8161 | 379.7296 | 361.6806 | 346.0409 | 333.7036 | 334.8604 | 344.4214 | 359.1008 | 380.0266 | 394.2968 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Northwest | 10.7500 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 37.0683 | (81) |
| Solar gains | 37.0683 | 75.4536 | 135.9434 | 223.2581 | 300.1026 | 319.9412 | 299.2984 | 238.6042 | 165.6491 | 92.2103 | 46.6415 | 30.2718 | (83) |
| Total gains | 438.9907 | 485.0050 | 529.7595 | 602.9876 | 661.7832 | 665.9821 | 633.0020 | 573.4645 | 510.0705 | 451.3111 | 426.6682 | 424.5686 | (84) |

## 7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a) | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 67.9763 | 68.2125 | 68.4456 | 69.5622 | 69.7752 | 70.7841 | 70.7841 | 70.9741 | 70.3920 | 69.7752 | 69.3457 | 68.9023 | |
| alpha | 5.5318 | 5.5475 | 5.5630 | 5.6375 | 5.6517 | 5.7189 | 5.7189 | 5.7316 | 5.6928 | 5.6517 | 5.6230 | 5.5935 | |
| util living area | 0.9963 | 0.9929 | 0.9827 | 0.9359 | 0.8049 | 0.5962 | 0.4395 | 0.5033 | 0.7825 | 0.9624 | 0.9921 | 0.9970 | (86) |
| MIT | 19.8683 | 20.0160 | 20.2661 | 20.6285 | 20.8858 | 20.9833 | 20.9975 | 20.9949 | 20.9285 | 20.5977 | 20.1861 | 19.8556 | (87) |
| Th 2 | 19.8340 | 19.8376 | 19.8410 | 19.8574 | 19.8605 | 19.8748 | 19.8748 | 19.8775 | 19.8693 | 19.8605 | 19.8543 | 19.8478 | (88) |
| util rest of house | 0.9948 | 0.9900 | 0.9751 | 0.9088 | 0.7382 | 0.4985 | 0.3285 | 0.3835 | 0.6873 | 0.9406 | 0.9882 | 0.9957 | (89) |
| MIT 2 | 18.5481 | 18.7386 | 19.0564 | 19.5064 | 19.7781 | 19.8676 | 19.8743 | 19.8762 | 19.8295 | 19.4833 | 18.9685 | 18.5421 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.6103 | (91) |
| MIT | 19.3538 | 19.5182 | 19.7947 | 20.1912 | 20.4541 | 20.5485 | 20.5598 | 20.5590 | 20.5002 | 20.1634 | 19.7116 | 19.3437 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.3538 | 19.5182 | 19.7947 | 20.1912 | 20.4541 | 20.5485 | 20.5598 | 20.5590 | 20.5002 | 20.1634 | 19.7116 | 19.3437 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9940 | 0.9889 | 0.9747 | 0.9178 | 0.7748 | 0.5579 | 0.3964 | 0.4569 | 0.7435 | 0.9475 | 0.9875 | 0.9949 | (94) |
| Useful gains | 436.3428 | 479.6192 | 516.3817 | 553.3928 | 512.7609 | 371.5726 | 250.9425 | 262.0065 | 379.2149 | 427.6175 | 421.3532 | 422.4213 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | 996.4852 | 964.2995 | 874.0078 | 730.3786 | 564.5373 | 378.1396 | 251.7210 | 263.6733 | 409.1219 | 616.7277 | 818.3376 | 988.9625 | (97) |
| Space heating kWh | 416.7459 | 325.7052 | 266.0738 | 127.4298 | 38.5216 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 140.6980 | 285.8287 | 421.5066 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 2022.5097 | |
| Solar heating kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | 416.7459 | 325.7052 | 266.0738 | 127.4298 | 38.5216 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 140.6980 | 285.8287 | 421.5066 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 2022.5097 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 39.9864 | (99) |

## 9a. Energy requirements - Individual heating systems, including micro-CHP

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | 0.0000 | (201) |
| Fraction of space heat from main system(s) | | | | | | | | | | | | 1.0000 | (202) |
| Efficiency of main space heating system 1 (in %) | | | | | | | | | | | | 92.3000 | (206) |
| Efficiency of main space heating system 2 (in %) | | | | | | | | | | | | 0.0000 | (207) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 | (208) |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| Space heating requirement | 416.7459 | 325.7052 | 266.0738 | 127.4298 | 38.5216 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 140.6980 | 285.8287 | 421.5066 | (98) |
| Space heating efficiency (main heating system 1) | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.3000 | 92.3000 | 92.3000 | (210) |
| Space heating fuel (main heating system) | | | | | | | | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 451.5124 | 352.8767 | 288.2707 | 138.0605 | 41.7352 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 152.4356 | 309.6736 | 456.6702 (211) |
| Space heating efficiency (main heating system 2) | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (212) |
| Space heating fuel (main heating system 2) | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (213) |
| Space heating fuel (secondary) | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (215) |
| Water heating | | | | | | | | | | | | |
| Water heating requirement | | | | | | | | | | | | |
| | 193.1728 | 170.9554 | 182.0689 | 161.3224 | 157.1859 | 142.5262 | 141.3808 | 146.5449 | 147.6386 | 163.5476 | 172.5500 | 191.2421 (64) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 (216) |
| (217)m | 85.7374 | 85.4816 | 84.9094 | 83.5364 | 81.4244 | 79.8000 | 79.8000 | 79.8000 | 79.8000 | 83.7241 | 85.1835 | 85.7805 (217) |
| Fuel for water heating, kWh/month | | | | | | | | | | | | |
| | 225.3074 | 199.9910 | 214.4273 | 193.1163 | 193.0453 | 178.6043 | 177.1690 | 183.6402 | 185.0107 | 195.3411 | 202.5627 | 222.9434 (219) |
| Space cooling fuel requirement | | | | | | | | | | | | |
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (221) |
| Pumps and Fa | 7.3041 | 6.5973 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 (231) |
| Lighting | 15.6186 | 12.5299 | 11.2817 | 8.2655 | 6.3845 | 5.2162 | 5.8242 | 7.5705 | 9.8333 | 12.9018 | 14.5725 | 16.0527 (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (233a)m | -11.3184 | -17.0347 | -26.1253 | -31.4159 | -35.7111 | -34.0281 | -33.6308 | -30.8371 | -26.2356 | -20.3665 | -12.8252 | -9.6649 (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | |
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (233b)m | -3.4934 | -7.5578 | -15.4150 | -23.7369 | -31.9583 | -32.3059 | -31.9096 | -26.7410 | -19.2518 | -10.9797 | -4.7196 | -2.7462 (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | |
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235d) |

| | |
|---|---|
| Annual totals kWh/year | |
| Space heating fuel - main system 1 | 2191.2348 (211) |
| Space heating fuel - main system 2 | 0.0000 (213) |
| Space heating fuel - secondary | 0.0000 (215) |
| Efficiency of water heater | 79.8000 |
| Water heating fuel used | 2371.1587 (219) |
| Space cooling fuel | 0.0000 (221) |
| Electricity for pumps and fans: | |
| Total electricity for the above, kWh/year | 86.0000 (231) |
| Electricity for lighting (calculated in Appendix L) | 126.0514 (232) |
| Energy saving/generation technologies (Appendices M ,N and Q) | |
| PV generation | -500.0086 (233) |
| Wind generation | 0.0000 (234) |
| Hydro-electric generation (Appendix N) | 0.0000 (235a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 (235) |
| Appendix Q - special features | |
| Energy saved or generated | -0.0000 (236) |
| Energy used | 0.0000 (237) |
| Total delivered energy for all uses | 4274.4362 (238) |

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 2191.2348 | 0.2100 | 460.1593 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2371.1587 | 0.2100 | 497.9433 | (264) |
| Space and water heating | | | 958.1026 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 126.0514 | 0.1443 | 18.1931 | (268) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -289.1934 | 0.1332 | -38.5267 | |
| PV Unit electricity exported | -210.8152 | 0.1252 | -26.3912 | |
| Total | | | -64.9179 | (269) |
| Total CO2, kg/year | | | 923.3071 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 18.2500 | (273) |

13a. Primary energy - Individual heating systems including micro-CHP

| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 2191.2348 | 1.1300 | 2476.0953 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2371.1587 | 1.1300 | 2679.4093 | (278) |
| Space and water heating | | | 5155.5046 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 126.0514 | 1.5338 | 193.3418 | (282) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -289.1934 | 1.4923 | -431.5588 | |
| PV Unit electricity exported | -210.8152 | 0.4595 | -96.8669 | |
| Total | | | -528.4257 | (283) |
| Total Primary energy kWh/year | | | 4950.5215 | (286) |
| Target Primary Energy Rate (TPER) | | | 97.8800 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Property Reference** | Unit 38 | **Issued on Date** | 17/05/2025 |
| **Assessment Reference** | 00001 | **Prop Type Ref** | Unit 38 |
| **Property** | | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 79 C | **DER** | 5.07 | **TER** | 12.53 |
| **Environmental** | 96 A | **% DER < TER** | | | 59.54 |
| **$CO_2$ Emissions (t/year)** | 0.41 | **DFEE** | 32.58 | **TFEE** | 35.84 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 9.08 |
| **% DPER < TPER** | 19.38 | **DPER** | 53.71 | **TPER** | 66.62 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Robert Arnold | **Assessor ID** | BA04-0001 |
| **Client** | | | |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 91.6600 | (1b) | x 2.9500 | (2b) = | 270.3970 | (1b) - (3b) (4) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 91.6600 | | | | | |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | | 270.3970 | (5) |

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2. Ventilation rate

---

| | m3 per hour | | |
|---|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 | (6a) |
| Number of open flues | 0 * 20 = | 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | 0 * 10 = | 0.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |

| | Air changes per hour | | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 0.0000 / (5) = | 0.0000 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 3.0000 | (17) |
| Infiltration rate | | 0.1500 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.1500 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.1912 | 0.1875 | 0.1837 | 0.1650 | 0.1612 | 0.1425 | 0.1425 | 0.1388 | 0.1500 | 0.1612 | 0.1687 | 0.1762 | (22b) |

Balanced mechanical ventilation with heat recovery

| | | |
|---|---|---|
| If mechanical ventilation | | 0.5000 (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | | 0.5000 (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | | 81.0000 (23c) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective ac | 0.2862 | 0.2825 | 0.2787 | 0.2600 | 0.2562 | 0.2375 | 0.2375 | 0.2337 | 0.2450 | 0.2562 | 0.2637 | 0.2712 | (25) |

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3. Heat losses and heat loss parameter

---

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| Windows | | | 11.0200 | 1.0536 | 11.6111 | | | (27) |
| Front Door | | | 1.8900 | 1.4000 | 2.6460 | | | (26) |
| Glass Door | | | 2.2900 | 1.3258 | 3.0360 | | | (27) |
| External Walls | 36.8700 | 13.3100 | 23.5600 | 0.1500 | 3.5340 | 150.0000 | 3534.0000 | (29a) |
| Wall to Communal Corridor | 35.2200 | 1.8900 | 33.3300 | 0.1300 | 4.3329 | 150.0000 | 4999.5000 | (29a) |
| Wall to Stairs | 10.5400 | | 10.5400 | 0.1100 | 1.1594 | 150.0000 | 1581.0000 | (29a) |
| External Roof | 45.0700 | | 45.0700 | 0.1000 | 4.5070 | 9.0000 | 405.6300 | (30) |
| Total net area of external elements Aum(A, m2) | | | 127.7000 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 30.8264 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Floor | | | 91.6600 | | | 80.0000 | 7332.8000 | (32d) |
| Party Ceiling | | | 41.1900 | | | 100.0000 | 4119.0000 | (32b) |

| | | |
|---|---|---|
| Heat capacity Cm = Sum(A x k) | (28)...(30) + (32) + (32a)...(32e) = 21971.9300 | (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | 239.7112 | (35) |

List of Thermal Bridges

| | Length | Psi-value | Total | |
|---|---|---|---|---|
| K1 Element | | | | |
| E1 Steel lintel with perforated steel base plate | 7.1500 | 0.0500 | 0.3575 | |
| E3 Sill | 1.0225 | 0.0500 | 0.0511 | |
| E4 Jamb | 20.6600 | 0.0500 | 1.0330 | |
| E7 Party floor between dwellings (in blocks of flats) | 5.3750 | 0.0350 | 0.1881 | |
| E18 Party wall between dwellings | 2.9500 | 0.0600 | 0.1770 | |
| E24 Eaves (insulation at ceiling level - inverted) | 7.0425 | 0.1200 | 0.8451 | |
| E24 Eaves (insulation at ceiling level - inverted) | 11.9400 | 0.1200 | 1.4328 | |
| E15 Flat roof with parapet | 12.5000 | 0.5600 | 7.0000 | |
| E16 Corner (normal) | 2.9500 | 0.0900 | 0.2655 | |
| E25 Staggered party wall between dwellings | 2.9500 | 0.0600 | 0.1770 | |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | | 11.5271 | (36) |
| Point Thermal bridges | | (36a) = | 0.0000 | |
| Total fabric heat loss | | (33) + (36) + (36a) = | 42.3535 | (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 25.5424 | 25.2078 | 24.8731 | 23.2001 | 22.8654 | 21.1924 | 21.1924 | 20.8577 | 21.8616 | 22.8654 | 23.5347 | 24.2039 | (38) |
| Heat transfer coeff | 67.8959 | 67.5613 | 67.2267 | 65.5536 | 65.2190 | 63.5459 | 63.5459 | 63.2113 | 64.2151 | 65.2190 | 65.8882 | 66.5575 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 65.4700 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 0.7407 | 0.7371 | 0.7334 | 0.7152 | 0.7115 | 0.6933 | 0.6933 | 0.6896 | 0.7006 | 0.7115 | 0.7188 | 0.7261 | (40) |
| HLP (average) | | | | | | | | | | | | 0.7143 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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4. Water heating energy requirements (kWh/year)

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Assumed occupancy | | | | | | | | | | | | 2.6478 | (42) |
| Hot water usage for mixer showers | 66.8806 | 65.8566 | 64.3476 | 62.0263 | 59.9464 | 57.0366 | 54.7352 | 57.4257 | 58.7789 | 61.6609 | 64.6622 | 66.8203 | (42a) |
| Hot water usage for baths | 28.9690 | 28.5317 | 27.9096 | 26.9779 | 26.1383 | 24.9825 | 24.1056 | 25.1779 | 25.7406 | 26.8859 | 28.0766 | 28.9460 | (42b) |
| Hot water usage for other uses | 41.7458 | 40.2278 | 38.7097 | 37.1917 | 35.6737 | 34.1556 | 34.1556 | 35.6737 | 37.1917 | 38.7097 | 40.2278 | 41.7458 | (42c) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 126.4706 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 137.5954 | 134.6161 | 130.9670 | 126.1959 | 121.7584 | 116.1748 | 112.9964 | 118.2773 | 121.7113 | 127.2565 | 132.9666 | 137.5121 | (44) |
| Energy conte | 202.5642 | 178.1243 | 187.1491 | 164.8434 | 156.8980 | 134.3522 | 124.8644 | 139.2145 | 141.1790 | 163.9829 | 179.7088 | 201.9466 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1974.8273 | |
| Distribution loss (46)m = 0.15 x (45)m | 30.3846 | 26.7186 | 28.0724 | 24.7265 | 23.5347 | 20.1528 | 18.7297 | 20.8822 | 21.1768 | 24.5974 | 26.9563 | 30.2920 | (46) |
| Water storage loss: | | | | | | | | | | | | | |
| Store volume | | | | | | | | | | | | 110.0000 | (47) |
| b) If manufacturer declared loss factor is not known : | | | | | | | | | | | | | |
| Hot water storage loss factor from Table 2 (kWh/litre/day) | | | | | | | | | | | | 0.0152 | (51) |
| Volume factor from Table 2a | | | | | | | | | | | | 1.0294 | (52) |
| Temperature factor from Table 2b | | | | | | | | | | | | 0.6000 | (53) |
| Enter (49) or (54) in (55) | | | | | | | | | | | | 1.0327 | (55) |
| Total storage loss | 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (56) |
| If cylinder contains dedicated solar storage | 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (57) |
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | 257.8410 | 228.0518 | 242.4259 | 218.3371 | 212.1748 | 187.8459 | 180.1412 | 194.4913 | 194.6726 | 219.2597 | 233.2024 | 257.2234 | (62) |
| WWHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | 257.8410 | 228.0518 | 242.4259 | 218.3371 | 212.1748 | 187.8459 | 180.1412 | 194.4913 | 194.6726 | 219.2597 | 233.2024 | 257.2234 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2625.6671 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2626 | (64) |
| Electric shower(s) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | 111.5740 | 99.1683 | 106.4485 | 97.6054 | 96.3900 | 87.4671 | 85.7389 | 90.5103 | 89.7369 | 98.7458 | 102.5481 | 111.3687 | (65) |

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5. Internal gains (see Table 5 and 5a)

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| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Metabolic gains (Table 5), Watts | | | | | | | | | | | | | |
| (66)m | 132.3883 | 132.3883 | 132.3883 | 132.3883 | 132.3883 | 132.3883 | 132.3883 | 132.3883 | 132.3883 | 132.3883 | 132.3883 | 132.3883 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 129.9735 | 143.8992 | 129.9735 | 134.3059 | 129.9735 | 134.3059 | 129.9735 | 129.9735 | 134.3059 | 129.9735 | 134.3059 | 129.9735 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 242.0988 | 244.6110 | 238.2802 | 224.8029 | 207.7901 | 191.8005 | 181.1185 | 178.6062 | 184.9370 | 198.4143 | 215.4271 | 231.4167 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 36.2388 | 36.2388 | 36.2388 | 36.2388 | 36.2388 | 36.2388 | 36.2388 | 36.2388 | 36.2388 | 36.2388 | 36.2388 | 36.2388 | (69) |
| Pumps, fans | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | -105.9107 | -105.9107 | -105.9107 | -105.9107 | -105.9107 | -105.9107 | -105.9107 | -105.9107 | -105.9107 | -105.9107 | -105.9107 | -105.9107 | (71) |
| Water heating gains (Table 5) | 149.9651 | 147.5719 | 143.0760 | 135.5630 | 129.5565 | 121.4820 | 115.2404 | 121.6536 | 124.6347 | 132.7228 | 142.4279 | 149.6891 | (72) |
| Total internal gains | 584.7538 | 598.7985 | 574.0462 | 557.3883 | 530.0365 | 510.3049 | 489.0488 | 492.9498 | 506.5940 | 523.8271 | 554.8775 | 573.7958 | (73) |

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6. Solar gains

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| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Southeast | 11.0200 | 36.7938 | 0.4500 | 0.7000 | 0.7700 | 88.5116 | (77) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southeast | | | 2.2900 | | 36.7938 | | 0.4500 | | 0.7000 | | 0.7700 | | 18.3931 (77) |
| Solar gains | 106.9047 | 182.0983 | 249.1548 | 308.7149 | 345.7864 | 343.2859 | 330.9642 | 303.3072 | 269.7820 | 201.2574 | 128.0472 | 91.4882 | (83) |
| Total gains | 691.6585 | 780.8968 | 823.2010 | 866.1032 | 875.8230 | 853.5908 | 820.0130 | 796.2570 | 776.3760 | 725.0845 | 682.9247 | 665.2839 | (84) |

7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, ni1,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 89.8922 | 90.3374 | 90.7871 | 93.1042 | 93.5818 | 96.0457 | 96.0457 | 96.5542 | 95.0448 | 93.5818 | 92.6313 | 91.6999 | |
| alpha | 6.9928 | 7.0225 | 7.0525 | 7.2069 | 7.2388 | 7.4030 | 7.4030 | 7.4369 | 7.3363 | 7.2388 | 7.1754 | 7.1133 | |
| util living area | | | | | | | | | | | | | |
| | 0.9875 | 0.9704 | 0.9365 | 0.8362 | 0.6769 | 0.4754 | 0.3409 | 0.3650 | 0.5667 | 0.8474 | 0.9659 | 0.9898 | (86) |
| MIT | 20.4095 | 20.5675 | 20.7326 | 20.9093 | 20.9819 | 20.9988 | 20.9999 | 20.9999 | 20.9959 | 20.9158 | 20.6630 | 20.3961 | (87) |
| Th 2 | 20.3050 | 20.3082 | 20.3114 | 20.3274 | 20.3307 | 20.3468 | 20.3468 | 20.3500 | 20.3403 | 20.3307 | 20.3242 | 20.3178 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9841 | 0.9631 | 0.9218 | 0.8059 | 0.6331 | 0.4274 | 0.2903 | 0.3135 | 0.5142 | 0.8128 | 0.9564 | 0.9870 | (89) |
| MIT 2 | 19.6227 | 19.8223 | 20.0258 | 20.2411 | 20.3164 | 20.3461 | 20.3467 | 20.3500 | 20.3377 | 20.2541 | 19.9559 | 19.6164 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.3390 | (91) |
| MIT | 19.8894 | 20.0749 | 20.2654 | 20.4676 | 20.5420 | 20.5674 | 20.5681 | 20.5703 | 20.5608 | 20.4784 | 20.1956 | 19.8807 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.8894 | 20.0749 | 20.2654 | 20.4676 | 20.5420 | 20.5674 | 20.5681 | 20.5703 | 20.5608 | 20.4784 | 20.1956 | 19.8807 | (93) |

8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9817 | 0.9603 | 0.9207 | 0.8126 | 0.6471 | 0.4436 | 0.3075 | 0.3310 | 0.5319 | 0.8209 | 0.9543 | 0.9849 | (94) |
| Useful gains | 679.0042 | 749.8966 | 757.9403 | 703.7699 | 566.7875 | 378.6822 | 252.1315 | 263.5597 | 412.9251 | 595.2085 | 651.7179 | 655.2209 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | | | | | | | | | | | | | |
| | 1058.4543 | 1025.2377 | 925.4027 | 758.2987 | 576.6671 | 379.2017 | 252.1597 | 263.6071 | 414.8828 | 644.2602 | 862.8448 | 1043.6675 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 282.3109 | 185.0292 | 124.5920 | 39.2608 | 7.3505 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 36.4944 | 152.0114 | 289.0042 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 1116.0533 | |
| Solar heating kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | | | | | | | | | | | | | |
| | 282.3109 | 185.0292 | 124.5920 | 39.2608 | 7.3505 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 36.4944 | 152.0114 | 289.0042 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 1116.0533 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 12.1760 | (99) |

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ext. temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | |
| Heat loss rate W | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 597.3316 | 470.2397 | 480.4058 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (100) |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.9859 | 0.9958 | 0.9944 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (101) |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 588.9281 | 468.2819 | 477.7098 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (102) |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 927.2676 | 891.6297 | 865.7845 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103) |
| Space cooling kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 243.6045 | 314.9708 | 288.7276 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (104) |
| Cooled fraction | | | | | | | | | | fC = cooled area / (4) = | | 0.9928 | (105) |
| Intermittency factor (Table 10b) | | | | | | | | | | | | | |
| | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | (106) |
| Space cooling kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 60.4626 | 78.1757 | 71.6622 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) |
| Space cooling requirement | | | | | | | | | | | | 210.3005 | (107) |

9b. Energy requirements

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | 0.0000 | (301) |
| Fraction of space heat from community system | | | | | | | | | | | | 1.0000 | (302) |
| Fraction of heat from community Heat pump-Space and Water | | | | | | | | | | | | 1.0000 | (303a) |
| Factor for control and charging method (Table 4c(3)) for space heating | | | | | | | | | | | | 1.0000 | (305) |
| Factor for charging method (Table 4c(3)) for water heating | | | | | | | | | | | | 1.0000 | (305a) |
| Distribution loss factor (Table 12c) for community heating system | | | | | | | | | | | | 2.0000 | (306) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 | (208) |
| Space heating: | | | | | | | | | | | | | |
| Space heating requirement | | | | | | | | | | | | | |
| | 282.3109 | 185.0292 | 124.5920 | 39.2608 | 7.3505 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 36.4944 | 152.0114 | 289.0042 | (98) |
| Space heat from Heat pump = (98) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 307a | 564.6218 | 370.0583 | 249.1839 | 78.5216 | 14.7009 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 72.9889 | 304.0227 | 578.0085 | |
| Space heating requirement | | | | | | | | | | | | | |
| | 564.6218 | 370.0583 | 249.1839 | 78.5216 | 14.7009 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 72.9889 | 304.0227 | 578.0085 | (307) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | | | | | | | | | | | 0.0000 | (308) |
| Space heating fuel for secondary/supplementary system | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (309) |
| Water heating | | | | | | | | | | | | | |
| Annual water heating requirement | | | | | | | | | | | | | |
| | 257.8410 | 228.0518 | 242.4259 | 218.3371 | 212.1748 | 187.8459 | 180.1412 | 194.4913 | 194.6726 | 219.2597 | 233.2024 | 257.2234 | (64) |
| Water heat from Heat pump = (64) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 310a | 515.6819 | 456.1035 | 484.8518 | 436.6742 | 424.3496 | 375.6918 | 360.2824 | 388.9826 | 389.3453 | 438.5194 | 466.4049 | 514.4468 | |
| Water heating fuel | | | | | | | | | | | | | |
| | 515.6819 | 456.1035 | 484.8518 | 436.6742 | 424.3496 | 375.6918 | 360.2824 | 388.9826 | 389.3453 | 438.5194 | 466.4049 | 514.4468 | (310) |
| Cooling System Energy Efficiency Ratio | | | | | | | | | | | | 2.6000 | (314) |
| Space coolin | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 23.2548 | 30.0676 | 27.5624 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (315) |
| Pumps and Fa | 24.7115 | 22.3201 | 24.7115 | 23.9144 | 24.7115 | 23.9144 | 24.7115 | 24.7115 | 23.9144 | 24.7115 | 23.9144 | 24.7115 | (331) |
| Lighting | 29.8861 | 23.9758 | 21.5875 | 15.8159 | 12.2167 | 9.9811 | 11.1445 | 14.4860 | 18.8159 | 24.6875 | 27.8844 | 30.7168 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333a)m | -4.8642 | -7.9443 | -13.3107 | -17.3966 | -20.9322 | -20.3670 | -20.0770 | -17.7831 | -14.1872 | -9.9736 | -5.6944 | -4.0763 | (333a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334a) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335a) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (333b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335b) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - community heating | 2232.1065 | (307) |
| Space heating fuel - secondary | 0.0000 | (309) |
| Water heating fuel - community heating | 5251.3342 | (310) |
| Efficiency of water heater | 0.0000 | (311) |
| Electricity used for heat distribution | 22.3211 | (313) |
| Space cooling fuel | 80.8848 | (321) |
| | | |
| Electricity for pumps and fans: | | |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8820) | | |
| mechanical ventilation fans (SFP = 0.8820) | 290.9580 | (330a) |
| Total electricity for the above, kWh/year | 290.9580 | (331) |
| Electricity for lighting (calculated in Appendix L) | 241.1983 | (332) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -156.6066 | (333) |
| Wind generation | 0.0000 | (334) |
| Hydro-electric generation (Appendix N) | 0.0000 | (335a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (335) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (336) |
| Energy used | 0.0000 | (337) |
| Total delivered energy for all uses | 7939.8752 | (338) |

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12b. Carbon dioxide emissions - Community heating scheme

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (367) |
| Space and Water heating from Heat pump | 2672.6574 | 0.1580 | 125.9237 | (367) |
| Electrical energy for heat distribution (space & water) | 22.3211 | 0.0000 | 10.9232 | (372) |
| Overall CO2 factor for heat network | | | 0.0536 | (386) |
| Total CO2 associated with community systems | | | 401.0378 | (373) |
| Space and water heating | | | 401.0378 | (376) |
| Space cooling | 80.8848 | 0.1139 | 9.2151 | (377) |
| Pumps, fans and electric keep-hot | 290.9580 | 0.1387 | 40.3595 | (378) |
| Energy for lighting | 241.1983 | 0.1443 | 34.8124 | (379) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -156.6066 | 0.1317 | -20.6271 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -20.6271 | (380) |
| Total CO2, kg/year | | | 464.7976 | (383) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 5.0700 | (384) |

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13b. Primary energy - Community heating scheme

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| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (467a) |
| Space and Water heating from Heat pump | 2672.6574 | 1.5847 | 1263.3264 | (467) |
| Electrical energy for heat distribution (space & water) | 22.3211 | 0.0000 | 115.2390 | (472) |
| Overall CO2 factor for heat network | | | 0.5654 | (486) |
| Total CO2 associated with community systems | | | 4230.9193 | (473) |
| Space and water heating | | | 4230.9193 | (476) |
| Space cooling | 80.8848 | 1.4199 | 114.8511 | (477) |
| Pumps, fans and electric keep-hot | 290.9580 | 1.5128 | 440.1612 | (478) |
| Energy for lighting | 241.1983 | 1.5338 | 369.9580 | (479) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -156.6066 | 1.4866 | -232.8146 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -232.8146 | (480) |
| Total Primary energy kWh/year | | | 4923.0751 | (483) |
| Dwelling Primary energy Rate (DPER) | | | 53.7100 | (484) |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

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| | | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | |
| Ground floor | | 91.6600 | (1b) | x 2.9500 | (2b) = | 270.3970 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 91.6600 | | | | | | (4) |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | | 270.3970 | (5) |

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2. Ventilation rate

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| | m3 per hour | |
|---|---|---|
| Number of open chimneys | 0 * 80 = 0.0000 | (6a) |

| | | |
|---|---|---|
| Number of open flues | 0 * 20 = | 0.0000 (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 (6f) |
| Number of intermittent extract fans | 3 * 10 = | 30.0000 (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 (7c) |

| | | Air changes per hour | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 30.0000 / (5) = | 0.1109 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3609 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.3609 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.4602 | 0.4512 | 0.4422 | 0.3970 | 0.3880 | 0.3429 | 0.3429 | 0.3339 | 0.3609 | 0.3880 | 0.4061 | 0.4241 | (22b) |
| Effective ac | 0.6059 | 0.6018 | 0.5978 | 0.5788 | 0.5753 | 0.5588 | 0.5588 | 0.5557 | 0.5651 | 0.5753 | 0.5824 | 0.5899 | (25) |

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## 3. Heat losses and heat loss parameter

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| Element | Gross | Openings | NetArea | U-value | A x U | K-value | A x K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | m2 | m2 | m2 | W/m2K | W/K | kJ/m2K | kJ/K | |
| TER Opaque door | | | 1.8900 | 1.0000 | 1.8900 | | | (26) |
| TER Opening Type | | | 13.3100 | 1.1450 | 15.2405 | | | (27) |
| External Walls | 36.8700 | 13.3100 | 23.5600 | 0.1800 | 4.2408 | | | (29a) |
| Wall to Communal Corridor | 35.2200 | 1.8900 | 33.3300 | 0.1800 | 5.9994 | | | (29a) |
| Wall to Stairs | 10.5400 | | 10.5400 | 0.1800 | 1.8972 | | | (29a) |
| External Roof | 45.0700 | | 45.0700 | 0.1100 | 4.9577 | | | (30) |
| Total net area of external elements Aum(A, m2) | | | 127.7000 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 34.2256 | | | (33) |

| | | |
|---|---|---|
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | 230.7237 | (35) |

List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E1 Steel lintel with perforated steel base plate | 7.1500 | 0.0500 | 0.3575 |
| E3 Sill | 1.0225 | 0.0500 | 0.0511 |
| E4 Jamb | 20.6600 | 0.0500 | 1.0330 |
| E7 Party floor between dwellings (in blocks of flats) | 5.3750 | 0.0700 | 0.3763 |
| E18 Party wall between dwellings | 2.9500 | 0.0600 | 0.1770 |
| E24 Eaves (insulation at ceiling level - inverted) | 7.0425 | 0.2400 | 1.6902 |
| E24 Eaves (insulation at ceiling level - inverted) | 11.9400 | 0.2400 | 2.8656 |
| E15 Flat roof with parapet | 12.5000 | 0.5600 | 7.0000 |
| E16 Corner (normal) | 2.9500 | 0.0900 | 0.2655 |
| E25 Staggered party wall between dwellings | 2.9500 | 0.0600 | 0.1770 |

| | | |
|---|---|---|
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | 13.9932 | (36) |
| Point Thermal bridges | (36a) = 0.0000 | |
| Total fabric heat loss | (33) + (36) + (36a) = 48.2187 | (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 54.0647 | 53.6978 | 53.3381 | 51.6488 | 51.3328 | 49.8614 | 49.8614 | 49.5890 | 50.4282 | 51.3328 | 51.9722 | 52.6406 | (38) |
| Heat transfer coeff | 102.2834 | 101.9165 | 101.5569 | 99.8676 | 99.5515 | 98.0802 | 98.0802 | 97.8077 | 98.6469 | 99.5515 | 100.1909 | 100.8593 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 99.8660 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.1159 | 1.1119 | 1.1080 | 1.0895 | 1.0861 | 1.0700 | 1.0700 | 1.0671 | 1.0762 | 1.0861 | 1.0931 | 1.1004 | (40) |
| HLP (average) | | | | | | | | | | | | 1.0895 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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## 4. Water heating energy requirements (kWh/year)

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| | | |
|---|---|---|
| Assumed occupancy | 2.6478 | (42) |

Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 68.6141 | 67.5830 | 66.0804 | 63.2055 | 61.0839 | 58.7179 | 57.3731 | 58.8643 | 60.4989 | 63.0393 | 65.9759 | 68.3512 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 29.6295 | 29.1895 | 28.5698 | 27.4273 | 26.5717 | 25.6231 | 25.1107 | 25.7260 | 26.3960 | 27.4111 | 28.5772 | 29.5294 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 41.7458 | 40.2278 | 38.7097 | 37.1917 | 35.6737 | 34.1556 | 34.1556 | 35.6737 | 37.1917 | 38.7097 | 40.2278 | 41.7458 | (42c) |

| | | |
|---|---|---|
| Average daily hot water use (litres/day) | 128.6819 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 139.9894 | 137.0002 | 133.3599 | 127.8245 | 123.3293 | 118.4966 | 116.6394 | 120.2640 | 124.0866 | 129.1601 | 134.7808 | 139.6264 | (44) |
| Energy conte | 221.7090 | 195.0865 | 204.9693 | 174.9853 | 166.0249 | 145.7054 | 141.0652 | 148.9119 | 153.0112 | 175.2690 | 192.0200 | 218.6211 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 2137.3789 | |
| Distribution loss (46)m = 0.15 x (45)m | 33.2564 | 29.2630 | 30.7454 | 26.2478 | 24.9037 | 21.8558 | 21.1598 | 22.3368 | 22.9517 | 26.2903 | 28.8030 | 32.7932 | (46) |

| | | |
|---|---|---|
| Water storage loss: | | |
| Store volume | 150.0000 | (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | 1.3938 | (48) |
| Temperature factor from Table 2b | 0.5400 | (49) |
| Enter (49) or (54) in (55) | 0.7527 | (55) |

Total storage loss

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (56) |

If cylinder contains dedicated solar storage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (57) |
| Primary loss 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |

Total heat required for water heating calculated for each month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 268.3039 | 237.1722 | 251.5642 | 220.0771 | 212.6199 | 190.7973 | 187.6601 | 195.5068 | 198.1030 | 221.8639 | 237.1118 | 265.2160 | (62) |
| WWHRS -31.3675 | -27.7417 | -29.0495 | -24.0541 | -22.4176 | -19.1829 | -17.9809 | -19.1209 | -19.8473 | -23.3978 | -26.5069 | -30.7866 | (63a) |
| PV diverter -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | 236.9364 | 209.4305 | 222.5147 | 196.0230 | 190.2023 | 171.6144 | 169.6793 | 176.3859 | 178.2557 | 198.4661 | 210.6049 | 234.4294 | (64) |
| | | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | 2394.5426 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2395 | (64) |
| Electric shower(s) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | 110.9942 | 98.5348 | 105.4282 | 94.2561 | 92.4792 | 84.5205 | 84.1801 | 86.7891 | 86.9497 | 95.5529 | 99.9201 | 109.9674 | (65) |

## 5. Internal gains (see Table 5 and 5a)

| Metabolic gains (Table 5), Watts | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 132.3883 | 132.3883 | 132.3883 | 132.3883 | 132.3883 | 132.3883 | 132.3883 | 132.3883 | 132.3883 | 132.3883 | 132.3883 | 132.3883 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 129.9735 | 143.8992 | 129.9735 | 134.3059 | 129.9735 | 134.3059 | 129.9735 | 129.9735 | 134.3059 | 129.9735 | 134.3059 | 129.9735 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 242.0988 | 244.6110 | 238.2802 | 224.8029 | 207.7901 | 191.8005 | 181.1185 | 178.6062 | 184.9370 | 198.4143 | 215.4271 | 231.4167 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 36.2388 | 36.2388 | 36.2388 | 36.2388 | 36.2388 | 36.2388 | 36.2388 | 36.2388 | 36.2388 | 36.2388 | 36.2388 | 36.2388 | (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.0000 | 3.0000 | 3.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | -105.9107 | -105.9107 | -105.9107 | -105.9107 | -105.9107 | -105.9107 | -105.9107 | -105.9107 | -105.9107 | -105.9107 | -105.9107 | -105.9107 | (71) |
| Water heating gains (Table 5) | 149.1857 | 146.6292 | 141.7046 | 130.9112 | 124.3000 | 117.3896 | 113.1453 | 116.6521 | 120.7635 | 128.4313 | 138.7779 | 147.8057 | (72) |
| Total internal gains | 586.9744 | 600.8559 | 575.6748 | 555.7365 | 527.7801 | 506.2125 | 486.9537 | 487.9482 | 502.7228 | 522.5356 | 554.2275 | 574.9124 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Southeast | 13.3100 | 36.7938 | 0.6300 | 0.7000 | 0.7700 | 149.6666 | (77) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 149.6666 | 254.9376 | 348.8167 | 432.2009 | 484.1010 | 480.6002 | 463.3499 | 424.6301 | 377.6948 | 281.7604 | 179.2661 | 128.0834 | (83) |
| Total gains | 736.6410 | 855.7935 | 924.4915 | 987.9374 | 1011.8811 | 986.8128 | 950.3036 | 912.5783 | 880.4176 | 804.2959 | 733.4936 | 702.9958 | (84) |

## 7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a) | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 57.4333 | 57.6401 | 57.8442 | 58.8227 | 59.0095 | 59.8947 | 59.8947 | 60.0615 | 59.5506 | 59.0095 | 58.6329 | 58.2443 | |
| alpha | 4.8289 | 4.8427 | 4.8563 | 4.9215 | 4.9340 | 4.9930 | 4.9930 | 5.0041 | 4.9700 | 4.9340 | 4.9089 | 4.8830 | |
| util living area | 0.9901 | 0.9791 | 0.9585 | 0.9028 | 0.7925 | 0.6102 | 0.4493 | 0.4857 | 0.7109 | 0.9173 | 0.9792 | 0.9920 | (86) |
| MIT | 19.7729 | 19.9925 | 20.2636 | 20.6012 | 20.8438 | 20.9677 | 20.9942 | 20.9915 | 20.9308 | 20.6248 | 20.1507 | 19.7461 | (87) |
| Th 2 | 19.9879 | 19.9911 | 19.9943 | 20.0094 | 20.0122 | 20.0254 | 20.0254 | 20.0278 | 20.0203 | 20.0122 | 20.0065 | 20.0005 | (88) |
| util rest of house | 0.9873 | 0.9732 | 0.9466 | 0.8755 | 0.7385 | 0.5276 | 0.3523 | 0.3867 | 0.6316 | 0.8881 | 0.9723 | 0.9896 | (89) |
| MIT 2 | 18.5764 | 18.8558 | 19.1962 | 19.6139 | 19.8824 | 20.0067 | 20.0234 | 20.0247 | 19.9749 | 19.6519 | 19.0693 | 18.5516 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.3390 | (91) |
| MIT | 18.9820 | 19.2411 | 19.5580 | 19.9486 | 20.2083 | 20.3324 | 20.3525 | 20.3524 | 20.2989 | 19.9817 | 19.4359 | 18.9565 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 18.9820 | 19.2411 | 19.5580 | 19.9486 | 20.2083 | 20.3324 | 20.3525 | 20.3524 | 20.2989 | 19.9817 | 19.4359 | 18.9565 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9834 | 0.9675 | 0.9403 | 0.8735 | 0.7501 | 0.5544 | 0.3852 | 0.4203 | 0.6555 | 0.8871 | 0.9671 | 0.9863 | (94) |
| Useful gains | 724.4084 | 828.0206 | 869.2565 | 863.0046 | 758.9898 | 547.1382 | 366.0576 | 383.5295 | 577.0756 | 713.4729 | 709.3665 | 693.3576 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | 1501.7258 | 1461.5942 | 1326.1305 | 1103.3924 | 847.0135 | 562.2375 | 368.0423 | 386.5757 | 611.5066 | 933.9590 | 1235.9407 | 1488.3336 | (97) |
| Space heating kWh | 578.3241 | 425.7615 | 339.9142 | 173.0792 | 65.4896 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 164.0417 | 379.1334 | 591.4622 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 2717.2059 | |
| Solar heating kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | 578.3241 | 425.7615 | 339.9142 | 173.0792 | 65.4896 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 164.0417 | 379.1334 | 591.4622 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 2717.2059 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 29.6444 | (99) |

## 9a. Energy requirements - Individual heating systems, including micro-CHP

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | 0.0000 | (201) |
| Fraction of space heat from main system(s) | | | | | | | | | | | | 1.0000 | (202) |
| Efficiency of main space heating system 1 (in %) | | | | | | | | | | | | 92.3000 | (206) |
| Efficiency of main space heating system 2 (in %) | | | | | | | | | | | | 0.0000 | (207) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 | (208) |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| Space heating requirement | 578.3241 | 425.7615 | 339.9142 | 173.0792 | 65.4896 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 164.0417 | 379.1334 | 591.4622 | (98) |
| Space heating efficiency (main heating system 1) | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.3000 | 92.3000 | 92.3000 | (210) |
| Space heating fuel (main heating system) | | | | | | | | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 626.5700 | 461.2800 | 368.2711 | 187.5181 | 70.9530 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 177.7266 | 410.7621 | 640.8041 (211) |
| Space heating efficiency (main heating system 2) | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (212) |
| Space heating fuel (main heating system 2) | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (213) |
| Space heating fuel (secondary) | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (215) |
| Water heating | | | | | | | | | | | | |
| Water heating requirement | | | | | | | | | | | | |
| | 236.9364 | 209.4305 | 222.5147 | 196.0230 | 190.2023 | 171.6144 | 169.6793 | 176.3859 | 178.2557 | 198.4661 | 210.6049 | 234.4294 (64) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 (216) |
| (217)m | 85.9817 | 85.6163 | 85.0070 | 83.7818 | 81.9267 | 79.8000 | 79.8000 | 79.8000 | 79.8000 | 83.6358 | 85.3619 | 86.0454 (217) |
| Fuel for water heating, kWh/month | | | | | | | | | | | | |
| | 275.5660 | 244.6152 | 261.7605 | 233.9686 | 232.1615 | 215.0556 | 212.6306 | 221.0350 | 223.3780 | 237.2979 | 246.7199 | 272.4485 (219) |
| Space cooling fuel requirement | | | | | | | | | | | | |
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (221) |
| Pumps and Fa | 7.3041 | 6.5973 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 (231) |
| Lighting | 27.0059 | 21.6652 | 19.5071 | 14.2917 | 11.0393 | 9.0192 | 10.0704 | 13.0899 | 17.0025 | 22.3083 | 25.1971 | 27.7565 (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (233a)m | -20.1056 | -30.0368 | -45.7121 | -54.5038 | -61.5039 | -58.3945 | -57.6728 | -53.0833 | -45.4822 | -35.6833 | -22.6935 | -17.1902 (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | |
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (233b)m | -6.7360 | -14.5291 | -29.5663 | -45.4428 | -61.1251 | -61.8145 | -61.0981 | -51.2584 | -36.9491 | -21.1216 | -9.1008 | -5.3010 (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | |
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235d) |

| | |
|---|---|
| Annual totals kWh/year | |
| Space heating fuel - main system 1 | 2943.8850 (211) |
| Space heating fuel - main system 2 | 0.0000 (213) |
| Space heating fuel - secondary | 0.0000 (215) |
| Efficiency of water heater | 79.8000 |
| Water heating fuel used | 2876.6373 (219) |
| Space cooling fuel | 0.0000 (221) |
| Electricity for pumps and fans: | |
| Total electricity for the above, kWh/year | 86.0000 (231) |
| Electricity for lighting (calculated in Appendix L) | 217.9532 (232) |
| Energy saving/generation technologies (Appendices M ,N and Q) | |
| PV generation | -906.1050 (233) |
| Wind generation | 0.0000 (234) |
| Hydro-electric generation (Appendix N) | 0.0000 (235a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 (235) |
| Appendix Q - special features | |
| Energy saved or generated | -0.0000 (236) |
| Energy used | 0.0000 (237) |
| Total delivered energy for all uses | 5218.3706 (238) |

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 2943.8850 | 0.2100 | 618.2159 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2876.6373 | 0.2100 | 604.0938 | (264) |
| Space and water heating | | | 1222.3097 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 217.9532 | 0.1443 | 31.4574 | (268) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -502.0620 | 0.1334 | -66.9744 | |
| PV Unit electricity exported | -404.0430 | 0.1252 | -50.5947 | |
| Total | | | -117.5691 | (269) |
| Total CO2, kg/year | | | 1148.1272 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 12.5300 | (273) |

13a. Primary energy - Individual heating systems including micro-CHP

| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 2943.8850 | 1.1300 | 3326.5901 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2876.6373 | 1.1300 | 3250.6002 | (278) |
| Space and water heating | | | 6577.1903 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 217.9532 | 1.5338 | 334.3040 | (282) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -502.0620 | 1.4930 | -749.5543 | |
| PV Unit electricity exported | -404.0430 | 0.4596 | -185.7039 | |
| Total | | | -935.2582 | (283) |
| Total Primary energy kWh/year | | | 6106.3368 | (286) |
| Target Primary Energy Rate (TPER) | | | 66.6200 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Property Reference** | Unit 39 | **Issued on Date** | 17/05/2025 |
| **Assessment Reference** | 00001 | **Prop Type Ref** | Unit 39 |
| **Property** | | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 76 C | **DER** | 7.35 | **TER** | 18.51 |
| **Environmental** | 95 A | **% DER < TER** | | | 60.29 |
| **$CO_2$ Emissions (t/year)** | 0.33 | **DFEE** | 46.04 | **TFEE** | 50.56 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 8.94 |
| **% DPER < TPER** | 21.81 | **DPER** | 77.62 | **TPER** | 99.27 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Robert Arnold | **Assessor ID** | BA04-0001 |
| **Client** | | | |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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## 1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 50.5800 | (1b) | x 2.9500 | (2b) = | 149.2110 | (1b) - (3b) (4) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 50.5800 | | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | 149.2110 | (5) |

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## 2. Ventilation rate

---

| | | m3 per hour | |
|---|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 | (6a) |
| Number of open flues | 0 * 20 = | 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | 0 * 10 = | 0.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |

| | Air changes per hour | | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 0.0000 / (5) = | 0.0000 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 3.0000 | (17) |
| Infiltration rate | | 0.1500 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.1500 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.1912 | 0.1875 | 0.1837 | 0.1650 | 0.1612 | 0.1425 | 0.1425 | 0.1388 | 0.1500 | 0.1612 | 0.1687 | 0.1762 | (22b) |

Balanced mechanical ventilation with heat recovery

| | | |
|---|---|---|
| If mechanical ventilation | | 0.5000 (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | | 0.5000 (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | | 80.1000 (23c) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective ac | 0.2907 | 0.2870 | 0.2833 | 0.2645 | 0.2607 | 0.2420 | 0.2420 | 0.2382 | 0.2495 | 0.2607 | 0.2682 | 0.2757 | (25) |

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## 3. Heat losses and heat loss parameter

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| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| Windows | | | 11.0000 | 1.0536 | 11.5900 | | | (27) |
| Front Door | | | 1.8900 | 1.4000 | 2.6460 | | | (26) |
| Glass Door | | | 2.2900 | 1.3258 | 3.0360 | | | (27) |
| External Walls | 29.4000 | 13.2900 | 16.1100 | 0.1500 | 2.4165 | 150.0000 | 2416.5000 | (29a) |
| Wall to Communal Corridor | 29.4000 | 1.8900 | 27.5100 | 0.1300 | 3.5763 | 150.0000 | 4126.5000 | (29a) |
| External Roof | 16.2300 | | 16.2300 | 0.1000 | 1.6230 | 9.0000 | 146.0700 | (30) |
| Total net area of external elements Aum(A, m2) | | | 75.0300 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 24.8878 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 37 | | | 14.9700 | 0.0000 | 0.0000 | 70.0000 | 1047.9000 | (32) |
| Party Wall to Unit 41 | | | 14.9700 | 0.0000 | 0.0000 | 70.0000 | 1047.9000 | (32) |
| Party Floor | | | 50.5800 | | | 80.0000 | 4046.4000 | (32d) |
| Party Ceiling | | | 29.8400 | | | 100.0000 | 2984.0000 | (32b) |
| Internal Walls | | | 98.5600 | | | 9.0000 | 887.0400 | (32c) |

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 16702.3100 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 330.2157 (35)
List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E1 Steel lintel with perforated steel base plate | 5.8800 | 0.0500 | 0.2940 |
| E4 Jamb | 13.5600 | 0.0500 | 0.6780 |
| E18 Party wall between dwellings | 5.9000 | 0.0300 | 0.1770 |
| E24 Eaves (insulation at ceiling level - inverted) | 9.9680 | 0.1200 | 1.1962 |
| E24 Eaves (insulation at ceiling level - inverted) | 9.9680 | 0.1200 | 1.1962 |
| E7 Party floor between dwellings (in blocks of flats) | 9.9680 | 0.0350 | 0.3489 |
| E15 Flat roof with parapet | 9.9680 | 0.5600 | 5.5821 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 9.4723 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 34.3601 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 14.3164 | 14.1318 | 13.9471 | 13.0239 | 12.8392 | 11.9160 | 11.9160 | 11.7313 | 12.2853 | 12.8392 | 13.2085 | 13.5778 | (38) |
| Heat transfer coeff | 48.6765 | 48.4919 | 48.3072 | 47.3840 | 47.1993 | 46.2761 | 46.2761 | 46.0914 | 46.6454 | 47.1993 | 47.5686 | 47.9379 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 47.3378 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 0.9624 | 0.9587 | 0.9551 | 0.9368 | 0.9332 | 0.9149 | 0.9149 | 0.9113 | 0.9222 | 0.9332 | 0.9405 | 0.9478 | (40) |
| HLP (average) | | | | | | | | | | | | 0.9359 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

## 4. Water heating energy requirements (kWh/year)

Assumed occupancy 1.7072 (42)
Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 51.5083 | 50.7197 | 49.5576 | 47.7698 | 46.1680 | 43.9270 | 42.1545 | 44.2266 | 45.2688 | 47.4884 | 49.7999 | 51.4619 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 22.3383 | 22.0011 | 21.5214 | 20.8030 | 20.1555 | 19.2642 | 18.5880 | 19.4149 | 19.8489 | 20.7320 | 21.6502 | 22.3206 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.1133 | 30.9456 | 29.7778 | 28.6100 | 27.4423 | 26.2745 | 26.2745 | 27.4423 | 28.6100 | 29.7778 | 30.9456 | 32.1133 | (42c) |

Average daily hot water use (litres/day) 97.3935 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 105.9599 | 103.6664 | 100.8567 | 97.1828 | 93.7657 | 89.4657 | 87.0171 | 91.0838 | 93.7277 | 97.9982 | 102.3956 | 105.8958 | (44) |
| Energy conte | 155.9913 | 137.1716 | 144.1222 | 126.9450 | 120.8266 | 103.4642 | 96.1565 | 107.2073 | 108.7195 | 126.2805 | 138.3910 | 155.5157 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1520.7914 | |
| Distribution loss (46)m = 0.15 x (45)m | 23.3987 | 20.5757 | 21.6183 | 19.0417 | 18.1240 | 15.5196 | 14.4235 | 16.0811 | 16.3079 | 18.9421 | 20.7587 | 23.3274 | (46) |
| Water storage loss: | | | | | | | | | | | | | |
| Store volume | | | | | | | | | | | | 110.0000 | (47) |
| b) If manufacturer declared loss factor is not known : | | | | | | | | | | | | | |
| Hot water storage loss factor from Table 2 (kWh/litre/day) | | | | | | | | | | | | 0.0152 | (51) |
| Volume factor from Table 2a | | | | | | | | | | | | 1.0294 | (52) |
| Temperature factor from Table 2b | | | | | | | | | | | | 0.6000 | (53) |
| Enter (49) or (54) in (55) | | | | | | | | | | | | 1.0327 | (55) |
| Total storage loss | 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (56) |
| If cylinder contains dedicated solar storage | 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (57) |
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | 211.2681 | 187.0990 | 199.3990 | 180.4387 | 176.1034 | 156.9578 | 151.4333 | 162.4841 | 162.2131 | 181.5573 | 191.8847 | 210.7925 | (62) |
| WWHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | 211.2681 | 187.0990 | 199.3990 | 180.4387 | 176.1034 | 156.9578 | 151.4333 | 162.4841 | 162.2131 | 181.5573 | 191.8847 | 210.7925 | (64) |
| | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | | 2171.6312 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2172 | (64) |
| Electric shower(s) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | 96.0886 | 85.5515 | 92.1421 | 85.0042 | 84.3963 | 77.1968 | 76.1935 | 79.8679 | 78.9442 | 86.2097 | 88.8100 | 95.9304 | (65) |

## 5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 85.3594 | 85.3594 | 85.3594 | 85.3594 | 85.3594 | 85.3594 | 85.3594 | 85.3594 | 85.3594 | 85.3594 | 85.3594 | 85.3594 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 75.0224 | 83.0605 | 75.0224 | 77.5231 | 75.0224 | 77.5231 | 75.0224 | 75.0224 | 77.5231 | 75.0224 | 77.5231 | 75.0224 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 148.7402 | 150.2837 | 146.3942 | 138.1140 | 127.6617 | 117.8381 | 111.2753 | 109.7318 | 113.6213 | 121.9015 | 132.3538 | 142.1774 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 31.5359 | 31.5359 | 31.5359 | 31.5359 | 31.5359 | 31.5359 | 31.5359 | 31.5359 | 31.5359 | 31.5359 | 31.5359 | 31.5359 | (69) |
| Pumps, fans | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | -68.2875 | -68.2875 | -68.2875 | -68.2875 | -68.2875 | -68.2875 | -68.2875 | -68.2875 | -68.2875 | -68.2875 | -68.2875 | -68.2875 | (71) |
| Water heating gains (Table 5) | 129.1513 | 127.3088 | 123.8469 | 118.0613 | 113.4359 | 107.2177 | 102.4106 | 107.3493 | 109.6447 | 115.8733 | 123.3472 | 128.9387 | (72) |
| Total internal gains | 401.5217 | 409.2608 | 393.8713 | 382.3063 | 364.7278 | 351.1867 | 337.3160 | 340.7113 | 349.3969 | 361.4049 | 381.8318 | 394.7463 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Northwest | 11.0000 | 11.2829 | 0.4500 | 0.7000 | 0.7700 | 27.0931 | (81) |
| Northwest | 2.2900 | 11.2829 | 0.4500 | 0.7000 | 0.7700 | 5.6403 | (81) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 32.7334 | 66.6298 | 120.0457 | 197.1495 | 265.0076 | 282.5261 | 264.2974 | 210.7010 | 146.2775 | 81.4269 | 41.1871 | 26.7317 | (83) |
| Total gains | 434.2551 | 475.8905 | 513.9170 | 579.4557 | 629.7354 | 633.7129 | 601.6134 | 551.4122 | 495.6744 | 442.8318 | 423.0189 | 421.4781 | (84) |

7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, ni1,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 95.3135 | 95.6764 | 96.0422 | 97.9135 | 98.2965 | 100.2576 | 100.2576 | 100.6593 | 99.4639 | 98.2965 | 97.5334 | 96.7820 | |
| alpha | 7.3542 | 7.3784 | 7.4028 | 7.5276 | 7.5531 | 7.6838 | 7.6838 | 7.7106 | 7.6309 | 7.5531 | 7.5022 | 7.4521 | |
| util living area | | | | | | | | | | | | | |
| | 0.9953 | 0.9897 | 0.9709 | 0.8780 | 0.6826 | 0.4666 | 0.3384 | 0.3844 | 0.6407 | 0.9232 | 0.9871 | 0.9962 | (86) |
| MIT | 20.3384 | 20.4614 | 20.6495 | 20.8873 | 20.9841 | 20.9992 | 20.9999 | 20.9999 | 20.9925 | 20.8568 | 20.5752 | 20.3286 | (87) |
| Th 2 | 20.1148 | 20.1179 | 20.1209 | 20.1363 | 20.1394 | 20.1548 | 20.1548 | 20.1579 | 20.1487 | 20.1394 | 20.1332 | 20.1271 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9935 | 0.9857 | 0.9598 | 0.8421 | 0.6251 | 0.4054 | 0.2734 | 0.3141 | 0.5659 | 0.8903 | 0.9812 | 0.9946 | (89) |
| MIT 2 | 19.3602 | 19.5180 | 19.7532 | 20.0368 | 20.1289 | 20.1545 | 20.1548 | 20.1579 | 20.1449 | 20.0140 | 19.6748 | 19.3576 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.6103 | (91) |
| MIT | 19.9572 | 20.0938 | 20.3002 | 20.5559 | 20.6508 | 20.6700 | 20.6706 | 20.6718 | 20.6622 | 20.5284 | 20.2243 | 19.9502 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.9572 | 20.0938 | 20.3002 | 20.5559 | 20.6508 | 20.6700 | 20.6706 | 20.6718 | 20.6622 | 20.5284 | 20.2243 | 19.9502 | (93) |

8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9931 | 0.9856 | 0.9624 | 0.8605 | 0.6597 | 0.4428 | 0.3131 | 0.3570 | 0.6115 | 0.9065 | 0.9820 | 0.9942 | (94) |
| Useful gains | 431.2432 | 469.0153 | 494.5922 | 498.6100 | 415.4212 | 280.5961 | 188.3552 | 196.8468 | 303.0925 | 401.4190 | 415.3843 | 419.0441 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | | | | | | | | | | | | | |
| | 762.1395 | 736.7749 | 666.6502 | 552.3034 | 422.4729 | 280.8978 | 188.3724 | 196.8918 | 306.0975 | 468.6121 | 624.3057 | 755.0320 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 246.1869 | 179.9345 | 128.0112 | 38.6592 | 5.2464 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 49.9917 | 150.4234 | 249.9750 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 1048.4283 | |
| Solar heating kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | | | | | | | | | | | | | |
| | 246.1869 | 179.9345 | 128.0112 | 38.6592 | 5.2464 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 49.9917 | 150.4234 | 249.9750 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 1048.4283 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 20.7281 | (99) |

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ext. temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | |
| Heat loss rate W | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 434.9953 | 342.4431 | 350.2950 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (100) |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.9901 | 0.9970 | 0.9938 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (101) |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 430.6744 | 341.4236 | 348.1296 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (102) |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 700.1338 | 664.6856 | 606.5283 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103) |
| Space cooling kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 194.0107 | 240.5069 | 192.2486 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (104) |
| Cooled fraction | | | | | | | | | | fC = cooled area / (4) = | | 0.9885 | (105) |
| Intermittency factor (Table 10b) | | | | | | | | | | | | | |
| | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | (106) |
| Space cooling kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 47.9465 | 59.4373 | 47.5110 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) |
| Space cooling requirement | | | | | | | | | | | | 154.8948 | (107) |

9b. Energy requirements

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | 0.0000 | (301) |
| Fraction of space heat from community system | | | | | | | | | | | | 1.0000 | (302) |
| Fraction of heat from community Heat pump-Space and Water | | | | | | | | | | | | 1.0000 | (303a) |
| Factor for control and charging method (Table 4c(3)) for space heating | | | | | | | | | | | | 1.0000 | (305) |
| Factor for charging method (Table 4c(3)) for water heating | | | | | | | | | | | | 1.0000 | (305a) |
| Distribution loss factor (Table 12c) for community heating system | | | | | | | | | | | | 2.0000 | (306) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 | (208) |
| Space heating: | | | | | | | | | | | | | |
| Space heating requirement | | | | | | | | | | | | | |
| | 246.1869 | 179.9345 | 128.0112 | 38.6592 | 5.2464 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 49.9917 | 150.4234 | 249.9750 | (98) |
| Space heat from Heat pump = (98) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 307a | 492.3737 | 359.8689 | 256.0224 | 77.3185 | 10.4929 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 99.9834 | 300.8468 | 499.9500 | |
| Space heating requirement | | | | | | | | | | | | | |
| | 492.3737 | 359.8689 | 256.0224 | 77.3185 | 10.4929 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 99.9834 | 300.8468 | 499.9500 | (307) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | | | | | | | | | | | 0.0000 | (308) |
| Space heating fuel for secondary/supplementary system | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (309) |
| Water heating | | | | | | | | | | | | | |
| Annual water heating requirement | | | | | | | | | | | | | |
| | 211.2681 | 187.0990 | 199.3990 | 180.4387 | 176.1034 | 156.9578 | 151.4333 | 162.4841 | 162.2131 | 181.5573 | 191.8847 | 210.7925 | (64) |
| Water heat from Heat pump = (64) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 310a | 422.5363 | 374.1980 | 398.7980 | 360.8773 | 352.2069 | 313.9157 | 302.8666 | 324.9683 | 324.4263 | 363.1147 | 383.7694 | 421.5850 | |
| Water heating fuel | | | | | | | | | | | | | |
| | 422.5363 | 374.1980 | 398.7980 | 360.8773 | 352.2069 | 313.9157 | 302.8666 | 324.9683 | 324.4263 | 363.1147 | 383.7694 | 421.5850 | (310) |
| Cooling System Energy Efficiency Ratio | | | | | | | | | | | | 2.6000 | (314) |
| Space coolin | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 18.4410 | 22.8605 | 18.2735 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (315) |
| Pumps and Fa | 13.2034 | 11.9257 | 13.2034 | 12.7775 | 13.2034 | 12.7775 | 13.2034 | 13.2034 | 12.7775 | 13.2034 | 12.7775 | 13.2034 | (331) |
| Lighting | 14.5049 | 11.6364 | 10.4772 | 7.6761 | 5.9292 | 4.8442 | 5.4088 | 7.0306 | 9.1321 | 11.9818 | 13.5334 | 14.9080 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333a)m | -4.6937 | -7.5620 | -12.4949 | -16.0972 | -19.1600 | -18.5714 | -18.3108 | -16.3185 | -13.1593 | -9.4100 | -5.4618 | -3.9438 | (333a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (335a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335a) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (333b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335b) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - community heating | 2096.8567 | (307) |
| Space heating fuel - secondary | 0.0000 | (309) |
| Water heating fuel - community heating | 4343.2624 | (310) |
| Efficiency of water heater | 0.0000 | (311) |
| Electricity used for heat distribution | 20.9686 | (313) |
| Space cooling fuel | 59.5749 | (321) |
| | | |
| Electricity for pumps and fans: | | |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8540) | | |
| mechanical ventilation fans (SFP = 0.8540) | 155.4600 | (330a) |
| Total electricity for the above, kWh/year | 155.4600 | (331) |
| Electricity for lighting (calculated in Appendix L) | 117.0627 | (332) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -145.1834 | (333) |
| Wind generation | 0.0000 | (334) |
| Hydro-electric generation (Appendix N) | 0.0000 | (335a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (335) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (336) |
| Energy used | 0.0000 | (337) |
| Total delivered energy for all uses | 6627.0332 | (338) |

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12b. Carbon dioxide emissions - Community heating scheme

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (367) |
| Space and Water heating from Heat pump | 2300.0425 | 0.1574 | 117.8452 | (367) |
| Electrical energy for heat distribution (space & water) | 20.9686 | 0.0000 | 9.4114 | (372) |
| Overall CO2 factor for heat network | | | 0.0537 | (386) |
| Total CO2 associated with community systems | | | 345.5329 | (373) |
| Space and water heating | | | 345.5329 | (376) |
| Space cooling | 59.5749 | 0.1141 | 6.7971 | (377) |
| Pumps, fans and electric keep-hot | 155.4600 | 0.1387 | 21.5642 | (378) |
| Energy for lighting | 117.0627 | 0.1443 | 16.8958 | (379) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -145.1834 | 0.1320 | -19.1592 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -19.1592 | (380) |
| Total CO2, kg/year | | | 371.6306 | (383) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 7.3500 | (384) |

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13b. Primary energy - Community heating scheme

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| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (467a) |
| Space and Water heating from Heat pump | 2300.0425 | 1.5826 | 1185.1470 | (467) |
| Electrical energy for heat distribution (space & water) | 20.9686 | 0.0000 | 99.2153 | (472) |
| Overall CO2 factor for heat network | | | 0.5656 | (486) |
| Total CO2 associated with community systems | | | 3642.6185 | (473) |
| Space and water heating | | | 3642.6185 | (476) |
| Space cooling | 59.5749 | 1.4205 | 84.6271 | (477) |
| Pumps, fans and electric keep-hot | 155.4600 | 1.5128 | 235.1798 | (478) |
| Energy for lighting | 117.0627 | 1.5338 | 179.5546 | (479) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -145.1834 | 1.4876 | -215.9707 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -215.9707 | (480) |
| Total Primary energy kWh/year | | | 3926.0094 | (483) |
| Dwelling Primary energy Rate (DPER) | | | 77.6200 | (484) |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

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| | | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | |
| Ground floor | | 50.5800 | (1b) | x 2.9500 | (2b) = | 149.2110 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 50.5800 | | | | | | (4) |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | | 149.2110 | (5) |

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2. Ventilation rate

---

| | m3 per hour | |
|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 (6a) |
| Number of open flues | 0 * 20 = | 0.0000 (6b) |

| | | |
|---|---|---|
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 (6f) |
| Number of intermittent extract fans | 2 * 10 = | 20.0000 (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 (7c) |
| | Air changes per hour | |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 20.0000 / (5) = | 0.1340 (8) |
| Pressure test | | Yes |
| Pressure Test Method | | Blower Door |
| Measured/design AP50 | | 5.0000 (17) |
| Infiltration rate | | 0.3840 (18) |
| Number of sides sheltered | | 0 (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.3840 (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.4896 | 0.4800 | 0.4704 | 0.4224 | 0.4128 | 0.3648 | 0.3648 | 0.3552 | 0.3840 | 0.4128 | 0.4320 | 0.4512 | (22b) |
| Effective ac | 0.6199 | 0.6152 | 0.6107 | 0.5892 | 0.5852 | 0.5666 | 0.5666 | 0.5631 | 0.5737 | 0.5852 | 0.5933 | 0.6018 | (25) |

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## 3. Heat losses and heat loss parameter

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| Element | Gross | Openings | NetArea | U-value | A x U | K-value | A x K | |
|---|---|---|---|---|---|---|---|---|
| | m2 | m2 | m2 | W/m2K | W/K | kJ/m2K | kJ/K | |
| Main dwelling | | | | | | | | |
| TER Opaque door | | | 1.8900 | 1.0000 | 1.8900 | | | (26) |
| TER Opening Type | | | 10.7500 | 1.1450 | 12.3092 | | | (27) |
| External Walls | 29.4000 | 10.7500 | 18.6500 | 0.1800 | 3.3570 | | | (29a) |
| Wall to Communal Corridor | 29.4000 | 1.8900 | 27.5100 | 0.1800 | 4.9518 | | | (29a) |
| External Roof | 16.2300 | | 16.2300 | 0.1100 | 1.7853 | | | (30) |
| Total net area of external elements Aum(A, m2) | | | 75.0300 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 24.2933 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 37 | | | 14.9700 | 0.0000 | 0.0000 | | | (32) |
| Party Wall to Unit 41 | | | 14.9700 | 0.0000 | 0.0000 | | | (32) |

| | | |
|---|---|---|
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | 318.4166 | (35) |

List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E1 Steel lintel with perforated steel base plate | 5.8800 | 0.0500 | 0.2940 |
| E4 Jamb | 13.5600 | 0.0500 | 0.6780 |
| E18 Party wall between dwellings | 5.9000 | 0.0600 | 0.3540 |
| E24 Eaves (insulation at ceiling level - inverted) | 9.9680 | 0.2400 | 2.3923 |
| E24 Eaves (insulation at ceiling level - inverted) | 9.9680 | 0.2400 | 2.3923 |
| E7 Party floor between dwellings (in blocks of flats) | 9.9680 | 0.0700 | 0.6978 |
| E15 Flat roof with parapet | 9.9680 | 0.5600 | 5.5821 |

| | | |
|---|---|---|
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | 12.3905 (36) |
| Point Thermal bridges | (36a) = | 0.0000 |
| Total fabric heat loss | (33) + (36) + (36a) = | 36.6837 (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 30.5226 | 30.2934 | 30.0687 | 29.0134 | 28.8160 | 27.8969 | 27.8969 | 27.7266 | 28.2509 | 28.8160 | 29.2154 | 29.6330 | (38) |
| Heat transfer coeff | 67.2063 | 66.9771 | 66.7524 | 65.6971 | 65.4997 | 64.5806 | 64.5806 | 64.4104 | 64.9346 | 65.4997 | 65.8991 | 66.3167 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 65.6962 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.3287 | 1.3242 | 1.3197 | 1.2989 | 1.2950 | 1.2768 | 1.2768 | 1.2734 | 1.2838 | 1.2950 | 1.3029 | 1.3111 | (40) |
| HLP (average) | | | | | | | | | | | | 1.2989 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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## 4. Water heating energy requirements (kWh/year)

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| | | |
|---|---|---|
| Assumed occupancy | 1.7072 | (42) |

Hot water usage for mixer showers

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 52.8434 | 52.0493 | 50.8921 | 48.6780 | 47.0440 | 45.2218 | 44.1861 | 45.3346 | 46.5935 | 48.5499 | 50.8116 | 52.6409 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 22.8476 | 22.5083 | 22.0305 | 21.1494 | 20.4897 | 19.7582 | 19.3631 | 19.8376 | 20.3542 | 21.1370 | 22.0361 | 22.7704 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.1133 | 30.9456 | 29.7778 | 28.6100 | 27.4423 | 26.2745 | 26.2745 | 27.4423 | 28.6100 | 29.7778 | 30.9456 | 32.1133 | (42c) |

| | | |
|---|---|---|
| Average daily hot water use (litres/day) | | 99.0971 (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 107.8043 | 105.5031 | 102.7003 | 98.4374 | 94.9760 | 91.2546 | 89.8237 | 92.6144 | 95.5577 | 99.4647 | 103.7933 | 107.5246 | (44) |
| Energy conte | 170.7357 | 150.2351 | 157.8466 | 134.7559 | 127.8560 | 112.2081 | 108.6340 | 114.6760 | 117.8322 | 134.9726 | 147.8726 | 168.3576 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1645.9824 | |

Distribution loss (46)m = 0.15 x (45)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 25.6104 | 22.5353 | 23.6770 | 20.2134 | 19.1784 | 16.8312 | 16.2951 | 17.2014 | 17.6748 | 20.2459 | 22.1809 | 25.2536 | (46) |

| | | |
|---|---|---|
| Water storage loss: | | |
| Store volume | 150.0000 | (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | 1.3938 | (48) |
| Temperature factor from Table 2b | 0.5400 | (49) |
| Enter (49) or (54) in (55) | 0.7527 | (55) |

Total storage loss

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (56) |

If cylinder contains dedicated solar storage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (57) |
| Primary loss 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |

Total heat required for water heating calculated for each month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 217.3306 | 192.3208 | 204.4415 | 179.8478 | 174.4509 | 157.3000 | 155.2289 | 161.2709 | 162.9241 | 181.5675 | 192.9644 | 214.9525 | (62) |
| WWHRS -24.1578 | -21.3654 | -22.3726 | -18.5254 | -17.2650 | -14.7738 | -13.8481 | -14.7260 | -15.2855 | -18.0199 | -20.4144 | -23.7104 | (63a) |
| PV diverter -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | | | | | | | | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 193.1728 | 170.9554 | 182.0689 | 161.3224 | 157.1859 | 142.5262 | 141.3808 | 146.5449 | 147.6386 | 163.5476 | 172.5500 | 191.2421 (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 1970.1356 (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 1970 (64) |
| Electric shower(s) | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (64a) |
| | | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | 0.0000 (64a) |
| Heat gains from water heating, kWh/month | | | | | | | | | | | | |
| | 94.0456 | 83.6217 | 89.7599 | 80.8798 | 79.7880 | 73.3827 | 73.3967 | 75.4057 | 75.2527 | 82.1543 | 85.2411 | 93.2548 (65) |

## 5. Internal gains (see Table 5 and 5a)

| Metabolic gains (Table 5), Watts | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 85.3594 | 85.3594 | 85.3594 | 85.3594 | 85.3594 | 85.3594 | 85.3594 | 85.3594 | 85.3594 | 85.3594 | 85.3594 | 85.3594 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 75.1690 | 83.2228 | 75.1690 | 77.6747 | 75.1690 | 77.6747 | 75.1690 | 75.1690 | 77.6747 | 75.1690 | 77.6747 | 75.1690 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 148.7402 | 150.2837 | 146.3942 | 138.1140 | 127.6617 | 117.8381 | 111.2753 | 109.7318 | 113.6213 | 121.9015 | 132.3538 | 142.1774 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 31.5359 | 31.5359 | 31.5359 | 31.5359 | 31.5359 | 31.5359 | 31.5359 | 31.5359 | 31.5359 | 31.5359 | 31.5359 | 31.5359 | (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.0000 | 3.0000 | 3.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | | | | | | | | | | | | | |
| | -68.2875 | -68.2875 | -68.2875 | -68.2875 | -68.2875 | -68.2875 | -68.2875 | -68.2875 | -68.2875 | -68.2875 | -68.2875 | -68.2875 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 126.4053 | 124.4371 | 120.6450 | 112.3331 | 107.2420 | 101.9204 | 98.6515 | 101.3517 | 104.5176 | 110.4225 | 118.3904 | 125.3425 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 401.9224 | 409.5515 | 393.8161 | 379.7296 | 361.6806 | 346.0409 | 333.7036 | 334.8604 | 344.4214 | 359.1008 | 380.0266 | 394.2968 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Northwest | 10.7500 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 37.0683 | (81) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 37.0683 | 75.4536 | 135.9434 | 223.2581 | 300.1026 | 319.9412 | 299.2984 | 238.6042 | 165.6491 | 92.2103 | 46.6415 | 30.2718 | (83) |
| Total gains | 438.9907 | 485.0050 | 529.7595 | 602.9876 | 661.7832 | 665.9821 | 633.0020 | 573.4645 | 510.0705 | 451.3111 | 426.6682 | 424.5686 | (84) |

## 7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 66.5675 | 66.7953 | 67.0201 | 68.0966 | 68.3019 | 69.2740 | 69.2740 | 69.4570 | 68.8963 | 68.3019 | 67.8879 | 67.4604 | |
| alpha | 5.4378 | 5.4530 | 5.4680 | 5.5398 | 5.5535 | 5.6183 | 5.6183 | 5.6305 | 5.5931 | 5.5535 | 5.5259 | 5.4974 | |
| util living area | | | | | | | | | | | | | |
| | 0.9963 | 0.9929 | 0.9829 | 0.9375 | 0.8102 | 0.6038 | 0.4461 | 0.5105 | 0.7884 | 0.9632 | 0.9921 | 0.9969 | (86) |
| MIT | 19.8376 | 19.9866 | 20.2401 | 20.6086 | 20.8756 | 20.9808 | 20.9970 | 20.9940 | 20.9216 | 20.5797 | 20.1607 | 19.8246 | (87) |
| Th 2 | 19.8184 | 19.8219 | 19.8254 | 19.8417 | 19.8448 | 19.8591 | 19.8591 | 19.8617 | 19.8535 | 19.8448 | 19.8386 | 19.8321 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9947 | 0.9899 | 0.9754 | 0.9109 | 0.7437 | 0.5042 | 0.3320 | 0.3876 | 0.6931 | 0.9417 | 0.9882 | 0.9956 | (89) |
| MIT 2 | 18.4983 | 18.6904 | 19.0126 | 19.4708 | 19.7544 | 19.8506 | 19.8584 | 19.8602 | 19.8095 | 19.4497 | 18.9253 | 18.4918 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.6103 | (91) |
| MIT | 19.3157 | 19.4815 | 19.7617 | 20.1652 | 20.4387 | 20.5404 | 20.5533 | 20.5522 | 20.4882 | 20.1394 | 19.6793 | 19.3052 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.3157 | 19.4815 | 19.7617 | 20.1652 | 20.4387 | 20.5404 | 20.5533 | 20.5522 | 20.4882 | 20.1394 | 19.6793 | 19.3052 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9939 | 0.9888 | 0.9749 | 0.9193 | 0.7799 | 0.5647 | 0.4019 | 0.4629 | 0.7490 | 0.9483 | 0.9875 | 0.9948 | (94) |
| Useful gains | 436.2944 | 479.5751 | 516.4392 | 554.3435 | 516.1035 | 376.1039 | 254.3782 | 265.4846 | 382.0539 | 427.9616 | 421.3235 | 422.3773 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | | | | | | | | | | | | | |
| | 1009.1488 | 976.6265 | 885.2533 | 740.0944 | 572.3797 | 383.6348 | 255.3080 | 267.4435 | 414.8163 | 624.8247 | 828.9651 | 1001.7284 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 426.2037 | 334.0186 | 274.3977 | 133.7406 | 41.8695 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 146.4662 | 293.5019 | 431.0372 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 2081.2354 | |
| Solar heating kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | | | | | | | | | | | | | |
| | 426.2037 | 334.0186 | 274.3977 | 133.7406 | 41.8695 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 146.4662 | 293.5019 | 431.0372 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 2081.2354 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 41.1474 | (99) |

## 9a. Energy requirements - Individual heating systems, including micro-CHP

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | 0.0000 | (201) |
| Fraction of space heat from main system(s) | | | | | | | | | | | | 1.0000 | (202) |
| Efficiency of main space heating system 1 (in %) | | | | | | | | | | | | 92.3000 | (206) |
| Efficiency of main space heating system 2 (in %) | | | | | | | | | | | | 0.0000 | (207) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 | (208) |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| Space heating requirement | | | | | | | | | | | | | |
| | 426.2037 | 334.0186 | 274.3977 | 133.7406 | 41.8695 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 146.4662 | 293.5019 | 431.0372 | (98) |
| Space heating efficiency (main heating system 1) | | | | | | | | | | | | | |
| | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.3000 | 92.3000 | 92.3000 | (210) |
| Space heating fuel (main heating system) | | | | | | | | | | | | | |
| | 461.7592 | 361.8836 | 297.2890 | 144.8977 | 45.3624 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 158.6849 | 317.9869 | 466.9959 | (211) |
| Space heating efficiency (main heating system 2) | | | | | | | | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (212) |
| Space heating fuel (main heating system 2) | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (213) |
| Space heating fuel (secondary) | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (215) |
| Water heating | | | | | | | | | | | | |
| Water heating requirement | | | | | | | | | | | | |
| | 193.1728 | 170.9554 | 182.0689 | 161.3224 | 157.1859 | 142.5262 | 141.3808 | 146.5449 | 147.6386 | 163.5476 | 172.5500 | 191.2421 (64) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 (216) |
| (217)m | 85.7826 | 85.5342 | 84.9773 | 83.6424 | 81.5383 | 79.8000 | 79.8000 | 79.8000 | 79.8000 | 83.8133 | 85.2407 | 85.8252 (217) |
| Fuel for water heating, kWh/month | | | | | | | | | | | | |
| | 225.1888 | 199.8680 | 214.2559 | 192.8715 | 192.7756 | 178.6043 | 177.1690 | 183.6402 | 185.0107 | 195.1333 | 202.4268 | 222.8273 (219) |
| Space cooling fuel requirement | | | | | | | | | | | | |
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (221) |
| Pumps and Fa | 7.3041 | 6.5973 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 (231) |
| Lighting | 15.6186 | 12.5299 | 11.2817 | 8.2655 | 6.3845 | 5.2162 | 5.8242 | 7.5705 | 9.8333 | 12.9018 | 14.5725 | 16.0527 (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (233a)m | -11.3184 | -17.0347 | -26.1253 | -31.4159 | -35.7111 | -34.0281 | -33.6308 | -30.8371 | -26.2356 | -20.3665 | -12.8252 | -9.6649 (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | |
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (233b)m | -3.4934 | -7.5578 | -15.4150 | -23.7369 | -31.9583 | -32.3059 | -31.9096 | -26.7410 | -19.2518 | -10.9797 | -4.7196 | -2.7462 (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | |
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235d) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - main system 1 | 2254.8596 | (211) |
| Space heating fuel - main system 2 | 0.0000 | (213) |
| Space heating fuel - secondary | 0.0000 | (215) |
| Efficiency of water heater | 79.8000 | |
| Water heating fuel used | 2369.7715 | (219) |
| Space cooling fuel | 0.0000 | (221) |
| | | |
| Electricity for pumps and fans: | | |
| Total electricity for the above, kWh/year | 86.0000 | (231) |
| Electricity for lighting (calculated in Appendix L) | 126.0514 | (232) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -500.0086 | (233) |
| Wind generation | 0.0000 | (234) |
| Hydro-electric generation (Appendix N) | 0.0000 | (235a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (235) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (236) |
| Energy used | 0.0000 | (237) |
| Total delivered energy for all uses | 4336.6738 | (238) |

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 2254.8596 | 0.2100 | 473.5205 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2369.7715 | 0.2100 | 497.6520 | (264) |
| Space and water heating | | | 971.1725 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 126.0514 | 0.1443 | 18.1931 | (268) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -289.1934 | 0.1332 | -38.5267 | |
| PV Unit electricity exported | -210.8152 | 0.1252 | -26.3912 | |
| Total | | | -64.9179 | (269) |
| Total CO2, kg/year | | | 936.3770 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 18.5100 | (273) |

13a. Primary energy - Individual heating systems including micro-CHP

| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 2254.8596 | 1.1300 | 2547.9913 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2369.7715 | 1.1300 | 2677.8418 | (278) |
| Space and water heating | | | 5225.8331 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 126.0514 | 1.5338 | 193.3418 | (282) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -289.1934 | 1.4923 | -431.5588 | |
| PV Unit electricity exported | -210.8152 | 0.4595 | -96.8669 | |
| Total | | | -528.4257 | (283) |
| Total Primary energy kWh/year | | | 5020.8500 | (286) |
| Target Primary Energy Rate (TPER) | | | 99.2700 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Property Reference** | Unit 40 | **Issued on Date** | 17/05/2025 |
| **Assessment Reference** | 00001 | **Prop Type Ref** | Unit 40 |
| **Property** | | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 78 C | **DER** | 5.76 | **TER** | 14.89 |
| **Environmental** | 95 A | **% DER < TER** | | | 61.32 |
| **$CO_2$ Emissions (t/year)** | 0.37 | **DFEE** | 36.79 | **TFEE** | 41.78 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 11.94 |
| **% DPER < TPER** | 23.37 | **DPER** | 60.96 | **TPER** | 79.55 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Robert Arnold | **Assessor ID** | BA04-0001 |
| **Client** | | | |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 72.8500 | (1b) | x 2.9500 | (2b) = | 214.9075 | (1b) - (3b) (4) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 72.8500 | | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | 214.9075 | (5) |

---

2. Ventilation rate

---

| | | m3 per hour | |
|---|---|---|---|
| Number of open chimneys | | 0 * 80 = | 0.0000 (6a) |
| Number of open flues | | 0 * 20 = | 0.0000 (6b) |
| Number of chimneys / flues attached to closed fire | | 0 * 10 = | 0.0000 (6c) |
| Number of flues attached to solid fuel boiler | | 0 * 20 = | 0.0000 (6d) |
| Number of flues attached to other heater | | 0 * 35 = | 0.0000 (6e) |
| Number of blocked chimneys | | 0 * 20 = | 0.0000 (6f) |
| Number of intermittent extract fans | | 0 * 10 = | 0.0000 (7a) |
| Number of passive vents | | 0 * 10 = | 0.0000 (7b) |
| Number of flueless gas fires | | 0 * 40 = | 0.0000 (7c) |

| | | Air changes per hour | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 0.0000 | / (5) = | 0.0000 (8) |
| Pressure test | | | Yes |
| Pressure Test Method | | | Blower Door |
| Measured/design AP50 | | | 3.0000 (17) |
| Infiltration rate | | | 0.1500 (18) |
| Number of sides sheltered | | | 0 (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] | = | 1.0000 (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) | = | 0.1500 (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.1912 | 0.1875 | 0.1837 | 0.1650 | 0.1612 | 0.1425 | 0.1425 | 0.1388 | 0.1500 | 0.1612 | 0.1687 | 0.1762 | (22b) |

Balanced mechanical ventilation with heat recovery

| | |
|---|---|
| If mechanical ventilation | 0.5000 (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | 0.5000 (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | 81.0000 (23c) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective ac | 0.2862 | 0.2825 | 0.2787 | 0.2600 | 0.2562 | 0.2375 | 0.2375 | 0.2337 | 0.2450 | 0.2562 | 0.2637 | 0.2712 | (25) |

---

3. Heat losses and heat loss parameter

---

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| Windows | | | 7.9500 | 1.0536 | 8.3764 | | | (27) |
| Front Door | | | 1.8900 | 1.4000 | 2.6460 | | | (26) |
| Glass Door | | | 2.2900 | 1.3258 | 3.0360 | | | (27) |
| External Walls | 30.3200 | 12.1300 | 18.1900 | 0.1500 | 2.7285 | 150.0000 | 2728.5000 | (29a) |
| Wall to Communal Corridor | 26.6800 | | 26.6800 | 0.1300 | 3.4684 | 150.0000 | 4002.0000 | (29a) |
| Wall to Stairs | 25.6400 | | 25.6400 | 0.1100 | 2.8204 | 150.0000 | 3846.0000 | (29a) |
| External Roof | 37.3300 | | 37.3300 | 0.1000 | 3.7330 | 9.0000 | 335.9700 | (30) |
| Total net area of external elements Aum(A, m2) | | | 119.9700 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 26.8087 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 38 | | | 22.6500 | 0.0000 | 0.0000 | 110.0000 | 2491.5000 | (32) |
| Party Floor | | | 72.8500 | | | 80.0000 | 5828.0000 | (32d) |
| Party Ceiling | | | 31.2000 | | | 100.0000 | 3120.0000 | (32b) |
| Internal Walls | | | 187.2000 | | | 9.0000 | 1684.8000 | (32c) |

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 24036.7700 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 329.9488 (35)
List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E1 Steel lintel with perforated steel base plate | 4.8700 | 0.0500 | 0.2435 |
| E3 Sill | 1.0225 | 0.0500 | 0.0511 |
| E4 Jamb | 12.0600 | 0.0500 | 0.6030 |
| E7 Party floor between dwellings (in blocks of flats) | 6.0470 | 0.0350 | 0.2116 |
| E18 Party wall between dwellings | 11.8000 | 0.0300 | 0.3540 |
| E7 Party floor between dwellings (in blocks of flats) | 9.0450 | 0.0350 | 0.3166 |
| E16 Corner (normal) | 5.9000 | 0.0900 | 0.5310 |
| E17 Corner (inverted - internal area greater than external area) | 2.9500 | -0.0900 | -0.2655 |
| E15 Flat roof with parapet | 15.0400 | 0.5600 | 8.4224 |
| E24 Eaves (insulation at ceiling level - inverted) | 13.9200 | 0.1200 | 1.6704 |
| E24 Eaves (insulation at ceiling level - inverted) | 4.2470 | 0.1200 | 0.5096 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 12.6478 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 39.4565 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 20.3007 | 20.0348 | 19.7688 | 18.4391 | 18.1731 | 16.8434 | 16.8434 | 16.5774 | 17.3753 | 18.1731 | 18.7050 | 19.2369 | (38) |
| Heat transfer coeff | 59.7572 | 59.4913 | 59.2253 | 57.8956 | 57.6296 | 56.2999 | 56.2999 | 56.0339 | 56.8318 | 57.6296 | 58.1615 | 58.6934 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 57.8291 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 0.8203 | 0.8166 | 0.8130 | 0.7947 | 0.7911 | 0.7728 | 0.7728 | 0.7692 | 0.7801 | 0.7911 | 0.7984 | 0.8057 | (40) |
| HLP (average) | | | | | | | | | | | | 0.7938 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

---
4. Water heating energy requirements (kWh/year)
---

Assumed occupancy 2.3133 (42)
Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 61.4139 | 60.4737 | 59.0880 | 56.9564 | 55.0466 | 52.3746 | 50.2613 | 52.7319 | 53.9745 | 56.6209 | 59.3769 | 61.3586 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 26.6110 | 26.2093 | 25.6378 | 24.7820 | 24.0107 | 22.9490 | 22.1434 | 23.1285 | 23.6454 | 24.6975 | 25.7913 | 26.5899 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 38.3203 | 36.9268 | 35.5334 | 34.1399 | 32.7464 | 31.3530 | 31.3530 | 32.7464 | 34.1399 | 35.5334 | 36.9268 | 38.3203 | (42c) |

Average daily hot water use (litres/day) 116.1303 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 126.3453 | 123.6099 | 120.2593 | 115.8783 | 111.8037 | 106.6766 | 103.7578 | 108.6068 | 111.7598 | 116.8517 | 122.0950 | 126.2688 | (44) |
| Energy conte | 186.0021 | 163.5608 | 171.8480 | 151.3661 | 144.0704 | 123.3679 | 114.6554 | 127.8322 | 129.6358 | 150.5753 | 165.0155 | 185.4350 | (45) |
| Energy content (annual) | | | | | | | | | | | Total = Sum(45)m = | 1813.3645 | |
| Distribution loss (46)m = 0.15 x (45)m | 27.9003 | 24.5341 | 25.7772 | 22.7049 | 21.6106 | 18.5052 | 17.1983 | 19.1748 | 19.4454 | 22.5863 | 24.7523 | 27.8152 | (46) |
| Water storage loss: | | | | | | | | | | | | | |
| Store volume | | | | | | | | | | | | 110.0000 | (47) |
| b) If manufacturer declared loss factor is not known : | | | | | | | | | | | | | |
| Hot water storage loss factor from Table 2 (kWh/litre/day) | | | | | | | | | | | | 0.0152 | (51) |
| Volume factor from Table 2a | | | | | | | | | | | | 1.0294 | (52) |
| Temperature factor from Table 2b | | | | | | | | | | | | 0.6000 | (53) |
| Enter (49) or (54) in (55) | | | | | | | | | | | | 1.0327 | (55) |
| Total storage loss | 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (56) |
| If cylinder contains dedicated solar storage | 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (57) |
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | 241.2789 | 213.4883 | 227.1248 | 204.8598 | 199.3472 | 176.8616 | 169.9322 | 183.1090 | 183.1295 | 205.8521 | 218.5092 | 240.7118 | (62) |
| WWHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | 241.2789 | 213.4883 | 227.1248 | 204.8598 | 199.3472 | 176.8616 | 169.9322 | 183.1090 | 183.1295 | 205.8521 | 218.5092 | 240.7118 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2464.2043 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2464 | (64) |
| Electric shower(s) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | 106.0671 | 94.3259 | 101.3609 | 93.1242 | 92.1249 | 83.8148 | 82.3444 | 86.7257 | 85.8989 | 94.2877 | 97.6626 | 105.8786 | (65) |

---
5. Internal gains (see Table 5 and 5a)
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Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 115.6640 | 115.6640 | 115.6640 | 115.6640 | 115.6640 | 115.6640 | 115.6640 | 115.6640 | 115.6640 | 115.6640 | 115.6640 | 115.6640 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 110.2125 | 122.0210 | 110.2125 | 113.8862 | 110.2125 | 113.8862 | 110.2125 | 110.2125 | 113.8862 | 110.2125 | 113.8862 | 110.2125 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 203.8553 | 205.9707 | 200.6400 | 189.2916 | 174.9663 | 161.5025 | 152.5078 | 150.3925 | 155.7231 | 167.0716 | 181.3969 | 194.8607 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 34.5664 | 34.5664 | 34.5664 | 34.5664 | 34.5664 | 34.5664 | 34.5664 | 34.5664 | 34.5664 | 34.5664 | 34.5664 | 34.5664 | (69) |
| Pumps, fans | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | -92.5312 | -92.5312 | -92.5312 | -92.5312 | -92.5312 | -92.5312 | -92.5312 | -92.5312 | -92.5312 | -92.5312 | -92.5312 | -92.5312 | (71) |
| Water heating gains (Table 5) | 142.5634 | 140.3660 | 136.2378 | 129.3391 | 123.8237 | 116.4094 | 110.6779 | 116.5667 | 119.3040 | 126.7308 | 135.6425 | 142.3099 | (72) |
| Total internal gains | 514.3303 | 526.0568 | 504.7895 | 490.2162 | 466.7017 | 449.4973 | 431.0974 | 434.8709 | 446.6126 | 461.7141 | 488.6248 | 505.0823 | (73) |

---
6. Solar gains
---

| [Jan] | Area m2 | Solar flux Table 6a | g Specific data | FF Specific data | Access factor | Gains W |
|---|---|---|---|---|---|---|

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | W/m2 | or Table 6b | | or Table 6c | | Table 6d | | | |
| Southeast | | | | | 7.9500 | 36.7938 | | 0.4500 | 0.7000 | 0.7700 | | 63.8537 | (77) |
| Southeast | | | | | 2.2900 | 36.7938 | | 0.4500 | 0.7000 | 0.7700 | | 18.3931 | (77) |
| Solar gains | 82.2468 | 140.0967 | 191.6863 | 237.5087 | 266.0295 | 264.1057 | 254.6261 | 233.3483 | 207.5558 | 154.8366 | 98.5127 | 70.3861 | (83) |
| Total gains | 596.5771 | 666.1535 | 696.4758 | 727.7248 | 732.7312 | 713.6031 | 685.7235 | 668.2192 | 654.1683 | 616.5507 | 587.1375 | 575.4684 | (84) |

7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, ni1,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 111.7335 | 112.2330 | 112.7369 | 115.3263 | 115.8585 | 118.5949 | 118.5949 | 119.1578 | 117.4850 | 115.8585 | 114.7989 | 113.7586 | |
| alpha | 8.4489 | 8.4822 | 8.5158 | 8.6884 | 8.7239 | 8.9063 | 8.9063 | 8.9439 | 8.8323 | 8.7239 | 8.6533 | 8.5839 | |
| util living area | 0.9948 | 0.9855 | 0.9632 | 0.8789 | 0.7180 | 0.5044 | 0.3612 | 0.3857 | 0.5968 | 0.8840 | 0.9820 | 0.9959 | (86) |
| MIT | 20.5010 | 20.6281 | 20.7679 | 20.9245 | 20.9878 | 20.9995 | 21.0000 | 21.0000 | 20.9979 | 20.9327 | 20.7130 | 20.4894 | (87) |
| Th 2 | 20.2358 | 20.2389 | 20.2421 | 20.2579 | 20.2611 | 20.2770 | 20.2770 | 20.2801 | 20.2706 | 20.2611 | 20.2547 | 20.2484 | (88) |
| util rest of house | 0.9927 | 0.9803 | 0.9505 | 0.8459 | 0.6662 | 0.4477 | 0.3019 | 0.3254 | 0.5351 | 0.8459 | 0.9745 | 0.9943 | (89) |
| MIT 2 | 19.6658 | 19.8279 | 20.0014 | 20.1912 | 20.2528 | 20.2767 | 20.2769 | 20.2801 | 20.2695 | 20.2050 | 19.9483 | 19.6618 | (90) |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.4048 | (91) |
| MIT | 20.0039 | 20.1518 | 20.3117 | 20.4880 | 20.5503 | 20.5693 | 20.5696 | 20.5715 | 20.5644 | 20.4996 | 20.2578 | 19.9968 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 20.0039 | 20.1518 | 20.3117 | 20.4880 | 20.5503 | 20.5693 | 20.5696 | 20.5715 | 20.5644 | 20.4996 | 20.2578 | 19.9968 | (93) |

8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9920 | 0.9796 | 0.9518 | 0.8567 | 0.6868 | 0.4706 | 0.3259 | 0.3498 | 0.5601 | 0.8591 | 0.9745 | 0.9936 | (94) |
| Useful gains | 591.7799 | 652.5490 | 662.9069 | 623.4771 | 503.2668 | 335.8539 | 223.4829 | 233.7338 | 366.3922 | 529.6542 | 572.1791 | 571.7913 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | 938.4215 | 907.3506 | 818.0011 | 670.8952 | 510.0392 | 336.0714 | 223.4898 | 233.7465 | 367.3816 | 570.5098 | 765.2794 | 927.1684 | (97) |
| Space heating kWh | 257.9014 | 171.2267 | 115.3901 | 34.1411 | 5.0387 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 30.3966 | 139.0322 | 264.4006 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 1017.5273 | |
| Solar heating kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | 257.9014 | 171.2267 | 115.3901 | 34.1411 | 5.0387 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 30.3966 | 139.0322 | 264.4006 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 1017.5273 | |
| Space heating per m2 | | | | | | | | | | (98c) / (4) = | | 13.9674 | (99) |

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ext. temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | |
| Heat loss rate W | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 529.2189 | 416.6191 | 425.8579 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (100) |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.9889 | 0.9975 | 0.9964 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (101) |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 523.3673 | 415.5627 | 424.3341 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (102) |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 772.9998 | 743.5194 | 724.4225 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 179.7354 | 243.9998 | 223.2657 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (104) |
| Cooled fraction | | | | | | | | | fC = cooled area / (4) = | | | 0.9883 | (105) |
| Intermittency factor (Table 10b) | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | (106) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 44.4096 | 60.2882 | 55.1652 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) |
| Space cooling requirement | | | | | | | | | | | | 159.8630 | (107) |

9b. Energy requirements

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | 0.0000 | (301) |
| Fraction of space heat from community system | | | | | | | | | | | | 1.0000 | (302) |
| Fraction of heat from community Heat pump-Space and Water | | | | | | | | | | | | 1.0000 | (303a) |
| Factor for control and charging method (Table 4c(3)) for space heating | | | | | | | | | | | | 1.0000 | (305) |
| Factor for charging method (Table 4c(3)) for water heating | | | | | | | | | | | | 1.0000 | (305a) |
| Distribution loss factor (Table 12c) for community heating system | | | | | | | | | | | | 2.0000 | (306) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 | (208) |
| Space heating: | | | | | | | | | | | | | |
| Space heating requirement | | | | | | | | | | | | | |
| | 257.9014 | 171.2267 | 115.3901 | 34.1411 | 5.0387 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 30.3966 | 139.0322 | 264.4006 | (98) |
| Space heat from Heat pump = (98) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 307a | 515.8027 | 342.4534 | 230.7802 | 68.2821 | 10.0774 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 60.7931 | 278.0644 | 528.8012 | |
| Space heating requirement | | | | | | | | | | | | | |
| | 515.8027 | 342.4534 | 230.7802 | 68.2821 | 10.0774 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 60.7931 | 278.0644 | 528.8012 | (307) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | | | | | | | | | | | 0.0000 | (308) |
| Space heating fuel for secondary/supplementary system | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (309) |
| Water heating | | | | | | | | | | | | | |
| Annual water heating requirement | | | | | | | | | | | | | |
| | 241.2789 | 213.4883 | 227.1248 | 204.8598 | 199.3472 | 176.8616 | 169.9322 | 183.1090 | 183.1295 | 205.8521 | 218.5092 | 240.7118 | (64) |
| Water heat from Heat pump = (64) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 310a | 482.5578 | 426.9766 | 454.2496 | 409.7195 | 398.6944 | 353.7232 | 339.8644 | 366.2180 | 366.2590 | 411.7042 | 437.0183 | 481.4236 | |
| Water heating fuel | | | | | | | | | | | | | |
| | 482.5578 | 426.9766 | 454.2496 | 409.7195 | 398.6944 | 353.7232 | 339.8644 | 366.2180 | 366.2590 | 411.7042 | 437.0183 | 481.4236 | (310) |
| Cooling System Energy Efficiency Ratio | | | | | | | | | | | | 2.6000 | (314) |
| Space coolin | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 17.0806 | 23.1878 | 21.2174 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (315) |
| Pumps and Fa | 19.6403 | 17.7397 | 19.6403 | 19.0068 | 19.6403 | 19.0068 | 19.6403 | 19.6403 | 19.0068 | 19.6403 | 19.0068 | 19.6403 | (331) |
| Lighting | 23.8116 | 19.1026 | 17.1997 | 12.6013 | 9.7336 | 7.9524 | 8.8793 | 11.5417 | 14.9915 | 19.6696 | 22.2168 | 24.4734 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (333a)m | -4.8083 | -7.8181 | -13.0396 | -16.9615 | -20.3351 | -19.7602 | -19.4803 | -17.2903 | -13.8437 | -9.7869 | -5.6179 | -4.0329 | (333a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335a) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (333b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335b) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - community heating | 2035.0546 | (307) |
| Space heating fuel - secondary | 0.0000 | (309) |
| Water heating fuel - community heating | 4928.4086 | (310) |
| Efficiency of water heater | 0.0000 | (311) |
| Electricity used for heat distribution | 20.3505 | (313) |
| Space cooling fuel | 61.4858 | (321) |
| | | |
| Electricity for pumps and fans: | | |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8820) | | |
| mechanical ventilation fans (SFP = 0.8820) | 231.2491 | (330a) |
| Total electricity for the above, kWh/year | 231.2491 | (331) |
| Electricity for lighting (calculated in Appendix L) | 192.1735 | (332) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -152.7747 | (333) |
| Wind generation | 0.0000 | (334) |
| Hydro-electric generation (Appendix N) | 0.0000 | (335a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (335) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (336) |
| Energy used | 0.0000 | (337) |
| Total delivered energy for all uses | 7295.5967 | (338) |

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12b. Carbon dioxide emissions - Community heating scheme

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (367) |
| Space and Water heating from Heat pump | 2486.9511 | 0.1581 | 114.9009 | (367) |
| Electrical energy for heat distribution (space & water) | 20.3505 | 0.0000 | 10.1574 | (372) |
| Overall CO2 factor for heat network | | | 0.0536 | (386) |
| Total CO2 associated with community systems | | | 372.9212 | (373) |
| Space and water heating | | | 372.9212 | (376) |
| Space cooling | 61.4858 | 0.1138 | 6.9999 | (377) |
| Pumps, fans and electric keep-hot | 231.2491 | 0.1387 | 32.0771 | (378) |
| Energy for lighting | 192.1735 | 0.1443 | 27.7366 | (379) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -152.7747 | 0.1318 | -20.1351 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -20.1351 | (380) |
| Total CO2, kg/year | | | 419.5997 | (383) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 5.7600 | (384) |

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13b. Primary energy - Community heating scheme

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| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (467a) |
| Space and Water heating from Heat pump | 2486.9511 | 1.5852 | 1152.1495 | (467) |
| Electrical energy for heat distribution (space & water) | 20.3505 | 0.0000 | 107.2062 | (472) |
| Overall CO2 factor for heat network | | | 0.5652 | (486) |
| Total CO2 associated with community systems | | | 3936.0002 | (473) |
| Space and water heating | | | 3936.0002 | (476) |
| Space cooling | 61.4858 | 1.4196 | 87.2881 | (477) |
| Pumps, fans and electric keep-hot | 231.2491 | 1.5128 | 349.8336 | (478) |
| Energy for lighting | 192.1735 | 1.5338 | 294.7621 | (479) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -152.7747 | 1.4869 | -227.1658 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -227.1658 | (480) |
| Total Primary energy kWh/year | | | 4440.7181 | (483) |
| Dwelling Primary energy Rate (DPER) | | | 60.9600 | (484) |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 72.8500 | (1b) | x 2.9500 | (2b) | = 214.9075 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 72.8500 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | | = 214.9075 | (5) |

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2. Ventilation rate

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| | | | |
|---|---|---|---|
| | | m3 per hour | |
| Number of open chimneys | 0 * 80 = | 0.0000 | (6a) |
| Number of open flues | 0 * 20 = | 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | 3 * 10 = | 30.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |
| | Air changes per hour | | |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 30.0000 / (5) = | 0.1396 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3896 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.3896 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.4967 | 0.4870 | 0.4773 | 0.4286 | 0.4188 | 0.3701 | 0.3701 | 0.3604 | 0.3896 | 0.4188 | 0.4383 | 0.4578 | (22b) |
| Effective ac | 0.6234 | 0.6186 | 0.6139 | 0.5918 | 0.5877 | 0.5685 | 0.5685 | 0.5649 | 0.5759 | 0.5877 | 0.5961 | 0.6048 | (25) |

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## 3. Heat losses and heat loss parameter

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| TER Opaque door | | | 1.8900 | 1.0000 | 1.8900 | | | (26) |
| TER Opening Type | | | 10.2400 | 1.1450 | 11.7252 | | | (27) |
| External Walls | 30.3200 | 12.1300 | 18.1900 | 0.1800 | 3.2742 | | | (29a) |
| Wall to Communal Corridor | 26.6800 | | 26.6800 | 0.1800 | 4.8024 | | | (29a) |
| Wall to Stairs | 25.6400 | | 25.6400 | 0.1800 | 4.6152 | | | (29a) |
| External Roof | 37.3300 | | 37.3300 | 0.1100 | 4.1063 | | | (30) |
| Total net area of external elements Aum(A, m2) | | | 119.9700 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 30.4133 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 38 | | | 22.6500 | 0.0000 | 0.0000 | | | (32) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 321.3833 (35)

List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E1 Steel lintel with perforated steel base plate | 4.8700 | 0.0500 | 0.2435 |
| E3 Sill | 1.0225 | 0.0500 | 0.0511 |
| E4 Jamb | 12.0600 | 0.0500 | 0.6030 |
| E7 Party floor between dwellings (in blocks of flats) | 6.0470 | 0.0700 | 0.4233 |
| E18 Party wall between dwellings | 11.8000 | 0.0600 | 0.7080 |
| E7 Party floor between dwellings (in blocks of flats) | 9.0450 | 0.0700 | 0.6332 |
| E16 Corner (normal) | 5.9000 | 0.0900 | 0.5310 |
| E17 Corner (inverted - internal area greater than external area) | 2.9500 | -0.0900 | -0.2655 |
| E15 Flat roof with parapet | 15.0400 | 0.5600 | 8.4224 |
| E24 Eaves (insulation at ceiling level - inverted) | 13.9200 | 0.2400 | 3.3408 |
| E24 Eaves (insulation at ceiling level - inverted) | 4.2470 | 0.2400 | 1.0193 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 15.7100 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 46.1233 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 44.2092 | 43.8695 | 43.5364 | 41.9722 | 41.6796 | 40.3172 | 40.3172 | 40.0649 | 40.8420 | 41.6796 | 42.2716 | 42.8906 | (38) |
| Heat transfer coeff | 90.3326 | 89.9928 | 89.6598 | 88.0956 | 87.8029 | 86.4405 | 86.4405 | 86.1882 | 86.9653 | 87.8029 | 88.3950 | 89.0139 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 88.0942 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.2400 | 1.2353 | 1.2307 | 1.2093 | 1.2053 | 1.1866 | 1.1866 | 1.1831 | 1.1938 | 1.2053 | 1.2134 | 1.2219 | (40) |
| HLP (average) | | | | | | | | | | | | 1.2093 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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## 4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.3133 (42)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hot water usage for mixer showers | 63.0058 | 62.0589 | 60.6792 | 58.0393 | 56.0911 | 53.9185 | 52.6836 | 54.0529 | 55.5539 | 57.8866 | 60.5832 | 62.7644 | (42a) |
| Hot water usage for baths | 27.2178 | 26.8136 | 26.2443 | 25.1948 | 24.4089 | 23.5374 | 23.0667 | 23.6320 | 24.2474 | 25.1799 | 26.2511 | 27.1258 | (42b) |
| Hot water usage for other uses | 38.3203 | 36.9268 | 35.5334 | 34.1399 | 32.7464 | 31.3530 | 31.3530 | 32.7464 | 34.1399 | 35.5334 | 36.9268 | 38.3203 | (42c) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 118.1610 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 128.5439 | 125.7993 | 122.4569 | 117.3739 | 113.2464 | 108.8089 | 107.1033 | 110.4313 | 113.9412 | 118.5999 | 123.7611 | 128.2104 | (44) |
| Energy conte | 203.5821 | 179.1366 | 188.2117 | 160.6791 | 152.4514 | 133.7932 | 129.5321 | 136.7370 | 140.5010 | 160.9389 | 176.3204 | 200.7466 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1962.6300 | |
| Distribution loss (46)m = 0.15 x (45)m | 30.5373 | 26.8705 | 28.2317 | 24.1019 | 22.8677 | 20.0690 | 19.4298 | 20.5106 | 21.0751 | 24.1408 | 26.4481 | 30.1120 | (46) |
| Water storage loss: | | | | | | | | | | | | | |
| Store volume | | | | | | | | | | | | 150.0000 | (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | | | | | | | | | | | | 1.3938 | (48) |
| Temperature factor from Table 2b | | | | | | | | | | | | 0.5400 | (49) |
| Enter (49) or (54) in (55) | | | | | | | | | | | | 0.7527 | (55) |
| Total storage loss | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (56) |
| If cylinder contains dedicated solar storage | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (57) |
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | | | | | | | | | | | | | |
| | 250.1770 | 221.2223 | 234.8066 | 205.7709 | 199.0463 | 178.8851 | 176.1270 | 183.3319 | 185.5928 | 207.5338 | 221.4123 | 247.3415 | (62) |
| WWHRS | -28.8036 | -25.4742 | -26.6751 | -22.0880 | -20.5852 | -17.6149 | -16.5112 | -17.5580 | -18.2251 | -21.4854 | -24.3403 | -28.2702 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | | | | | | | | | | | | | |
| | 221.3733 | 195.7481 | 208.1315 | 183.6829 | 178.4611 | 161.2702 | 159.6159 | 165.7739 | 167.3677 | 186.0485 | 197.0720 | 219.0713 | (64) |
| | | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | 2243.6163 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2244 | (64) |
| Electric shower(s) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | | | | | | | | | | | | | |
| | 104.9670 | 93.2315 | 99.8563 | 89.4993 | 87.9660 | 80.5597 | 80.3454 | 82.7410 | 82.7900 | 90.7881 | 94.7000 | 104.0242 | (65) |

## 5. Internal gains (see Table 5 and 5a)

| Metabolic gains (Table 5), Watts | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 115.6640 | 115.6640 | 115.6640 | 115.6640 | 115.6640 | 115.6640 | 115.6640 | 115.6640 | 115.6640 | 115.6640 | 115.6640 | 115.6640 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 110.2125 | 122.0210 | 110.2125 | 113.8862 | 110.2125 | 113.8862 | 110.2125 | 110.2125 | 113.8862 | 110.2125 | 113.8862 | 110.2125 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 203.8553 | 205.9707 | 200.6400 | 189.2916 | 174.9663 | 161.5025 | 152.5078 | 150.3925 | 155.7231 | 167.0716 | 181.3969 | 194.8607 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 34.5664 | 34.5664 | 34.5664 | 34.5664 | 34.5664 | 34.5664 | 34.5664 | 34.5664 | 34.5664 | 34.5664 | 34.5664 | 34.5664 | (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.0000 | 3.0000 | 3.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | | | | | | | | | | | | | |
| | -92.5312 | -92.5312 | -92.5312 | -92.5312 | -92.5312 | -92.5312 | -92.5312 | -92.5312 | -92.5312 | -92.5312 | -92.5312 | -92.5312 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 141.0846 | 138.7373 | 134.2155 | 124.3045 | 118.2339 | 111.8885 | 107.9911 | 111.2110 | 114.9862 | 122.0270 | 131.5278 | 139.8174 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 515.8516 | 527.4282 | 505.7671 | 488.1816 | 464.1119 | 444.9764 | 428.4106 | 429.5152 | 442.2948 | 460.0103 | 487.5101 | 505.5898 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Southeast | 10.2400 | 36.7938 | 0.6300 | 0.7000 | 0.7700 | 115.1455 | (77) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 115.1455 | 196.1353 | 268.3609 | 332.5122 | 372.4413 | 369.7480 | 356.4765 | 326.6876 | 290.5781 | 216.7713 | 137.9177 | 98.5405 | (83) |
| Total gains | 630.9971 | 723.5635 | 774.1280 | 820.6937 | 836.5532 | 814.7244 | 784.8872 | 756.2028 | 732.8728 | 676.7816 | 625.4278 | 604.1303 | (84) |

## 7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 71.9956 | 72.2674 | 72.5358 | 73.8238 | 74.0698 | 75.2372 | 75.2372 | 75.4575 | 74.7832 | 74.0698 | 73.5737 | 73.0621 | |
| alpha | 5.7997 | 5.8178 | 5.8357 | 5.9216 | 5.9380 | 6.0158 | 6.0158 | 6.0305 | 5.9855 | 5.9380 | 5.9049 | 5.8708 | |
| util living area | | | | | | | | | | | | | |
| | 0.9963 | 0.9911 | 0.9798 | 0.9415 | 0.8453 | 0.6563 | 0.4814 | 0.5192 | 0.7592 | 0.9500 | 0.9908 | 0.9971 | (86) |
| MIT | 19.9576 | 20.1325 | 20.3575 | 20.6510 | 20.8697 | 20.9779 | 20.9970 | 20.9954 | 20.9479 | 20.6783 | 20.2757 | 19.9392 | (87) |
| Th 2 | 19.8881 | 19.8919 | 19.8955 | 19.9126 | 19.9158 | 19.9308 | 19.9308 | 19.9336 | 19.9250 | 19.9158 | 19.9093 | 19.9025 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9947 | 0.9875 | 0.9712 | 0.9166 | 0.7856 | 0.5575 | 0.3663 | 0.4017 | 0.6659 | 0.9234 | 0.9863 | 0.9959 | (89) |
| MIT 2 | 18.7018 | 18.9264 | 19.2117 | 19.5798 | 19.8177 | 19.9206 | 19.9301 | 19.9324 | 19.8966 | 19.6209 | 19.1228 | 18.6891 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.4048 | (91) |
| MIT | 19.2101 | 19.4147 | 19.6755 | 20.0135 | 20.2436 | 20.3486 | 20.3620 | 20.3627 | 20.3222 | 20.0489 | 19.5895 | 19.1952 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.2101 | 19.4147 | 19.6755 | 20.0135 | 20.2436 | 20.3486 | 20.3620 | 20.3627 | 20.3222 | 20.0489 | 19.5895 | 19.1952 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9934 | 0.9854 | 0.9690 | 0.9193 | 0.8054 | 0.5974 | 0.4131 | 0.4496 | 0.7026 | 0.9273 | 0.9846 | 0.9948 | (94) |
| Useful gains | 626.8455 | 712.9907 | 750.1433 | 754.4691 | 673.7220 | 486.6943 | 324.2356 | 339.9796 | 514.9274 | 627.5960 | 615.7778 | 600.9672 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | | | | | | | | | | | | | |
| | 1346.8712 | 1306.2144 | 1181.3146 | 979.0459 | 750.1518 | 496.9132 | 325.1876 | 341.5370 | 541.1135 | 829.6429 | 1104.0066 | 1334.7778 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 535.6991 | 398.6463 | 320.7914 | 161.6953 | 56.8638 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 150.3229 | 351.5247 | 545.9551 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 2521.4987 | |
| Solar heating kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | | | | | | | | | | | | | |
| | 535.6991 | 398.6463 | 320.7914 | 161.6953 | 56.8638 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 150.3229 | 351.5247 | 545.9551 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 2521.4987 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 34.6122 | (99) |

## 9a. Energy requirements - Individual heating systems, including micro-CHP

| | | |
|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | 0.0000 | (201) |
| Fraction of space heat from main system(s) | 1.0000 | (202) |
| Efficiency of main space heating system 1 (in %) | 92.3000 | (206) |
| Efficiency of main space heating system 2 (in %) | 0.0000 | (207) |
| Efficiency of secondary/supplementary heating system, % | 0.0000 | (208) |

# Full SAP Calculation Printout

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement | | | | | | | | | | | | | |
| | 535.6991 | 398.6463 | 320.7914 | 161.6953 | 56.8638 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 150.3229 | 351.5247 | 545.9551 | (98) |
| Space heating efficiency (main heating system 1) | | | | | | | | | | | | | |
| | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.3000 | 92.3000 | 92.3000 | (210) |
| Space heating fuel (main heating system) | | | | | | | | | | | | | |
| | 580.3891 | 431.9028 | 347.5530 | 175.1845 | 61.6075 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 162.8634 | 380.8502 | 591.5006 | (211) |
| Space heating efficiency (main heating system 2) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (212) |
| Space heating fuel (main heating system 2) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (213) |
| Space heating fuel (secondary) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (215) |
| | | | | | | | | | | | | | |
| Water heating | | | | | | | | | | | | | |
| Water heating requirement | | | | | | | | | | | | | |
| | 221.3733 | 195.7481 | 208.1315 | 183.6829 | 178.4611 | 161.2702 | 159.6159 | 165.7739 | 167.3677 | 186.0485 | 197.0720 | 219.0713 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 | (216) |
| (217)m | 85.9650 | 85.6199 | 85.0265 | 83.7751 | 81.8034 | 79.8000 | 79.8000 | 79.8000 | 79.8000 | 83.5859 | 85.3424 | 86.0218 | (217) |
| Fuel for water heating, kWh/month | | | | | | | | | | | | | |
| | 257.5156 | 228.6245 | 244.7841 | 219.2572 | 218.1585 | 202.0929 | 200.0199 | 207.7368 | 209.7340 | 222.5836 | 230.9192 | 254.6694 | (219) |
| Space cooling fuel requirement | | | | | | | | | | | | | |
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (221) |
| Pumps and Fa | 7.3041 | 6.5973 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | (231) |
| Lighting | 22.9000 | 18.3712 | 16.5412 | 12.1188 | 9.3609 | 7.6480 | 8.5393 | 11.0998 | 14.4175 | 18.9165 | 21.3662 | 23.5364 | (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233a)m | -16.1430 | -24.2063 | -36.9774 | -44.2669 | -50.1193 | -47.6588 | -47.0830 | -43.2624 | -36.9492 | -28.8437 | -18.2556 | -13.7932 | (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233b)m | -5.1904 | -11.2140 | -22.8527 | -35.1692 | -47.3444 | -47.8815 | -47.3144 | -39.6669 | -28.5660 | -16.3040 | -7.0140 | -4.0824 | (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235d) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - main system 1 | 2731.8513 | (211) |
| Space heating fuel - main system 2 | 0.0000 | (213) |
| Space heating fuel - secondary | 0.0000 | (215) |
| Efficiency of water heater | 79.8000 | |
| Water heating fuel used | 2696.0956 | (219) |
| Space cooling fuel | 0.0000 | (221) |
| | | |
| Electricity for pumps and fans: | | |
| Total electricity for the above, kWh/year | 86.0000 | (231) |
| Electricity for lighting (calculated in Appendix L) | 184.8159 | (232) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -720.1588 | (233) |
| Wind generation | 0.0000 | (234) |
| Hydro-electric generation (Appendix N) | 0.0000 | (235a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (235) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (236) |
| Energy used | 0.0000 | (237) |
| Total delivered energy for all uses | 4978.6040 | (238) |

---

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

---

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 2731.8513 | 0.2100 | 573.6888 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2696.0956 | 0.2100 | 566.1801 | (264) |
| Space and water heating | | | 1139.8688 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 184.8159 | 0.1443 | 26.6747 | (268) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -407.5589 | 0.1333 | -54.3339 | |
| PV Unit electricity exported | -312.5999 | 0.1252 | -39.1347 | |
| Total | | | -93.4686 | (269) |
| Total CO2, kg/year | | | 1085.0042 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 14.8900 | (273) |

---

13a. Primary energy - Individual heating systems including micro-CHP

---

| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 2731.8513 | 1.1300 | 3086.9919 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2696.0956 | 1.1300 | 3046.5880 | (278) |
| Space and water heating | | | 6133.5799 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 184.8159 | 1.5338 | 283.4768 | (282) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -407.5589 | 1.4926 | -608.3381 | |
| PV Unit electricity exported | -312.5999 | 0.4595 | -143.6406 | |
| Total | | | -751.9788 | (283) |
| Total Primary energy kWh/year | | | 5795.1788 | (286) |
| Target Primary Energy Rate (TPER) | | | 79.5500 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Property Reference** | Unit 41 | **Issued on Date** | 17/05/2025 |
| **Assessment Reference** | 00001 | **Prop Type Ref** | Unit 41 |
| **Property** | | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 73 C | **DER** | 8.52 | **TER** | 20.95 |
| **Environmental** | 94 A | **% DER < TER** | | | 59.33 |
| **$CO_2$ Emissions (t/year)** | 0.38 | **DFEE** | 56.69 | **TFEE** | 61.58 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 7.93 |
| **% DPER < TPER** | 20.38 | **DPER** | 89.50 | **TPER** | 112.40 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Robert Arnold | **Assessor ID** | BA04-0001 |
| **Client** | | | |

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SAP 10 WORKSHEET FOR New Build (As Designed)  (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 50.7100 | (1b) | x 2.9500 | (2b) = | 149.5945 | (1b) - (3b) (4) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 50.7100 | | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | 149.5945 | (5) |

---

2. Ventilation rate

---

| | m3 per hour | |
|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 (6a) |
| Number of open flues | 0 * 20 = | 0.0000 (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 (6f) |
| Number of intermittent extract fans | 0 * 10 = | 0.0000 (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 (7c) |

| | Air changes per hour | |
|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 0.0000 / (5) = | 0.0000 (8) |
| Pressure test | | Yes |
| Pressure Test Method | | Blower Door |
| Measured/design AP50 | | 3.0000 (17) |
| Infiltration rate | | 0.1500 (18) |
| Number of sides sheltered | | 0 (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.1500 (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.1912 | 0.1875 | 0.1837 | 0.1650 | 0.1612 | 0.1425 | 0.1425 | 0.1388 | 0.1500 | 0.1612 | 0.1687 | 0.1762 | (22b) |

Balanced mechanical ventilation with heat recovery

| | |
|---|---|
| If mechanical ventilation | 0.5000 (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | 0.5000 (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | 80.1000 (23c) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective ac | 0.2907 | 0.2870 | 0.2833 | 0.2645 | 0.2607 | 0.2420 | 0.2420 | 0.2382 | 0.2495 | 0.2607 | 0.2682 | 0.2757 | (25) |

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3. Heat losses and heat loss parameter

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| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| Windows | | | 13.5700 | 1.0536 | 14.2979 | | | (27) |
| Front Door | | | 1.8900 | 1.4000 | 2.6460 | | | (26) |
| Glass Door | | | 2.2900 | 1.3258 | 3.0360 | | | (27) |
| External Walls | 44.4500 | 15.8600 | 28.5900 | 0.1500 | 4.2885 | 150.0000 | 4288.5000 | (29a) |
| Wall to Communal Corridor | 29.4700 | 1.8900 | 27.5800 | 0.1300 | 3.5854 | 150.0000 | 4137.0000 | (29a) |
| External Roof | 21.8800 | | 21.8800 | 0.1000 | 2.1880 | 9.0000 | 196.9200 | (30) |
| Total net area of external elements Aum(A, m2) | | | 95.8000 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 30.0418 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 39 | | | 14.9700 | 0.0000 | 0.0000 | 70.0000 | 1047.9000 | (32) |
| Party Floor | | | 50.5800 | | | 80.0000 | 4046.4000 | (32d) |
| Party Ceiling | | | 23.6800 | | | 100.0000 | 2368.0000 | (32b) |
| Internal Walls | | | 98.5600 | | | 9.0000 | 887.0400 | (32c) |

| | |
|---|---|
| Heat capacity Cm = Sum(A x k) | (28)...(30) + (32) + (32a)...(32e) = 16971.7600 (34) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 334.6827 (35)
List of Thermal Bridges

| | K1 Element | Length | Psi-value | Total | |
|---|---|---|---|---|---|
| E1 | Steel lintel with perforated steel base plate | 7.9400 | 0.0500 | 0.3970 | |
| E4 | Jamb | 22.1600 | 0.0500 | 1.1080 | |
| E18 | Party wall between dwellings | 5.9000 | 0.0300 | 0.1770 | |
| E24 | Eaves (insulation at ceiling level - inverted) | 15.0675 | 0.1200 | 1.8081 | |
| E24 | Eaves (insulation at ceiling level - inverted) | 15.0675 | 0.1200 | 1.8081 | |
| E7 | Party floor between dwellings (in blocks of flats) | 9.9920 | 0.0350 | 0.3497 | |
| E16 | Corner (normal) | 2.9500 | 0.0900 | 0.2655 | |
| E25 | Staggered party wall between dwellings | 2.9500 | 0.0600 | 0.1770 | |
| E15 | Flat roof with parapet | 15.0670 | 0.5600 | 8.4375 | |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 14.5279 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 44.5697 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 14.3532 | 14.1681 | 13.9830 | 13.0574 | 12.8722 | 11.9466 | 11.9466 | 11.7615 | 12.3169 | 12.8722 | 13.2425 | 13.6127 | (38) |
| Heat transfer coeff | 58.9229 | 58.7378 | 58.5527 | 57.6271 | 57.4420 | 56.5163 | 56.5163 | 56.3312 | 56.8866 | 57.4420 | 57.8122 | 58.1824 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 57.5808 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.1620 | 1.1583 | 1.1547 | 1.1364 | 1.1328 | 1.1145 | 1.1145 | 1.1109 | 1.1218 | 1.1328 | 1.1401 | 1.1474 | (40) |
| HLP (average) | | | | | | | | | | | | 1.1355 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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4. Water heating energy requirements (kWh/year)

---

Assumed occupancy 1.7110 (42)
Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 51.5710 | 50.7814 | 49.6178 | 47.8279 | 46.2241 | 43.9804 | 42.2058 | 44.2804 | 45.3239 | 47.5461 | 49.8604 | 51.5245 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 22.3653 | 22.0277 | 21.5474 | 20.8281 | 20.1799 | 19.2875 | 18.6105 | 19.4384 | 19.8729 | 20.7570 | 21.6763 | 22.3476 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.1526 | 30.9834 | 29.8142 | 28.6450 | 27.4758 | 26.3066 | 26.3066 | 27.4758 | 28.6450 | 29.8142 | 30.9834 | 32.1526 | (42c) |

Average daily hot water use (litres/day) 97.5120 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 106.0888 | 103.7925 | 100.9794 | 97.3010 | 93.8798 | 89.5746 | 87.1230 | 91.1946 | 93.8417 | 98.1174 | 102.5201 | 106.0246 | (44) |
| Energy conte | 156.1811 | 137.3384 | 144.2975 | 127.0994 | 120.9736 | 103.5900 | 96.2734 | 107.3377 | 108.8517 | 126.4341 | 138.5594 | 155.7049 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1522.6413 | |

Distribution loss (46)m = 0.15 x (45)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.4272 | 20.6008 | 21.6446 | 19.0649 | 18.1460 | 15.5385 | 14.4410 | 16.1007 | 16.3278 | 18.9651 | 20.7839 | 23.3557 | (46) |

Water storage loss:
Store volume 110.0000 (47)
b) If manufacturer declared loss factor is not known :
Hot water storage loss factor from Table 2 (kWh/litre/day) 0.0152 (51)
Volume factor from Table 2a 1.0294 (52)
Temperature factor from Table 2b 0.6000 (53)
Enter (49) or (54) in (55) 1.0327 (55)
Total storage loss

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (56) |

If cylinder contains dedicated solar storage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (57) |
| 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |

Primary loss
Combi loss
Total heat required for water heating calculated for each month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 211.4579 | 187.2659 | 199.5743 | 180.5931 | 176.2504 | 157.0837 | 151.5502 | 162.6145 | 162.3454 | 181.7109 | 192.0530 | 210.9817 | (62) |
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63a) |
| -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |

WWHRS
PV diverter
Solar input
FGHRS
Output from w/h

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 211.4579 | 187.2659 | 199.5743 | 180.5931 | 176.2504 | 157.0837 | 151.5502 | 162.6145 | 162.3454 | 181.7109 | 192.0530 | 210.9817 | (64) |
| | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2173.4811 | (64) |

12Total per year (kWh/year) 2173 (64)
Electric shower(s)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | 0.0000 | (64a) |

Heat gains from water heating, kWh/month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 96.1517 | 85.6070 | 92.2004 | 85.0555 | 84.4452 | 77.2386 | 76.2324 | 79.9112 | 78.9881 | 86.2608 | 88.8659 | 95.9933 | (65) |

---

5. Internal gains (see Table 5 and 5a)

---

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 85.5510 | 85.5510 | 85.5510 | 85.5510 | 85.5510 | 85.5510 | 85.5510 | 85.5510 | 85.5510 | 85.5510 | 85.5510 | 85.5510 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 75.1926 | 83.2490 | 75.1926 | 77.6991 | 75.1926 | 77.6991 | 75.1926 | 75.1926 | 77.6991 | 75.1926 | 77.6991 | 75.1926 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 149.0778 | 150.6248 | 146.7265 | 138.4275 | 127.9515 | 118.1055 | 111.5278 | 109.9808 | 113.8791 | 122.1781 | 132.6541 | 142.5001 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 31.5551 | 31.5551 | 31.5551 | 31.5551 | 31.5551 | 31.5551 | 31.5551 | 31.5551 | 31.5551 | 31.5551 | 31.5551 | 31.5551 | (69) |
| Pumps, fans | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | -68.4408 | -68.4408 | -68.4408 | -68.4408 | -68.4408 | -68.4408 | -68.4408 | -68.4408 | -68.4408 | -68.4408 | -68.4408 | -68.4408 | (71) |
| Water heating gains (Table 5) | 129.2361 | 127.3913 | 123.9252 | 118.1326 | 113.5016 | 107.2759 | 102.4629 | 107.4076 | 109.7057 | 115.9419 | 123.4249 | 129.0233 | (72) |
| Total internal gains | 402.1718 | 409.9304 | 394.5096 | 382.9245 | 365.3110 | 351.7457 | 337.8486 | 341.2464 | 349.9492 | 361.9780 | 382.4434 | 395.3813 | (73) |

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6. Solar gains

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| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Northeast | 2.5700 | 11.2829 | 0.4500 | 0.7000 | 0.7700 | 6.3299 | (75) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northwest | | | 11.0000 | | 11.2829 | | 0.4500 | | 0.7000 | | 0.7700 | | 27.0931 (81) |
| Northwest | | | 2.2900 | | 11.2829 | | 0.4500 | | 0.7000 | | 0.7700 | | 5.6403 (81) |
| Solar gains | 39.0633 | 79.5145 | 143.2599 | 235.2739 | 316.2543 | 337.1606 | 315.4068 | 251.4460 | 174.5645 | 97.1731 | 49.1518 | 31.9011 (83) | |
| Total gains | 441.2352 | 489.4449 | 537.7696 | 618.1984 | 681.5653 | 688.9063 | 653.2554 | 592.6923 | 524.5137 | 459.1511 | 431.5952 | 427.2824 (84) | |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| tau | 80.0092 | 80.2614 | 80.5151 | 81.8084 | 82.0720 | 83.4162 | 83.4162 | 83.6903 | 82.8733 | 82.0720 | 81.5464 | 81.0275 | |
| alpha | 6.3339 | 6.3508 | 6.3677 | 6.4539 | 6.4715 | 6.5611 | 6.5611 | 6.5794 | 6.5249 | 6.4715 | 6.4364 | 6.4018 | |
| util living area | 0.9966 | 0.9926 | 0.9793 | 0.9120 | 0.7420 | 0.5214 | 0.3802 | 0.4361 | 0.7163 | 0.9510 | 0.9914 | 0.9972 | (86) |
| MIT | 20.0940 | 20.2341 | 20.4628 | 20.7769 | 20.9524 | 20.9958 | 20.9995 | 20.9989 | 20.9719 | 20.7313 | 20.3727 | 20.0803 | (87) |
| Th 2 | 19.9506 | 19.9535 | 19.9564 | 19.9712 | 19.9742 | 19.9890 | 19.9890 | 19.9920 | 19.9831 | 19.9742 | 19.9683 | 19.9623 | (88) |
| util rest of house | 0.9951 | 0.9894 | 0.9703 | 0.8791 | 0.6754 | 0.4409 | 0.2931 | 0.3412 | 0.6253 | 0.9245 | 0.9872 | 0.9960 | (89) |
| MIT 2 | 18.9187 | 19.0988 | 19.3875 | 19.7685 | 19.9421 | 19.9873 | 19.9889 | 19.9917 | 19.9687 | 19.7297 | 19.2871 | 18.9103 | (90) |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.6088 | (91) |
| MIT | 19.6341 | 19.7899 | 20.0421 | 20.3824 | 20.5571 | 20.6012 | 20.6041 | 20.6049 | 20.5794 | 20.3394 | 19.9480 | 19.6225 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.6341 | 19.7899 | 20.0421 | 20.3824 | 20.5571 | 20.6012 | 20.6041 | 20.6049 | 20.5794 | 20.3394 | 19.9480 | 19.6225 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9945 | 0.9888 | 0.9712 | 0.8934 | 0.7143 | 0.4899 | 0.3462 | 0.3991 | 0.6802 | 0.9353 | 0.9870 | 0.9954 | (94) |
| Useful gains | 438.8123 | 483.9673 | 522.2836 | 552.2972 | 486.8614 | 337.5105 | 226.1583 | 236.5250 | 356.7964 | 429.4438 | 426.0054 | 425.3378 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | 903.5329 | 874.6023 | 792.9255 | 661.6972 | 508.7691 | 339.1659 | 226.2994 | 236.8659 | 368.5906 | 559.4526 | 742.7686 | 897.3187 | (97) |
| Space heating kWh | 345.7521 | 262.5067 | 201.3576 | 78.7680 | 16.2993 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 96.7266 | 228.0695 | 351.1537 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 1580.6336 | |
| Solar heating kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | 345.7521 | 262.5067 | 201.3576 | 78.7680 | 16.2993 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 96.7266 | 228.0695 | 351.1537 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 1580.6336 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 31.1701 | (99) |

## 8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ext. temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | |
| Heat loss rate W | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 531.2535 | 418.2209 | 428.1172 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (100) |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.9701 | 0.9884 | 0.9780 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (101) |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 515.3666 | 413.3549 | 418.6833 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (102) |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 764.5660 | 724.9706 | 654.7040 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 179.4236 | 231.8421 | 175.5995 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (104) |
| Cooled fraction | | | | | | | | | fC = cooled area / (4) = | | | 0.9860 | (105) |
| Intermittency factor (Table 10b) | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | (106) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 44.2279 | 57.1490 | 43.2852 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) |
| Space cooling requirement | | | | | | | | | | | | 144.6621 | (107) |

## 9b. Energy requirements

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | 0.0000 | (301) |
| Fraction of space heat from community system | | | | | | | | | | | | 1.0000 | (302) |
| Fraction of heat from community Heat pump-Space and Water | | | | | | | | | | | | 1.0000 | (303a) |
| Factor for control and charging method (Table 4c(3)) for space heating | | | | | | | | | | | | 1.0000 | (305) |
| Factor for charging method (Table 4c(3)) for water heating | | | | | | | | | | | | 1.0000 | (305a) |
| Distribution loss factor (Table 12c) for community heating system | | | | | | | | | | | | 2.0000 | (306) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 | (208) |
| Space heating: | | | | | | | | | | | | | |
| Space heating requirement | 345.7521 | 262.5067 | 201.3576 | 78.7680 | 16.2993 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 96.7266 | 228.0695 | 351.1537 | (98) |
| Space heat from Heat pump = (98) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 307a | 691.5042 | 525.0135 | 402.7151 | 157.5359 | 32.5987 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 193.4531 | 456.1391 | 702.3075 | |
| Space heating requirement | 691.5042 | 525.0135 | 402.7151 | 157.5359 | 32.5987 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 193.4531 | 456.1391 | 702.3075 | (307) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | | | | | | | | | | | 0.0000 | (308) |
| Space heating fuel for secondary/supplementary system | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (309) |
| Water heating | | | | | | | | | | | | | |
| Annual water heating requirement | 211.4579 | 187.2659 | 199.5743 | 180.5931 | 176.2504 | 157.0837 | 151.5502 | 162.6145 | 162.3454 | 181.7109 | 192.0530 | 210.9817 | (64) |
| Water heat from Heat pump = (64) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 310a | 422.9158 | 374.5318 | 399.1487 | 361.1862 | 352.5008 | 314.1674 | 303.1005 | 325.2291 | 324.6908 | 363.4219 | 384.1061 | 421.9634 | |
| Water heating fuel | 422.9158 | 374.5318 | 399.1487 | 361.1862 | 352.5008 | 314.1674 | 303.1005 | 325.2291 | 324.6908 | 363.4219 | 384.1061 | 421.9634 | (310) |
| Cooling System Energy Efficiency Ratio | | | | | | | | | | | | 2.6000 | (314) |
| Space coolin | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 17.0107 | 21.9804 | 16.6482 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (315) |
| Pumps and Fa | 13.2374 | 11.9563 | 13.2374 | 12.8104 | 13.2374 | 12.8104 | 13.2374 | 13.2374 | 12.8104 | 13.2374 | 12.8104 | 13.2374 | (331) |
| Lighting | 14.5378 | 11.6628 | 10.5010 | 7.6935 | 5.9427 | 4.8552 | 5.4211 | 7.0466 | 9.1528 | 12.0090 | 13.5641 | 14.9418 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333a)m | -4.6945 | -7.5639 | -12.4989 | -16.1035 | -19.1685 | -18.5800 | -18.3192 | -16.3255 | -13.1642 | -9.4127 | -5.4629 | -3.9444 | (333a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (334a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335a) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (333b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335b) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - community heating | 3161.2672 | (307) |
| Space heating fuel - secondary | 0.0000 | (309) |
| Water heating fuel - community heating | 4346.9622 | (310) |
| Efficiency of water heater | 0.0000 | (311) |
| Electricity used for heat distribution | 31.6127 | (313) |
| Space cooling fuel | 55.6393 | (321) |
| | | |
| Electricity for pumps and fans: | | |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8540) | | |
| mechanical ventilation fans (SFP = 0.8540) | 155.8595 | (330a) |
| Total electricity for the above, kWh/year | 155.8595 | (331) |
| Electricity for lighting (calculated in Appendix L) | 117.3284 | (332) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -145.2382 | (333) |
| Wind generation | 0.0000 | (334) |
| Hydro-electric generation (Appendix N) | 0.0000 | (335a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (335) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (336) |
| Energy used | 0.0000 | (337) |
| Total delivered energy for all uses | 7691.8183 | (338) |

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12b. Carbon dioxide emissions - Community heating scheme

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (367) |
| Space and Water heating from Heat pump | 2681.5105 | 0.1565 | 176.7236 | (367) |
| Electrical energy for heat distribution (space & water) | 31.6127 | 0.0000 | 11.0652 | (372) |
| Overall CO2 factor for heat network | | | 0.0541 | (386) |
| Total CO2 associated with community systems | | | 406.2522 | (373) |
| Space and water heating | | | 406.2522 | (376) |
| Space cooling | 55.6393 | 0.1141 | 6.3457 | (377) |
| Pumps, fans and electric keep-hot | 155.8595 | 0.1387 | 21.6196 | (378) |
| Energy for lighting | 117.3284 | 0.1443 | 16.9341 | (379) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -145.2382 | 0.1320 | -19.1663 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -19.1663 | (380) |
| Total CO2, kg/year | | | 431.9854 | (383) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 8.5200 | (384) |

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13b. Primary energy - Community heating scheme

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| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (467a) |
| Space and Water heating from Heat pump | 2681.5105 | 1.5795 | 1783.2919 | (467) |
| Electrical energy for heat distribution (space & water) | 31.6127 | 0.0000 | 116.0197 | (472) |
| Overall CO2 factor for heat network | | | 0.5673 | (486) |
| Total CO2 associated with community systems | | | 4259.5810 | (473) |
| Space and water heating | | | 4259.5810 | (476) |
| Space cooling | 55.6393 | 1.4204 | 79.0286 | (477) |
| Pumps, fans and electric keep-hot | 155.8595 | 1.5128 | 235.7843 | (478) |
| Energy for lighting | 117.3284 | 1.5338 | 179.9621 | (479) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -145.2382 | 1.4876 | -216.0515 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -216.0515 | (480) |
| Total Primary energy kWh/year | | | 4538.3046 | (483) |
| Dwelling Primary energy Rate (DPER) | | | 89.5000 | (484) |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

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| | | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | |
| Ground floor | | 50.7100 | (1b) | x 2.9500 | (2b) = | 149.5945 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 50.7100 | | | | | | (4) |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | | 149.5945 | (5) |

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2. Ventilation rate

---

m3 per hour

| | | |
|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 (6a) |
| Number of open flues | 0 * 20 = | 0.0000 (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 (6f) |
| Number of intermittent extract fans | 2 * 10 = | 20.0000 (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 (7c) |

| | | Air changes per hour | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 20.0000 / (5) = | 0.1337 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3837 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.3837 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.4892 | 0.4796 | 0.4700 | 0.4221 | 0.4125 | 0.3645 | 0.3645 | 0.3549 | 0.3837 | 0.4125 | 0.4317 | 0.4508 | (22b) |
| Effective ac | 0.6197 | 0.6150 | 0.6105 | 0.5891 | 0.5851 | 0.5664 | 0.5664 | 0.5630 | 0.5736 | 0.5851 | 0.5932 | 0.6016 | (25) |

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## 3. Heat losses and heat loss parameter

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| Element | Gross | Openings | NetArea | U-value | A x U | K-value | A x K | |
|---|---|---|---|---|---|---|---|---|
| | m2 | m2 | m2 | W/m2K | W/K | kJ/m2K | kJ/K | |
| Main dwelling | | | | | | | | |
| TER Opaque door | | | 1.8900 | 1.0000 | 1.8900 | | | (26) |
| TER Opening Type | | | 10.7900 | 1.1450 | 12.3550 | | | (27) |
| External Walls | 44.4500 | 10.7900 | 33.6600 | 0.1800 | 6.0588 | | | (29a) |
| Wall to Communal Corridor | 29.4700 | 1.8900 | 27.5800 | 0.1800 | 4.9644 | | | (29a) |
| External Roof | 21.8800 | | 21.8800 | 0.1100 | 2.4068 | | | (30) |
| Total net area of external elements Aum(A, m2) | | | 95.8000 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 27.6750 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 39 | | | 14.9700 | 0.0000 | 0.0000 | | | (32) |

| | |
|---|---|
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | 325.3433 (35) |

List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E1 Steel lintel with perforated steel base plate | 7.9400 | 0.0500 | 0.3970 |
| E4 Jamb | 22.1600 | 0.0500 | 1.1080 |
| E18 Party wall between dwellings | 5.9000 | 0.0600 | 0.3540 |
| E24 Eaves (insulation at ceiling level - inverted) | 15.0675 | 0.2400 | 3.6162 |
| E24 Eaves (insulation at ceiling level - inverted) | 15.0675 | 0.2400 | 3.6162 |
| E7 Party floor between dwellings (in blocks of flats) | 9.9920 | 0.0700 | 0.6994 |
| E16 Corner (normal) | 2.9500 | 0.0900 | 0.2655 |
| E25 Staggered party wall between dwellings | 2.9500 | 0.0600 | 0.1770 |
| E15 Flat roof with parapet | 15.0670 | 0.5600 | 8.4375 |

| | | |
|---|---|---|
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | 18.6709 (36) |
| Point Thermal bridges | (36a) = | 0.0000 |
| Total fabric heat loss | (33) + (36) + (36a) = | 46.3458 (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 30.5904 | 30.3610 | 30.1362 | 29.0801 | 28.8825 | 27.9627 | 27.9627 | 27.7923 | 28.3170 | 28.8825 | 29.2822 | 29.7001 | (38) |
| Heat transfer coeff | 76.9363 | 76.7069 | 76.4820 | 75.4259 | 75.2283 | 74.3085 | 74.3085 | 74.1382 | 74.6628 | 75.2283 | 75.6281 | 76.0459 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 75.4250 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.5172 | 1.5127 | 1.5082 | 1.4874 | 1.4835 | 1.4654 | 1.4654 | 1.4620 | 1.4723 | 1.4835 | 1.4914 | 1.4996 | (40) |
| HLP (average) | | | | | | | | | | | | 1.4874 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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## 4. Water heating energy requirements (kWh/year)

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| | | |
|---|---|---|
| Assumed occupancy | | 1.7110 (42) |

Hot water usage for mixer showers

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 52.9077 | 52.1126 | 50.9540 | 48.7372 | 47.1012 | 45.2768 | 44.2398 | 45.3897 | 46.6501 | 48.6090 | 50.8734 | 52.7050 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 22.8753 | 22.5355 | 22.0571 | 21.1750 | 20.5145 | 19.7821 | 19.3865 | 19.8616 | 20.3788 | 21.1625 | 22.0628 | 22.7979 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.1526 | 30.9834 | 29.8142 | 28.6450 | 27.4758 | 26.3066 | 26.3066 | 27.4758 | 28.6450 | 29.8142 | 30.9834 | 32.1526 | (42c) |

| | |
|---|---|
| Average daily hot water use (litres/day) | 99.2177 (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 107.9355 | 105.6315 | 102.8253 | 98.5572 | 95.0915 | 91.3656 | 89.9330 | 92.7271 | 95.6740 | 99.5857 | 103.9195 | 107.6554 | (44) |
| Energy conte | 170.9434 | 150.4178 | 158.0386 | 134.9198 | 128.0115 | 112.3446 | 108.7661 | 114.8155 | 117.9756 | 135.1368 | 148.0524 | 168.5624 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1647.9845 | |

Distribution loss (46)m = 0.15 x (45)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 25.6415 | 22.5627 | 23.7058 | 20.2380 | 19.2017 | 16.8517 | 16.3149 | 17.2223 | 17.6963 | 20.2705 | 22.2079 | 25.2844 | (46) |

| | |
|---|---|
| Water storage loss: | |
| Store volume | 150.0000 (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | 1.3938 (48) |
| Temperature factor from Table 2b | 0.5400 (49) |
| Enter (49) or (54) in (55) | 0.7527 (55) |

Total storage loss

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (56) |

If cylinder contains dedicated solar storage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (57) |
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |

Total heat required for water heating calculated for each month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 217.5383 | 192.5035 | 204.6335 | 180.0117 | 174.6064 | 157.4365 | 155.3610 | 161.4104 | 163.0674 | 181.7317 | 193.1443 | 215.1573 | (62) |
| WWHRS | -24.1872 | -21.3913 | -22.3998 | -18.5479 | -17.2860 | -14.7917 | -13.8649 | -14.7439 | -15.3041 | -18.0418 | -20.4392 | -23.7393 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | | | | | | | | | | | | | |
| | 193.3511 | 171.1122 | 182.2337 | 161.4638 | 157.3204 | 142.6447 | 141.4961 | 146.6665 | 147.7633 | 163.6899 | 172.7051 | 191.4180 | (64) |
| | | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | 1971.8648 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 1972 | (64) |
| Electric shower(s) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | | | | | | | | | | | | | |
| | 94.1146 | 83.6825 | 89.8238 | 80.9343 | 79.8397 | 73.4281 | 73.4407 | 75.4521 | 75.3003 | 82.2089 | 85.3009 | 93.3229 | (65) |

## 5. Internal gains (see Table 5 and 5a)

| Metabolic gains (Table 5), Watts | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 85.5510 | 85.5510 | 85.5510 | 85.5510 | 85.5510 | 85.5510 | 85.5510 | 85.5510 | 85.5510 | 85.5510 | 85.5510 | 85.5510 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 75.3344 | 83.4060 | 75.3344 | 77.8456 | 75.3344 | 77.8456 | 75.3344 | 75.3344 | 77.8456 | 75.3344 | 77.8456 | 75.3344 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 149.0778 | 150.6248 | 146.7265 | 138.4275 | 127.9515 | 118.1055 | 111.5278 | 109.9808 | 113.8791 | 122.1781 | 132.6541 | 142.5001 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 31.5551 | 31.5551 | 31.5551 | 31.5551 | 31.5551 | 31.5551 | 31.5551 | 31.5551 | 31.5551 | 31.5551 | 31.5551 | 31.5551 | (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.0000 | 3.0000 | 3.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | | | | | | | | | | | | | |
| | -68.4408 | -68.4408 | -68.4408 | -68.4408 | -68.4408 | -68.4408 | -68.4408 | -68.4408 | -68.4408 | -68.4408 | -68.4408 | -68.4408 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 126.4981 | 124.5275 | 120.7309 | 112.4088 | 107.3115 | 101.9834 | 98.7106 | 101.4141 | 104.5838 | 110.4958 | 118.4735 | 125.4340 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 402.5757 | 410.2235 | 394.4570 | 380.3471 | 362.2627 | 346.5998 | 334.2381 | 335.3946 | 344.9738 | 359.6737 | 380.6385 | 394.9338 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Northeast | 1.7500 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 6.0344 | (75) |
| Northwest | 9.0400 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 31.1719 | (81) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 37.2062 | 75.7343 | 136.4492 | 224.0888 | 301.2193 | 321.1317 | 300.4121 | 239.4920 | 166.2655 | 92.5534 | 46.8151 | 30.3845 | (83) |
| Total gains | 439.7819 | 485.9579 | 530.9062 | 604.4359 | 663.4820 | 667.7314 | 634.6502 | 574.8866 | 511.2393 | 452.2271 | 427.4535 | 425.3183 | (84) |

## 7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, ni1,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 59.5665 | 59.7446 | 59.9203 | 60.7593 | 60.9188 | 61.6729 | 61.6729 | 61.8146 | 61.3803 | 60.9188 | 60.5969 | 60.2639 | |
| alpha | 4.9711 | 4.9830 | 4.9947 | 5.0506 | 5.0613 | 5.1115 | 5.1115 | 5.1210 | 5.0920 | 5.0613 | 5.0398 | 5.0176 | |
| util living area | | | | | | | | | | | | | |
| | 0.9968 | 0.9942 | 0.9867 | 0.9541 | 0.8563 | 0.6709 | 0.5066 | 0.5759 | 0.8390 | 0.9727 | 0.9936 | 0.9973 | (86) |
| MIT | 19.6290 | 19.7814 | 20.0510 | 20.4535 | 20.7861 | 20.9549 | 20.9911 | 20.9837 | 20.8595 | 20.4426 | 19.9816 | 19.6144 | (87) |
| Th 2 | 19.6746 | 19.6780 | 19.6813 | 19.6970 | 19.6999 | 19.7136 | 19.7136 | 19.7161 | 19.7083 | 19.6999 | 19.6940 | 19.6878 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9954 | 0.9916 | 0.9803 | 0.9315 | 0.7918 | 0.5549 | 0.3632 | 0.4245 | 0.7428 | 0.9547 | 0.9902 | 0.9961 | (89) |
| MIT 2 | 18.1260 | 18.3226 | 18.6665 | 19.1724 | 19.5402 | 19.6937 | 19.7118 | 19.7123 | 19.6268 | 19.1719 | 18.5901 | 18.1166 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.6088 | (91) |
| MIT | 19.0410 | 19.2107 | 19.5093 | 19.9523 | 20.2986 | 20.4615 | 20.4906 | 20.4863 | 20.3772 | 19.9455 | 19.4372 | 19.0284 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.0410 | 19.2107 | 19.5093 | 19.9523 | 20.2986 | 20.4615 | 20.4906 | 20.4863 | 20.3772 | 19.9455 | 19.4372 | 19.0284 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9945 | 0.9903 | 0.9793 | 0.9368 | 0.8242 | 0.6247 | 0.4510 | 0.5174 | 0.7975 | 0.9589 | 0.9893 | 0.9953 | (94) |
| Useful gains | 437.3471 | 481.2528 | 519.9053 | 566.2070 | 546.8724 | 417.1549 | 286.2529 | 297.4509 | 407.7107 | 433.6539 | 422.8810 | 423.3250 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | | | | | | | | | | | | | |
| | 1134.1138 | 1097.7281 | 994.9810 | 833.6309 | 646.8604 | 435.5591 | 289.1047 | 302.9492 | 468.6724 | 703.0449 | 933.0367 | 1127.6374 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 518.3944 | 414.2714 | 353.4564 | 192.5452 | 74.3911 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 200.4269 | 367.3121 | 524.0085 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 2644.8059 | |
| Solar heating kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | | | | | | | | | | | | | |
| | 518.3944 | 414.2714 | 353.4564 | 192.5452 | 74.3911 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 200.4269 | 367.3121 | 524.0085 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 2644.8059 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 52.1555 | (99) |

## 9a. Energy requirements - Individual heating systems, including micro-CHP

| | | |
|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | 0.0000 | (201) |
| Fraction of space heat from main system(s) | 1.0000 | (202) |
| Efficiency of main space heating system 1 (in %) | 92.3000 | (206) |
| Efficiency of main space heating system 2 (in %) | 0.0000 | (207) |
| Efficiency of secondary/supplementary heating system, % | 0.0000 | (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement | | | | | | | | | | | | | |
| | 518.3944 | 414.2714 | 353.4564 | 192.5452 | 74.3911 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 200.4269 | 367.3121 | 524.0085 | (98) |
| Space heating efficiency (main heating system 1) | | | | | | | | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.3000 | 92.3000 | 92.3000 (210) |
| Space heating fuel (main heating system) | | | | | | | | | | | | |
| | 561.6408 | 448.8314 | 382.9430 | 208.6080 | 80.5970 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 217.1472 | 397.9546 | 567.7232 (211) |
| Space heating efficiency (main heating system 2) | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (212) |
| Space heating fuel (main heating system 2) | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (213) |
| Space heating fuel (secondary) | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (215) |
| Water heating | | | | | | | | | | | | |
| Water heating requirement | | | | | | | | | | | | |
| | 193.3511 | 171.1122 | 182.2337 | 161.4638 | 157.3204 | 142.6447 | 141.4961 | 146.6665 | 147.7633 | 163.6899 | 172.7051 | 191.4180 (64) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 (216) |
| (217)m | 86.1602 | 85.9660 | 85.5189 | 84.4556 | 82.4839 | 79.8000 | 79.8000 | 79.8000 | 79.8000 | 84.5150 | 85.7086 | 86.1989 (217) |
| Fuel for water heating, kWh/month | | | | | | | | | | | | |
| | 224.4088 | 199.0464 | 213.0917 | 191.1818 | 190.7285 | 178.7528 | 177.3135 | 183.7926 | 185.1670 | 193.6815 | 201.5027 | 222.0655 (219) |
| Space cooling fuel requirement | | | | | | | | | | | | |
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (221) |
| Pumps and Fa | 7.3041 | 6.5973 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 (231) |
| Lighting | 15.6530 | 12.5574 | 11.3066 | 8.2837 | 6.3985 | 5.2277 | 5.8370 | 7.5871 | 9.8549 | 12.9302 | 14.6046 | 16.0880 (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (233a)m | -11.3467 | -17.0768 | -26.1892 | -31.4918 | -35.7964 | -34.1089 | -33.7105 | -30.9105 | -26.2988 | -20.4163 | -12.8570 | -9.6891 (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | |
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (233b)m | -3.5032 | -7.5789 | -15.4579 | -23.8027 | -32.0470 | -32.3956 | -31.9983 | -26.8155 | -19.3056 | -11.0105 | -4.7328 | -2.7539 (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | |
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235d) |

| | |
|---|---|
| Annual totals kWh/year | |
| Space heating fuel - main system 1 | 2865.4452 (211) |
| Space heating fuel - main system 2 | 0.0000 (213) |
| Space heating fuel - secondary | 0.0000 (215) |
| Efficiency of water heater | 79.8000 |
| Water heating fuel used | 2360.7330 (219) |
| Space cooling fuel | 0.0000 (221) |
| | |
| Electricity for pumps and fans: | |
| Total electricity for the above, kWh/year | 86.0000 (231) |
| Electricity for lighting (calculated in Appendix L) | 126.3287 (232) |
| | |
| Energy saving/generation technologies (Appendices M ,N and Q) | |
| PV generation | -501.2938 (233) |
| Wind generation | 0.0000 (234) |
| Hydro-electric generation (Appendix N) | 0.0000 (235a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 (235) |
| Appendix Q - special features | |
| Energy saved or generated | -0.0000 (236) |
| Energy used | 0.0000 (237) |
| Total delivered energy for all uses | 4937.2131 (238) |

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 2865.4452 | 0.2100 | 601.7435 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2360.7330 | 0.2100 | 495.7539 | (264) |
| Space and water heating | | | 1097.4974 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 126.3287 | 0.1443 | 18.2331 | (268) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -289.8919 | 0.1332 | -38.6199 | |
| PV Unit electricity exported | -211.4018 | 0.1252 | -26.4647 | |
| Total | | | -65.0846 | (269) |
| Total CO2, kg/year | | | 1062.5752 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 20.9500 | (273) |

13a. Primary energy - Individual heating systems including micro-CHP

| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 2865.4452 | 1.1300 | 3237.9530 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2360.7330 | 1.1300 | 2667.6283 | (278) |
| Space and water heating | | | 5905.5813 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 126.3287 | 1.5338 | 193.7672 | (282) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -289.8919 | 1.4923 | -432.6019 | |
| PV Unit electricity exported | -211.4018 | 0.4595 | -97.1365 | |
| Total | | | -529.7384 | (283) |
| Total Primary energy kWh/year | | | 5699.7109 | (286) |
| Target Primary Energy Rate (TPER) | | | 112.4000 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Property Reference** | Unit 42 | **Issued on Date** | 17/05/2025 |
| **Assessment Reference** | 00001 | **Prop Type Ref** | Unit 42 |
| **Property** | | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 76 C | **DER** | 6.67 | **TER** | 15.72 |
| **Environmental** | 95 A | **% DER < TER** | | | 57.57 |
| **$CO_2$ Emissions (t/year)** | 0.37 | **DFEE** | 41.49 | **TFEE** | 42.99 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 3.50 |
| **% DPER < TPER** | 16.11 | **DPER** | 70.47 | **TPER** | 84.01 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Robert Arnold | **Assessor ID** | BA04-0001 |
| **Client** | | | |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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## 1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 63.0400 | (1b) | x 2.9500 | (2b) = | 185.9680 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 63.0400 | | | | | (4) |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | 185.9680 | (5) |

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## 2. Ventilation rate

---

| | | m3 per hour | |
|---|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 | (6a) |
| Number of open flues | 0 * 20 = | 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | 0 * 10 = | 0.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |

| | Air changes per hour | | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 0.0000 / (5) = | 0.0000 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 3.0000 | (17) |
| Infiltration rate | | 0.1500 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.1500 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.1912 | 0.1875 | 0.1837 | 0.1650 | 0.1612 | 0.1425 | 0.1425 | 0.1388 | 0.1500 | 0.1612 | 0.1687 | 0.1762 | (22b) |

Balanced mechanical ventilation with heat recovery

| | | |
|---|---|---|
| If mechanical ventilation | 0.5000 | (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | 0.5000 | (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | 81.0000 | (23c) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective ac | 0.2862 | 0.2825 | 0.2787 | 0.2600 | 0.2562 | 0.2375 | 0.2375 | 0.2337 | 0.2450 | 0.2562 | 0.2637 | 0.2712 | (25) |

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## 3. Heat losses and heat loss parameter

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| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| Windows | | | 12.1900 | 1.0536 | 12.8439 | | | (27) |
| Front Door | | | 1.8900 | 1.4000 | 2.6460 | | | (26) |
| Glass Door | | | 2.4000 | 1.3258 | 3.1818 | | | (27) |
| External Walls | 48.0200 | 14.5900 | 33.4300 | 0.1500 | 5.0145 | 150.0000 | 5014.5000 | (29a) |
| Wall to Communal Corridor | 20.7900 | 1.8900 | 18.9000 | 0.1400 | 2.6460 | 150.0000 | 2835.0000 | (29a) |
| External Roof | 63.0400 | | 63.0400 | 0.1000 | 6.3040 | 9.0000 | 567.3600 | (30) |
| Total net area of external elements Aum(A, m2) | | | 131.8500 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 32.6362 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 43 | | | 26.6100 | 0.0000 | 0.0000 | 70.0000 | 1862.7000 | (32) |
| Party Floor | | | 63.0400 | | | 80.0000 | 5043.2000 | (32d) |
| Internal Walls | | | 133.9900 | | | 9.0000 | 1205.9100 | (32c) |

| | | |
|---|---|---|
| Heat capacity Cm = Sum(A x k) | (28)...(30) + (32) + (32a)...(32e) = 16528.6700 | (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | 262.1934 | (35) |

List of Thermal Bridges

| | Length | Psi-value | Total | |
|---|---|---|---|---|
| K1 Element | | | | |
| E1 Steel lintel with perforated steel base plate | 7.4700 | 0.0500 | 0.3735 | |
| E3 Sill | 1.3600 | 0.0500 | 0.0680 | |
| E4 Jamb | 18.8700 | 0.0500 | 0.9435 | |
| E7 Party floor between dwellings (in blocks of flats) | 7.0500 | 0.0350 | 0.2468 | |
| E15 Flat roof with parapet | 16.2800 | 0.5600 | 9.1168 | |
| E18 Party wall between dwellings | 2.9500 | 0.0600 | 0.1770 | |
| E7 Party floor between dwellings (in blocks of flats) | 13.7440 | 0.0350 | 0.4810 | |
| E16 Corner (normal) | 5.9000 | 0.0900 | 0.5310 | |
| E17 Corner (inverted - internal area greater than external area) | 2.9500 | -0.0900 | -0.2655 | |
| E24 Eaves (insulation at ceiling level - inverted) | 3.1100 | 0.1200 | 0.3732 | |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | | 12.0453 | (36) |
| Point Thermal bridges | | (36a) = | 0.0000 | |
| Total fabric heat loss | | (33) + (36) + (36a) = | 44.6815 | (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 17.5670 | 17.3369 | 17.1067 | 15.9561 | 15.7259 | 14.5752 | 14.5752 | 14.3451 | 15.0355 | 15.7259 | 16.1862 | 16.6465 | (38) |
| Heat transfer coeff | 62.2485 | 62.0183 | 61.7882 | 60.6375 | 60.4074 | 59.2567 | 59.2567 | 59.0266 | 59.7170 | 60.4074 | 60.8677 | 61.3279 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 60.5800 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 0.9874 | 0.9838 | 0.9801 | 0.9619 | 0.9582 | 0.9400 | 0.9400 | 0.9363 | 0.9473 | 0.9582 | 0.9655 | 0.9728 | (40) |
| HLP (average) | | | | | | | | | | | | 0.9610 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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4. Water heating energy requirements (kWh/year)

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Assumed occupancy | | | | | | | | | | | | 2.0662 | (42) |
| Hot water usage for mixer showers | 57.3751 | 56.4966 | 55.2021 | 53.2107 | 51.4264 | 48.9302 | 46.9559 | 49.2640 | 50.4249 | 52.8972 | 55.4720 | 57.3233 | (42a) |
| Hot water usage for baths | 24.8689 | 24.4935 | 23.9594 | 23.1596 | 22.4388 | 21.4466 | 20.6938 | 21.6143 | 22.0974 | 23.0806 | 24.1028 | 24.8491 | (42b) |
| Hot water usage for other uses | 35.7895 | 34.4880 | 33.1866 | 31.8852 | 30.5837 | 29.2823 | 29.2823 | 30.5837 | 31.8852 | 33.1866 | 34.4880 | 35.7895 | (42c) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 108.4906 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 118.0334 | 115.4782 | 112.3481 | 108.2554 | 104.4490 | 99.6591 | 96.9320 | 101.4620 | 104.4074 | 109.1644 | 114.0628 | 117.9619 | (44) |
| Energy conte | 173.7656 | 152.8009 | 160.5432 | 141.4087 | 134.5930 | 115.2524 | 107.1127 | 119.4227 | 121.1074 | 140.6694 | 154.1597 | 173.2358 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1694.0714 | |
| Distribution loss (46)m = 0.15 x (45)m | 26.0648 | 22.9201 | 24.0815 | 21.2113 | 20.1890 | 17.2879 | 16.0669 | 17.9134 | 18.1661 | 21.1004 | 23.1240 | 25.9854 | (46) |
| Water storage loss: | | | | | | | | | | | | | |
| Store volume | | | | | | | | | | | | 110.0000 | (47) |
| b) If manufacturer declared loss factor is not known : | | | | | | | | | | | | | |
| Hot water storage loss factor from Table 2 (kWh/litre/day) | | | | | | | | | | | | 0.0152 | (51) |
| Volume factor from Table 2a | | | | | | | | | | | | 1.0294 | (52) |
| Temperature factor from Table 2b | | | | | | | | | | | | 0.6000 | (53) |
| Enter (49) or (54) in (55) | | | | | | | | | | | | 1.0327 | (55) |
| Total storage loss | 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (56) |
| If cylinder contains dedicated solar storage | 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (57) |
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | 229.0424 | 202.7284 | 215.8200 | 194.9024 | 189.8698 | 168.7461 | 162.3895 | 174.6995 | 174.6011 | 195.9462 | 207.6534 | 228.5126 | (62) |
| WWHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | 229.0424 | 202.7284 | 215.8200 | 194.9024 | 189.8698 | 168.7461 | 162.3895 | 174.6995 | 174.6011 | 195.9462 | 207.6534 | 228.5126 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2344.9111 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2345 | (64) |
| Electric shower(s) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | 101.9985 | 90.7483 | 97.6020 | 89.8133 | 88.9736 | 81.1164 | 79.8364 | 83.9295 | 83.0632 | 90.9940 | 94.0530 | 101.8223 | (65) |

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5. Internal gains (see Table 5 and 5a)

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Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 103.3077 | 103.3077 | 103.3077 | 103.3077 | 103.3077 | 103.3077 | 103.3077 | 103.3077 | 103.3077 | 103.3077 | 103.3077 | 103.3077 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 91.0635 | 100.8203 | 91.0635 | 94.0990 | 91.0635 | 94.0990 | 91.0635 | 91.0635 | 94.0990 | 91.0635 | 94.0990 | 91.0635 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 180.5436 | 182.4171 | 177.6960 | 167.6453 | 154.9582 | 143.0340 | 135.0680 | 133.1945 | 137.9156 | 147.9663 | 160.6534 | 172.5776 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 33.3308 | 33.3308 | 33.3308 | 33.3308 | 33.3308 | 33.3308 | 33.3308 | 33.3308 | 33.3308 | 33.3308 | 33.3308 | 33.3308 | (69) |
| Pumps, fans | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | -82.6461 | -82.6461 | -82.6461 | -82.6461 | -82.6461 | -82.6461 | -82.6461 | -82.6461 | -82.6461 | -82.6461 | -82.6461 | -82.6461 | (71) |
| Water heating gains (Table 5) | 137.0947 | 135.0421 | 131.1855 | 124.7407 | 119.5882 | 112.6616 | 107.3070 | 112.8084 | 115.3655 | 122.3038 | 130.6292 | 136.8580 | (72) |
| Total internal gains | 462.6942 | 472.2718 | 453.9374 | 440.4774 | 419.6022 | 403.7869 | 387.4308 | 391.0588 | 401.3724 | 415.3259 | 439.3739 | 454.4914 | (73) |

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6. Solar gains

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| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Southeast | 7.7400 | 36.7938 | 0.4500 | 0.7000 | 0.7700 | 62.1670 | (77) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southwest | | | | 4.4500 | 36.7938 | 0.4500 | 0.7000 | 0.7700 | | | | 35.7420 | (79) |
| Southeast | | | | 2.4000 | 36.7938 | 0.4500 | 0.7000 | 0.7700 | | | | 19.2766 | (77) |
| Solar gains | 117.1856 | 199.6104 | 273.1156 | 338.4035 | 379.0401 | 376.2991 | 362.7925 | 332.4757 | 295.7264 | 220.6120 | 140.3613 | 100.2864 | (83) |
| Total gains | 579.8798 | 671.8822 | 727.0530 | 778.8809 | 798.6423 | 780.0860 | 750.2233 | 723.5345 | 697.0988 | 635.9379 | 579.7352 | 554.7778 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| tau | 73.7576 | 74.0313 | 74.3070 | 75.7171 | 76.0055 | 77.4815 | 77.4815 | 77.7835 | 76.8843 | 76.0055 | 75.4308 | 74.8647 | |
| alpha | 5.9172 | 5.9354 | 5.9538 | 6.0478 | 6.0670 | 6.1654 | 6.1654 | 6.1856 | 6.1256 | 6.0670 | 6.0287 | 5.9910 | |
| util living area | 0.9858 | 0.9667 | 0.9290 | 0.8312 | 0.6765 | 0.4832 | 0.3472 | 0.3747 | 0.5812 | 0.8532 | 0.9653 | 0.9885 | (86) |
| MIT | 20.2114 | 20.4115 | 20.6279 | 20.8539 | 20.9636 | 20.9961 | 20.9996 | 20.9993 | 20.9883 | 20.8549 | 20.5154 | 20.1857 | (87) |
| Th 2 | 20.0938 | 20.0969 | 20.0999 | 20.1152 | 20.1183 | 20.1336 | 20.1336 | 20.1367 | 20.1275 | 20.1183 | 20.1121 | 20.1060 | (88) |
| util rest of house | 0.9815 | 0.9574 | 0.9103 | 0.7939 | 0.6211 | 0.4192 | 0.2790 | 0.3047 | 0.5120 | 0.8118 | 0.9540 | 0.9850 | (89) |
| MIT 2 | 19.1985 | 19.4493 | 19.7134 | 19.9812 | 20.0912 | 20.1317 | 20.1335 | 20.1365 | 20.1208 | 19.9906 | 19.5933 | 19.1758 | (90) |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.5206 | (91) |
| MIT | 19.7258 | 19.9502 | 20.1895 | 20.4355 | 20.5454 | 20.5817 | 20.5844 | 20.5857 | 20.5724 | 20.4406 | 20.0734 | 19.7016 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.7258 | 19.9502 | 20.1895 | 20.4355 | 20.5454 | 20.5817 | 20.5844 | 20.5857 | 20.5724 | 20.4406 | 20.0734 | 19.7016 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9793 | 0.9557 | 0.9124 | 0.8081 | 0.6485 | 0.4525 | 0.3145 | 0.3412 | 0.5477 | 0.8280 | 0.9534 | 0.9831 | (94) |
| Useful gains | 567.8978 | 642.0849 | 663.3396 | 629.4376 | 517.9298 | 352.9571 | 235.9729 | 246.8568 | 381.7983 | 526.5307 | 552.7407 | 545.3921 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | 960.2331 | 933.3905 | 845.8520 | 699.4870 | 534.3258 | 354.4562 | 236.1028 | 247.0682 | 386.5152 | 594.4444 | 789.6584 | 950.6789 | (97) |
| Space heating kWh | 291.8975 | 195.7574 | 135.7892 | 50.4356 | 12.1986 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 50.5277 | 170.5808 | 301.5334 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 1208.7202 | |
| Solar heating kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | 291.8975 | 195.7574 | 135.7892 | 50.4356 | 12.1986 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 50.5277 | 170.5808 | 301.5334 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 1208.7202 | |
| Space heating per m2 | | | | | | | | | | (98c) / (4) = | | 19.1739 | (99) |

## 8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ext. temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | |
| Heat loss rate W | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 557.0132 | 438.4997 | 448.6020 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (100) |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.9752 | 0.9908 | 0.9876 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (101) |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 543.2150 | 434.4532 | 443.0594 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (102) |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 864.1405 | 831.7035 | 801.3643 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 231.0663 | 295.5542 | 266.5788 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (104) |
| Cooled fraction | | | | | | | | | fC = cooled area / (4) = | | | 0.9994 | (105) |
| Intermittency factor (Table 10b) | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | (106) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 57.7299 | 73.8417 | 66.6024 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) |
| Space cooling requirement | | | | | | | | | | | | 198.1740 | (107) |

## 9b. Energy requirements

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | 0.0000 | (301) |
| Fraction of space heat from community system | | | | | | | | | | | | 1.0000 | (302) |
| Fraction of heat from community Heat pump-Space and Water | | | | | | | | | | | | 1.0000 | (303a) |
| Factor for control and charging method (Table 4c(3)) for space heating | | | | | | | | | | | | 1.0000 | (305) |
| Factor for charging method (Table 4c(3)) for water heating | | | | | | | | | | | | 1.0000 | (305a) |
| Distribution loss factor (Table 12c) for community heating system | | | | | | | | | | | | 2.0000 | (306) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 | (208) |
| Space heating: | | | | | | | | | | | | | |
| Space heating requirement | 291.8975 | 195.7574 | 135.7892 | 50.4356 | 12.1986 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 50.5277 | 170.5808 | 301.5334 | (98) |
| Space heat from Heat pump = (98) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 307a | 583.7949 | 391.5148 | 271.5784 | 100.8712 | 24.3972 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 101.0555 | 341.1615 | 603.0667 | |
| Space heating requirement | 583.7949 | 391.5148 | 271.5784 | 100.8712 | 24.3972 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 101.0555 | 341.1615 | 603.0667 | (307) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | | | | | | | | | | | 0.0000 | (308) |
| Space heating fuel for secondary/supplementary system | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (309) |
| Water heating | | | | | | | | | | | | | |
| Annual water heating requirement | 229.0424 | 202.7284 | 215.8200 | 194.9024 | 189.8698 | 168.7461 | 162.3895 | 174.6995 | 174.6011 | 195.9462 | 207.6534 | 228.5126 | (64) |
| Water heat from Heat pump = (64) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 310a | 458.0847 | 405.4568 | 431.6399 | 389.8047 | 379.7397 | 337.4922 | 324.7790 | 349.3989 | 349.2022 | 391.8924 | 415.3067 | 457.0251 | |
| Water heating fuel | 458.0847 | 405.4568 | 431.6399 | 389.8047 | 379.7397 | 337.4922 | 324.7790 | 349.3989 | 349.2022 | 391.8924 | 415.3067 | 457.0251 | (310) |
| Cooling System Energy Efficiency Ratio | | | | | | | | | | | | 2.6000 | (314) |
| Space coolin | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 22.2038 | 28.4006 | 25.6163 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (315) |
| Pumps and Fa | 16.9956 | 15.3508 | 16.9956 | 16.4473 | 16.9956 | 16.4473 | 16.9956 | 16.9956 | 16.4473 | 16.9956 | 16.4473 | 16.9956 | (331) |
| Lighting | 18.7154 | 15.0142 | 13.5186 | 9.9043 | 7.6504 | 6.2504 | 6.9789 | 9.0715 | 11.7830 | 15.4599 | 17.4619 | 19.2356 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333a)m | -4.7646 | -7.7205 | -12.8322 | -16.6329 | -19.8889 | -19.3090 | -19.0356 | -16.9195 | -13.5817 | -9.6425 | -5.5582 | -3.9989 | (333a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (334a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335a) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (333b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335b) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - community heating | 2417.4403 | (307) |
| Space heating fuel - secondary | 0.0000 | (309) |
| Water heating fuel - community heating | 4689.8223 | (310) |
| Efficiency of water heater | 0.0000 | (311) |
| Electricity used for heat distribution | 24.1744 | (313) |
| Space cooling fuel | 76.2208 | (321) |
| | | |
| Electricity for pumps and fans: | | |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8820) | | |
| mechanical ventilation fans (SFP = 0.8820) | 200.1090 | (330a) |
| Total electricity for the above, kWh/year | 200.1090 | (331) |
| Electricity for lighting (calculated in Appendix L) | 151.0441 | (332) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -149.8844 | (333) |
| Wind generation | 0.0000 | (334) |
| Hydro-electric generation (Appendix N) | 0.0000 | (335a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (335) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (336) |
| Energy used | 0.0000 | (337) |
| Total delivered energy for all uses | 7384.7521 | (338) |

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12b. Carbon dioxide emissions - Community heating scheme

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (367) |
| Space and Water heating from Heat pump | 2538.3081 | 0.1574 | 135.9130 | (367) |
| Electrical energy for heat distribution (space & water) | 24.1744 | 0.0000 | 10.4079 | (372) |
| Overall CO2 factor for heat network | | | 0.0538 | (386) |
| Total CO2 associated with community systems | | | 382.1202 | (373) |
| Space and water heating | | | 382.1202 | (376) |
| Space cooling | 76.2208 | 0.1140 | 8.6860 | (377) |
| Pumps, fans and electric keep-hot | 200.1090 | 0.1387 | 27.7576 | (378) |
| Energy for lighting | 151.0441 | 0.1443 | 21.8003 | (379) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -149.8844 | 0.1319 | -19.7635 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -19.7635 | (380) |
| Total CO2, kg/year | | | 420.6006 | (383) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 6.6700 | (384) |

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13b. Primary energy - Community heating scheme

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| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (467a) |
| Space and Water heating from Heat pump | 2538.3081 | 1.5828 | 1366.5019 | (467) |
| Electrical energy for heat distribution (space & water) | 24.1744 | 0.0000 | 109.5732 | (472) |
| Overall CO2 factor for heat network | | | 0.5660 | (486) |
| Total CO2 associated with community systems | | | 4022.9005 | (473) |
| Space and water heating | | | 4022.9005 | (476) |
| Space cooling | 76.2208 | 1.4200 | 108.2365 | (477) |
| Pumps, fans and electric keep-hot | 200.1090 | 1.5128 | 302.7249 | (478) |
| Energy for lighting | 151.0441 | 1.5338 | 231.6765 | (479) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -149.8844 | 1.4872 | -222.9033 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -222.9033 | (480) |
| Total Primary energy kWh/year | | | 4442.6351 | (483) |
| Dwelling Primary energy Rate (DPER) | | | 70.4700 | (484) |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 63.0400 | (1b) | x 2.9500 | (2b) | = 185.9680 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 63.0400 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | | = 185.9680 | (5) |

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2. Ventilation rate

---

m3 per hour

| | | |
|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 (6a) |
| Number of open flues | 0 * 20 = | 0.0000 (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 (6f) |
| Number of intermittent extract fans | 2 * 10 = | 20.0000 (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 (7c) |

| | | Air changes per hour | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 20.0000 / (5) = | 0.1075 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3575 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.3575 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.4559 | 0.4469 | 0.4380 | 0.3933 | 0.3844 | 0.3397 | 0.3397 | 0.3307 | 0.3575 | 0.3844 | 0.4022 | 0.4201 | (22b) |
| Effective ac | 0.6039 | 0.5999 | 0.5959 | 0.5773 | 0.5739 | 0.5577 | 0.5577 | 0.5547 | 0.5639 | 0.5739 | 0.5809 | 0.5882 | (25) |

## 3. Heat losses and heat loss parameter

| Element | Gross | Openings | NetArea | U-value | A x U | K-value | A x K | |
|---|---|---|---|---|---|---|---|---|
| | m2 | m2 | m2 | W/m2K | W/K | kJ/m2K | kJ/K | |
| Main dwelling | | | | | | | | |
| TER Opaque door | | | 1.8900 | 1.0000 | 1.8900 | | | (26) |
| TER Opening Type | | | 13.8600 | 1.1450 | 15.8702 | | | (27) |
| External Walls | 48.0200 | 13.8600 | 34.1600 | 0.1800 | 6.1488 | | | (29a) |
| Wall to Communal Corridor | 20.7900 | 1.8900 | 18.9000 | 0.1800 | 3.4020 | | | (29a) |
| External Roof | 63.0400 | | 63.0400 | 0.1100 | 6.9344 | | | (30) |
| Total net area of external elements Aum(A, m2) | | | 131.8500 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 34.2454 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 43 | | | 26.6100 | 0.0000 | 0.0000 | | | (32) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 262.1934 (35)

List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E1 Steel lintel with perforated steel base plate | 7.4700 | 0.0500 | 0.3735 |
| E3 Sill | 1.3600 | 0.0500 | 0.0680 |
| E4 Jamb | 18.8700 | 0.0500 | 0.9435 |
| E7 Party floor between dwellings (in blocks of flats) | 7.0500 | 0.0700 | 0.4935 |
| E15 Flat roof with parapet | 16.2800 | 0.5600 | 9.1168 |
| E18 Party wall between dwellings | 2.9500 | 0.0600 | 0.1770 |
| E7 Party floor between dwellings (in blocks of flats) | 13.7440 | 0.0700 | 0.9621 |
| E16 Corner (normal) | 5.9000 | 0.0900 | 0.5310 |
| E17 Corner (inverted - internal area greater than external area) | 2.9500 | -0.0900 | -0.2655 |
| E24 Eaves (insulation at ceiling level - inverted) | 3.1100 | 0.2400 | 0.7464 |

| | | |
|---|---|---|
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | 13.1463 (36) |
| Point Thermal bridges | (36a) = | 0.0000 |
| Total fabric heat loss | (33) + (36) + (36a) = | 47.3917 (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 37.0616 | 36.8139 | 36.5712 | 35.4312 | 35.2179 | 34.2250 | 34.2250 | 34.0411 | 34.6074 | 35.2179 | 35.6494 | 36.1005 | (38) |
| Heat transfer coeff | 84.4533 | 84.2056 | 83.9629 | 82.8229 | 82.6096 | 81.6167 | 81.6167 | 81.4328 | 81.9991 | 82.6096 | 83.0411 | 83.4922 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 82.8219 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.3397 | 1.3357 | 1.3319 | 1.3138 | 1.3104 | 1.2947 | 1.2947 | 1.2918 | 1.3007 | 1.3104 | 1.3173 | 1.3244 | (40) |
| HLP (average) | | | | | | | | | | | | 1.3138 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

## 4. Water heating energy requirements (kWh/year)

| | | |
|---|---|---|
| Assumed occupancy | | 2.0662 (42) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hot water usage for mixer showers | 58.8622 | 57.9776 | 56.6886 | 54.2223 | 52.4022 | 50.3725 | 49.2188 | 50.4981 | 51.9004 | 54.0797 | 56.5990 | 58.6367 | (42a) |
| Hot water usage for baths | 25.4359 | 25.0581 | 24.5262 | 23.5453 | 22.8109 | 21.9965 | 21.5566 | 22.0849 | 22.6600 | 23.5314 | 24.5325 | 25.3499 | (42b) |
| Hot water usage for other uses | 35.7895 | 34.4880 | 33.1866 | 31.8852 | 30.5837 | 29.2823 | 29.2823 | 30.5837 | 31.8852 | 33.1866 | 34.4880 | 35.7895 | (42c) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 110.3880 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 120.0876 | 117.5238 | 114.4014 | 109.6528 | 105.7969 | 101.6513 | 100.0578 | 103.1667 | 106.4456 | 110.7977 | 115.6195 | 119.7761 | (44) |
| Energy conte | 190.1894 | 167.3523 | 175.8307 | 150.1092 | 142.4229 | 124.9922 | 121.0112 | 127.7419 | 131.2580 | 150.3515 | 164.7212 | 187.5404 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1833.5208 | |
| Distribution loss (46)m = 0.15 x (45)m | 28.5284 | 25.1028 | 26.3746 | 22.5164 | 21.3634 | 18.7488 | 18.1517 | 19.1613 | 19.6887 | 22.5527 | 24.7082 | 28.1311 | (46) |
| Water storage loss: | | | | | | | | | | | | | |
| Store volume | | | | | | | | | | | | 150.0000 | (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | | | | | | | | | | | | 1.3938 | (48) |
| Temperature factor from Table 2b | | | | | | | | | | | | 0.5400 | (49) |
| Enter (49) or (54) in (55) | | | | | | | | | | | | 0.7527 | (55) |
| Total storage loss | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (56) |
| If cylinder contains dedicated solar storage | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (57) |
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | 236.7843 | 209.4380 | 222.4256 | 195.2011 | 189.0178 | 170.0840 | 167.6061 | 174.3368 | 176.3499 | 196.9464 | 209.8130 | 234.1353 | (62) |
| WWHRS | -26.9093 | -23.7988 | -24.9208 | -20.6354 | -19.2314 | -16.4565 | -15.4253 | -16.4033 | -17.0265 | -20.0724 | -22.7396 | -26.4110 | (63a) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | | | | | | | | | | | | | |
| | 209.8749 | 185.6392 | 197.5048 | 174.5657 | 169.7864 | 153.6275 | 152.1808 | 157.9335 | 159.3234 | 176.8740 | 187.0734 | 207.7242 | (64) |
| | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | | 2132.1079 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2132 | (64) |
| Electric shower(s) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | | | | | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | | | | | | | | | | | | | |
| | 100.5139 | 89.3132 | 95.7396 | 85.9848 | 84.6315 | 77.6334 | 77.5121 | 79.7501 | 79.7168 | 87.2678 | 90.8433 | 99.6331 | (65) |

## 5. Internal gains (see Table 5 and 5a)

| Metabolic gains (Table 5), Watts | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 103.3077 | 103.3077 | 103.3077 | 103.3077 | 103.3077 | 103.3077 | 103.3077 | 103.3077 | 103.3077 | 103.3077 | 103.3077 | 103.3077 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 91.0968 | 100.8571 | 91.0968 | 94.1333 | 91.0968 | 94.1333 | 91.0968 | 91.0968 | 94.1333 | 91.0968 | 94.1333 | 91.0968 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 180.5436 | 182.4171 | 177.6960 | 167.6453 | 154.9582 | 143.0340 | 135.0680 | 133.1945 | 137.9156 | 147.9663 | 160.6534 | 172.5776 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 33.3308 | 33.3308 | 33.3308 | 33.3308 | 33.3308 | 33.3308 | 33.3308 | 33.3308 | 33.3308 | 33.3308 | 33.3308 | 33.3308 | (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.0000 | 3.0000 | 3.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | | | | | | | | | | | | | |
| | -82.6461 | -82.6461 | -82.6461 | -82.6461 | -82.6461 | -82.6461 | -82.6461 | -82.6461 | -82.6461 | -82.6461 | -82.6461 | -82.6461 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 135.0993 | 132.9066 | 128.6823 | 119.4233 | 113.7521 | 107.8241 | 104.1830 | 107.1910 | 110.7177 | 117.2954 | 126.1712 | 133.9154 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 463.7320 | 473.1731 | 454.4674 | 438.1943 | 416.7993 | 398.9838 | 384.3400 | 385.4745 | 396.7590 | 413.3507 | 437.9502 | 454.5821 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Southeast | 9.6300 | 36.7938 | 0.6300 | 0.7000 | 0.7700 | 108.2862 | (77) |
| Southwest | 4.2300 | 36.7938 | 0.6300 | 0.7000 | 0.7700 | 47.5650 | (79) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 155.8512 | 265.4722 | 363.2307 | 450.0604 | 504.1051 | 500.4597 | 482.4966 | 442.1768 | 393.3020 | 293.4033 | 186.6738 | 133.3761 | (83) |
| Total gains | 619.5832 | 738.6453 | 817.6980 | 888.2547 | 920.9045 | 899.4435 | 866.8366 | 827.6513 | 790.0609 | 706.7541 | 624.6240 | 587.9582 | (84) |

## 7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, ni1,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 54.3649 | 54.5248 | 54.6824 | 55.4351 | 55.5783 | 56.2544 | 56.2544 | 56.3814 | 55.9920 | 55.5783 | 55.2895 | 54.9907 | |
| alpha | 4.6243 | 4.6350 | 4.6455 | 4.6957 | 4.7052 | 4.7503 | 4.7503 | 4.7588 | 4.7328 | 4.7052 | 4.6860 | 4.6660 | |
| util living area | | | | | | | | | | | | | |
| | 0.9874 | 0.9718 | 0.9422 | 0.8702 | 0.7428 | 0.5615 | 0.4106 | 0.4468 | 0.6670 | 0.8946 | 0.9734 | 0.9899 | (86) |
| MIT | 19.7345 | 19.9885 | 20.2907 | 20.6352 | 20.8658 | 20.9723 | 20.9949 | 20.9924 | 20.9381 | 20.6387 | 20.1310 | 19.6962 | (87) |
| Th 2 | 19.8099 | 19.8129 | 19.8159 | 19.8300 | 19.8327 | 19.8450 | 19.8450 | 19.8473 | 19.8402 | 19.8327 | 19.8273 | 19.8217 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9832 | 0.9629 | 0.9242 | 0.8322 | 0.6759 | 0.4685 | 0.3048 | 0.3379 | 0.5739 | 0.8546 | 0.9634 | 0.9865 | (89) |
| MIT 2 | 18.3852 | 18.7051 | 19.0783 | 19.4908 | 19.7318 | 19.8313 | 19.8437 | 19.8451 | 19.8049 | 19.5083 | 18.8983 | 18.3452 | (90) |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.5206 | (91) |
| MIT | 19.0877 | 19.3733 | 19.7095 | 20.0866 | 20.3222 | 20.4253 | 20.4430 | 20.4424 | 20.3949 | 20.0968 | 19.5401 | 19.0486 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.0877 | 19.3733 | 19.7095 | 20.0866 | 20.3222 | 20.4253 | 20.4430 | 20.4424 | 20.3949 | 20.0968 | 19.5401 | 19.0486 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9799 | 0.9589 | 0.9223 | 0.8413 | 0.7054 | 0.5162 | 0.3600 | 0.3947 | 0.6202 | 0.8648 | 0.9603 | 0.9836 | (94) |
| Useful gains | 607.1318 | 708.2707 | 754.2001 | 747.3299 | 649.6289 | 464.3146 | 312.0476 | 326.7060 | 490.0288 | 611.2281 | 599.8314 | 578.3026 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | | | | | | | | | | | | | |
| | 1248.8666 | 1218.7301 | 1109.1082 | 926.5089 | 712.2760 | 475.4450 | 313.6525 | 329.1830 | 516.1727 | 784.5303 | 1033.0399 | 1239.7398 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 477.4507 | 343.0287 | 264.0516 | 129.0089 | 46.6094 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 128.9369 | 311.9101 | 492.1093 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 2193.1056 | |
| Solar heating kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | | | | | | | | | | | | | |
| | 477.4507 | 343.0287 | 264.0516 | 129.0089 | 46.6094 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 128.9369 | 311.9101 | 492.1093 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 2193.1056 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 34.7891 | (99) |

## 9a. Energy requirements - Individual heating systems, including micro-CHP

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | 0.0000 | (201) |
| Fraction of space heat from main system(s) | | | | | | | | | | | | 1.0000 | (202) |
| Efficiency of main space heating system 1 (in %) | | | | | | | | | | | | 92.3000 | (206) |
| Efficiency of main space heating system 2 (in %) | | | | | | | | | | | | 0.0000 | (207) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 | (208) |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| Space heating requirement | | | | | | | | | | | | | |
| | 477.4507 | 343.0287 | 264.0516 | 129.0089 | 46.6094 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 128.9369 | 311.9101 | 492.1093 | (98) |

Space heating efficiency (main heating system 1)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 92.3000 | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.3000 | 92.3000 | 92.3000 | (210) |

Space heating fuel (main heating system)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 517.2813 | 371.6454 | 286.0798 | 139.7713 | 50.4978 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 139.6932 | 337.9308 | 533.1628 | (211) |

Space heating efficiency (main heating system 2)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (212) |

Space heating fuel (main heating system 2)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (213) |

Space heating fuel (secondary)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (215) |

Water heating

Water heating requirement

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 209.8749 | 185.6392 | 197.5048 | 174.5657 | 169.7864 | 153.6275 | 152.1808 | 157.9335 | 159.3234 | 176.8740 | 187.0734 | 207.7242 | (64) |

Efficiency of water heater

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | 79.8000 | (216) |
| (217)m | 85.8437 | 85.4172 | 84.7118 | 83.3918 | 81.5809 | 79.8000 | 79.8000 | 79.8000 | 79.8000 | 83.3622 | 85.1976 | 85.9236 | (217) |

Fuel for water heating, kWh/month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 244.4849 | 217.3322 | 233.1492 | 209.3320 | 208.1202 | 192.5157 | 190.7027 | 197.9117 | 199.6534 | 212.1752 | 219.5760 | 241.7545 | (219) |

Space cooling fuel requirement

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (221) |
| Pumps and Fa | 7.3041 | 6.5973 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | (231) |
| Lighting | 18.9281 | 15.1848 | 13.6723 | 10.0169 | 7.7373 | 6.3215 | 7.0582 | 9.1746 | 11.9169 | 15.6356 | 17.6603 | 19.4542 | (232) |

Electricity generated by PVs (Appendix M) (negative quantity)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (233a)m | -14.0221 | -21.0578 | -32.2213 | -38.6472 | -43.8317 | -41.7159 | -41.2152 | -37.8320 | -32.2560 | -25.1224 | -15.8687 | -11.9778 | (233a) |

Electricity generated by wind turbines (Appendix M) (negative quantity)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234a) |

Electricity generated by hydro-electric generators (Appendix M) (negative quantity)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235a) |

Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235c) |

Electricity generated by PVs (Appendix M) (negative quantity)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (233b)m | -4.4385 | -9.5929 | -19.5520 | -30.0920 | -40.5075 | -40.9589 | -40.4707 | -33.9299 | -24.4369 | -13.9457 | -5.9981 | -3.4907 | (233b) |

Electricity generated by wind turbines (Appendix M) (negative quantity)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234b) |

Electricity generated by hydro-electric generators (Appendix M) (negative quantity)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235b) |

Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235d) |

Annual totals kWh/year

| | | |
|---|---|---|
| Space heating fuel - main system 1 | 2376.0624 | (211) |
| Space heating fuel - main system 2 | 0.0000 | (213) |
| Space heating fuel - secondary | 0.0000 | (215) |
| Efficiency of water heater | 79.8000 | |
| Water heating fuel used | 2566.7078 | (219) |
| Space cooling fuel | 0.0000 | (221) |

Electricity for pumps and fans:

| | | |
|---|---|---|
| Total electricity for the above, kWh/year | 86.0000 | (231) |
| Electricity for lighting (calculated in Appendix L) | 152.7607 | (232) |

Energy saving/generation technologies (Appendices M ,N and Q)

| | | |
|---|---|---|
| PV generation | -623.1820 | (233) |
| Wind generation | 0.0000 | (234) |
| Hydro-electric generation (Appendix N) | 0.0000 | (235a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (235) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (236) |
| Energy used | 0.0000 | (237) |
| Total delivered energy for all uses | 4558.3489 | (238) |

---

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

---

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 2376.0624 | 0.2100 | 498.9731 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2566.7078 | 0.2100 | 539.0086 | (264) |
| Space and water heating | | | 1037.9817 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 152.7607 | 0.1443 | 22.0481 | (268) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -355.7683 | 0.1333 | -47.4155 | |
| PV Unit electricity exported | -267.4137 | 0.1252 | -33.4781 | |
| Total | | | -80.8935 | (269) |
| Total CO2, kg/year | | | 991.0655 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 15.7200 | (273) |

---

13a. Primary energy - Individual heating systems including micro-CHP

---

| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 2376.0624 | 1.1300 | 2684.9506 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2566.7078 | 1.1300 | 2900.3798 | (278) |
| Space and water heating | | | 5585.3303 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 152.7607 | 1.5338 | 234.3094 | (282) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -355.7683 | 1.4925 | -530.9812 | |
| PV Unit electricity exported | -267.4137 | 0.4595 | -122.8785 | |
| Total | | | -653.8597 | (283) |
| Total Primary energy kWh/year | | | 5295.8808 | (286) |
| Target Primary Energy Rate (TPER) | | | 84.0100 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Property Reference** | Unit 43 | **Issued on Date** | 17/05/2025 |
| **Assessment Reference** | 00001 | **Prop Type Ref** | Unit 43 |
| **Property** | | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 79 C | **DER** | 5.67 | **TER** | 13.97 |
| **Environmental** | 96 A | **% DER < TER** | | | 59.41 |
| **$CO_2$ Emissions (t/year)** | 0.32 | **DFEE** | 31.67 | **TFEE** | 33.45 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 5.32 |
| **% DPER < TPER** | 19.40 | **DPER** | 60.31 | **TPER** | 74.82 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Robert Arnold | **Assessor ID** | BA04-0001 |
| **Client** | | | |

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SAP 10 WORKSHEET FOR New Build (As Designed)  (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 61.4200 | (1b) | x 2.9500 | (2b) = | 181.1890 | (1b) - (3b) (4) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 61.4200 | | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | 181.1890 | (5) |

---

2. Ventilation rate

---

| | | m3 per hour | |
|---|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 | (6a) |
| Number of open flues | 0 * 20 = | 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | 0 * 10 = | 0.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |

| | Air changes per hour | | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 0.0000 / (5) = | 0.0000 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 3.0000 | (17) |
| Infiltration rate | | 0.1500 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.1500 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.1912 | 0.1875 | 0.1837 | 0.1650 | 0.1612 | 0.1425 | 0.1425 | 0.1388 | 0.1500 | 0.1612 | 0.1687 | 0.1762 | (22b) |

Balanced mechanical ventilation with heat recovery

| | | |
|---|---|---|
| If mechanical ventilation | | 0.5000 (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | | 0.5000 (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | | 81.0000 (23c) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective ac | 0.2862 | 0.2825 | 0.2787 | 0.2600 | 0.2562 | 0.2375 | 0.2375 | 0.2337 | 0.2450 | 0.2562 | 0.2637 | 0.2712 | (25) |

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3. Heat losses and heat loss parameter

---

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| Windows | | | 5.1600 | 1.0536 | 5.4368 | | | (27) |
| Front Door | | | 1.8900 | 1.4000 | 2.6460 | | | (26) |
| Glass Door | | | 2.4000 | 1.3258 | 3.1818 | | | (27) |
| External Walls | 30.2600 | 7.5600 | 22.7000 | 0.1500 | 3.4050 | 150.0000 | 3405.0000 | (29a) |
| Wall to Communal Corridor | 14.8900 | 1.8900 | 13.0000 | 0.1400 | 1.8200 | 150.0000 | 1950.0000 | (29a) |
| External Roof | 61.4300 | | 61.4300 | 0.1000 | 6.1430 | 9.0000 | 552.8700 | (30) |
| Total net area of external elements Aum(A, m2) | | | 106.5800 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 22.6326 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 42 | | | 26.6100 | 0.0000 | 0.0000 | 70.0000 | 1862.7000 | (32) |
| Party Wall to Unit 44 | | | 23.1500 | 0.0000 | 0.0000 | 70.0000 | 1620.5000 | (32) |
| Party Floor | | | 61.4300 | | | 80.0000 | 4914.4000 | (32d) |
| Internal Walls | | | 127.0300 | | | 9.0000 | 1143.2700 | (32c) |
| Heat capacity Cm = Sum(A x k) | | | | | (28)...(30) + (32) + (32a)...(32e) = | | 15448.7400 | (34) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 251.5262 (35)
List of Thermal Bridges

| K1 Element | Length | Psi-value | Total |
|---|---|---|---|
| E1 Steel lintel with perforated steel base plate | 4.7700 | 0.0500 | 0.2385 |
| E3 Sill | 1.3600 | 0.0500 | 0.0680 |
| E4 Jamb | 11.4600 | 0.0500 | 0.5730 |
| E23 Balcony within or between dwellings, balcony support penetrates wall insulation | 3.9400 | 0.0200 | 0.0788 |
| E18 Party wall between dwellings | 5.9000 | 0.0600 | 0.3540 |
| E7 Party floor between dwellings (in blocks of flats) | 5.0500 | 0.0350 | 0.1768 |
| E24 Eaves (insulation at ceiling level - inverted) | 3.1070 | 0.1200 | 0.3728 |
| E15 Flat roof with parapet | 7.0725 | 0.5600 | 3.9606 |
| E25 Staggered party wall between dwellings | 2.9500 | 0.0300 | 0.0885 |
| E17 Corner (inverted - internal area greater than external area) | 2.9500 | -0.0900 | -0.2655 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 5.6455 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 28.2781 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 17.1156 | 16.8913 | 16.6671 | 15.5460 | 15.3218 | 14.2007 | 14.2007 | 13.9765 | 14.6491 | 15.3218 | 15.7702 | 16.2187 | (38) |
| Heat transfer coeff | 45.3937 | 45.1694 | 44.9452 | 43.8241 | 43.5999 | 42.4788 | 42.4788 | 42.2546 | 42.9272 | 43.5999 | 44.0483 | 44.4968 | (39) |

Average = Sum(39)m / 12 = 43.7681

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 0.7391 | 0.7354 | 0.7318 | 0.7135 | 0.7099 | 0.6916 | 0.6916 | 0.6880 | 0.6989 | 0.7099 | 0.7172 | 0.7245 | (40) |
| HLP (average) | | | | | | | | | | | | 0.7126 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

---
4. Water heating energy requirements (kWh/year)
---

Assumed occupancy 2.0215 (42)
Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 56.6450 | 55.7778 | 54.4997 | 52.5336 | 50.7721 | 48.3076 | 46.3584 | 48.6372 | 49.7833 | 52.2242 | 54.7662 | 56.5939 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 24.5540 | 24.1833 | 23.6560 | 22.8664 | 22.1547 | 21.1750 | 20.4318 | 21.3406 | 21.8176 | 22.7883 | 23.7976 | 24.5345 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 35.3320 | 34.0472 | 32.7624 | 31.4776 | 30.1928 | 28.9080 | 28.9080 | 30.1928 | 31.4776 | 32.7624 | 34.0472 | 35.3320 | (42c) |

Average daily hot water use (litres/day) 107.1097 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 116.5310 | 114.0084 | 110.9182 | 106.8776 | 103.1196 | 98.3907 | 95.6982 | 100.1706 | 103.0785 | 107.7749 | 112.6110 | 116.4605 | (44) |
| Energy conte | 171.5538 | 150.8561 | 158.4998 | 139.6089 | 132.8800 | 113.7855 | 105.7493 | 117.9026 | 119.5659 | 138.8789 | 152.1975 | 171.0308 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1672.5093 | |
| Distribution loss (46)m = 0.15 x (45)m | 25.7331 | 22.6284 | 23.7750 | 20.9413 | 19.9320 | 17.0678 | 15.8624 | 17.6854 | 17.9349 | 20.8318 | 22.8296 | 25.6546 | (46) |

Water storage loss:
Store volume 110.0000 (47)
b) If manufacturer declared loss factor is not known :
Hot water storage loss factor from Table 2 (kWh/litre/day) 0.0152 (51)
Volume factor from Table 2a 1.0294 (52)
Temperature factor from Table 2b 0.6000 (53)
Enter (49) or (54) in (55) 1.0327 (55)
Total storage loss

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (56) |

If cylinder contains dedicated solar storage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (57) |
| Primary loss 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |

Total heat required for water heating calculated for each month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 226.8306 | 200.7835 | 213.7766 | 193.1026 | 188.1568 | 167.2792 | 161.0261 | 173.1795 | 173.0596 | 194.1557 | 205.6912 | 226.3076 | (62) |
| WWHRS 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63a) |
| PV diverter -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |

Output from w/h

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 226.8306 | 200.7835 | 213.7766 | 193.1026 | 188.1568 | 167.2792 | 161.0261 | 173.1795 | 173.0596 | 194.1557 | 205.6912 | 226.3076 | (64) |

Total per year (kWh/year) = Sum(64)m = 2323.3490 (64)
12Total per year (kWh/year) 2323 (64)
Electric shower(s)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)
Heat gains from water heating, kWh/month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 101.2631 | 90.1016 | 96.9226 | 89.2149 | 88.4040 | 80.6286 | 79.3831 | 83.4241 | 82.5506 | 90.3987 | 93.4006 | 101.0892 | (65) |

---
5. Internal gains (see Table 5 and 5a)
---

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 101.0743 | 101.0743 | 101.0743 | 101.0743 | 101.0743 | 101.0743 | 101.0743 | 101.0743 | 101.0743 | 101.0743 | 101.0743 | 101.0743 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 98.2663 | 108.7948 | 98.2663 | 101.5418 | 98.2663 | 101.5418 | 98.2663 | 98.2663 | 101.5418 | 98.2663 | 101.5418 | 98.2663 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 176.5135 | 178.3451 | 173.7294 | 163.9031 | 151.4991 | 139.8412 | 132.0529 | 130.2213 | 134.8370 | 144.6633 | 157.0673 | 168.7252 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 33.1074 | 33.1074 | 33.1074 | 33.1074 | 33.1074 | 33.1074 | 33.1074 | 33.1074 | 33.1074 | 33.1074 | 33.1074 | 33.1074 | (69) |
| Pumps, fans 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | -80.8594 | -80.8594 | -80.8594 | -80.8594 | -80.8594 | -80.8594 | -80.8594 | -80.8594 | -80.8594 | -80.8594 | -80.8594 | -80.8594 | (71) |
| Water heating gains (Table 5) | 136.1063 | 134.0798 | 130.2724 | 123.9096 | 118.8226 | 111.9842 | 106.6977 | 112.1291 | 114.6536 | 121.5036 | 129.7231 | 135.8725 | (72) |
| Total internal gains | 464.2083 | 474.5420 | 455.5903 | 442.6768 | 421.9103 | 406.6895 | 390.3392 | 393.9389 | 404.3547 | 417.7555 | 441.6544 | 456.1863 | (73) |

---
6. Solar gains
---

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W |
|---|---|---|---|---|---|---|

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southeast | | | 5.1600 | | 36.7938 | | 0.4500 | | 0.7000 | | 0.7700 | | 41.4447 (77) |
| Southeast | | | 2.4000 | | 36.7938 | | 0.4500 | | 0.7000 | | 0.7700 | | 19.2766 (77) |
| Solar gains | 60.7212 | 103.4307 | 141.5184 | 175.3482 | 196.4046 | 194.9843 | 187.9857 | 172.2767 | 153.2345 | 114.3130 | 72.7300 | 51.9647 (83) | |
| Total gains | 524.9296 | 577.9727 | 597.1088 | 618.0250 | 618.3149 | 601.6738 | 578.3249 | 566.2156 | 557.5892 | 532.0684 | 514.3845 | 508.1511 (84) | |

## 7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 (85) | |
| Utilisation factor for gains for living area, nil,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 94.5356 | 95.0049 | 95.4788 | 97.9214 | 98.4250 | 101.0226 | 101.0226 | 101.5587 | 99.9673 | 98.4250 | 97.4229 | 96.4411 | |
| alpha | 7.3024 | 7.3337 | 7.3653 | 7.5281 | 7.5617 | 7.7348 | 7.7348 | 7.7706 | 7.6645 | 7.5617 | 7.4949 | 7.4294 | |
| util living area | 0.9779 | 0.9553 | 0.9153 | 0.8053 | 0.6462 | 0.4513 | 0.3232 | 0.3432 | 0.5293 | 0.8018 | 0.9439 | 0.9811 (86) | |
| MIT | 20.5407 | 20.6712 | 20.8023 | 20.9385 | 20.9889 | 20.9994 | 21.0000 | 20.9999 | 20.9979 | 20.9494 | 20.7611 | 20.5313 (87) | |
| Th 2 | 20.3064 | 20.3097 | 20.3129 | 20.3289 | 20.3321 | 20.3482 | 20.3482 | 20.3515 | 20.3418 | 20.3321 | 20.3257 | 20.3193 (88) | |
| util rest of house | 0.9723 | 0.9449 | 0.8969 | 0.7725 | 0.6030 | 0.4056 | 0.2753 | 0.2949 | 0.4796 | 0.7634 | 0.9295 | 0.9762 (89) | |
| MIT 2 | 19.7858 | 19.9484 | 20.1072 | 20.2723 | 20.3237 | 20.3479 | 20.3482 | 20.3515 | 20.3406 | 20.2882 | 20.0730 | 19.7850 (90) | |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.5557 (91) | |
| MIT | 20.2053 | 20.3500 | 20.4934 | 20.6425 | 20.6933 | 20.7099 | 20.7104 | 20.7118 | 20.7059 | 20.6556 | 20.4554 | 20.1997 (92) | |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 20.2053 | 20.3500 | 20.4934 | 20.6425 | 20.6933 | 20.7099 | 20.7104 | 20.7118 | 20.7059 | 20.6556 | 20.4554 | 20.1997 (93) | |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9714 | 0.9456 | 0.9020 | 0.7882 | 0.6266 | 0.4310 | 0.3019 | 0.3217 | 0.5072 | 0.7825 | 0.9325 | 0.9752 (94) | |
| Useful gains | 509.8908 | 546.5134 | 538.6091 | 487.1506 | 387.4309 | 259.3212 | 174.5927 | 182.1751 | 282.7862 | 416.3673 | 479.6540 | 495.5392 (95) | |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 (96) | |
| Heat loss rate W | 721.9995 | 697.8694 | 628.9382 | 514.6034 | 392.1066 | 259.5424 | 174.6043 | 182.1935 | 283.5708 | 438.4232 | 588.2822 | 711.9365 (97) | |
| Space heating kWh | 157.8089 | 101.7112 | 67.2048 | 19.7660 | 3.4787 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 16.4096 | 78.2123 | 160.9996 (98a) | |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 605.5911 | |
| Solar heating kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (98b) | |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | 157.8089 | 101.7112 | 67.2048 | 19.7660 | 3.4787 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 16.4096 | 78.2123 | 160.9996 (98c) | |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 605.5911 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 9.8598 (99) | |

## 8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ext. temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | |
| Heat loss rate W | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 399.3005 | 314.3430 | 321.1346 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (100) | |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.9906 | 0.9975 | 0.9967 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (101) | |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 395.5557 | 313.5447 | 320.0741 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (102) | |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 646.0689 | 621.6128 | 608.5031 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (103) | |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 180.3695 | 229.2026 | 214.5912 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (104) | |
| Cooled fraction | | | | | | | | | fC = cooled area / (4) = | | | 0.9932 (105) | |
| Intermittency factor (Table 10b) | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 (106) | |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 44.7840 | 56.9088 | 53.2809 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (107) | |
| Space cooling requirement | | | | | | | | | | | | 154.9738 (107) | |

## 9b. Energy requirements

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | 0.0000 (301) | |
| Fraction of space heat from community system | | | | | | | | | | | | 1.0000 (302) | |
| Fraction of heat from community Heat pump-Space and Water | | | | | | | | | | | | 1.0000 (303a) | |
| Factor for control and charging method (Table 4c(3)) for space heating | | | | | | | | | | | | 1.0000 (305) | |
| Factor for charging method (Table 4c(3)) for water heating | | | | | | | | | | | | 1.0000 (305a) | |
| Distribution loss factor (Table 12c) for community heating system | | | | | | | | | | | | 2.0000 (306) | |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 (208) | |
| Space heating: | | | | | | | | | | | | | |
| Space heating requirement | 157.8089 | 101.7112 | 67.2048 | 19.7660 | 3.4787 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 16.4096 | 78.2123 | 160.9996 (98) | |
| Space heat from Heat pump = (98) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 307a | 315.6178 | 203.4225 | 134.4097 | 39.5321 | 6.9575 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 32.8191 | 156.4245 | 321.9991 | |
| Space heating requirement | 315.6178 | 203.4225 | 134.4097 | 39.5321 | 6.9575 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 32.8191 | 156.4245 | 321.9991 (307) | |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | | | | | | | | | | | 0.0000 (308) | |
| Space heating fuel for secondary/supplementary system | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (309) | |
| Water heating | | | | | | | | | | | | | |
| Annual water heating requirement | 226.8306 | 200.7835 | 213.7766 | 193.1026 | 188.1568 | 167.2792 | 161.0261 | 173.1795 | 173.0596 | 194.1557 | 205.6912 | 226.3076 (64) | |
| Water heat from Heat pump = (64) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 310a | 453.6612 | 401.5671 | 427.5532 | 386.2051 | 376.3136 | 334.5584 | 322.0523 | 346.3589 | 346.1192 | 388.3114 | 411.3824 | 452.6151 | |
| Water heating fuel | 453.6612 | 401.5671 | 427.5532 | 386.2051 | 376.3136 | 334.5584 | 322.0523 | 346.3589 | 346.1192 | 388.3114 | 411.3824 | 452.6151 (310) | |
| Cooling System Energy Efficiency Ratio | | | | | | | | | | | | 2.6000 (314) | |
| Space coolin | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 17.2246 | 21.8880 | 20.4927 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (315) | |
| Pumps and Fa | 16.5588 | 14.9563 | 16.5588 | 16.0247 | 16.5588 | 16.0247 | 16.5588 | 16.5588 | 16.0247 | 16.5588 | 16.0247 | 16.5588 (331) | |
| Lighting | 19.9930 | 16.0391 | 14.4415 | 10.5804 | 8.1726 | 6.6771 | 7.4554 | 9.6907 | 12.5873 | 16.5152 | 18.6539 | 20.5487 (332) | |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333a)m | -4.7593 | -7.7080 | -12.8038 | -16.5848 | -19.8202 | -19.2382 | -18.9676 | -16.8666 | -13.5474 | -9.6249 | -5.5512 | -3.9949 (333a) | |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (334a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335a) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (333b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335b) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - community heating | 1211.1822 | (307) |
| Space heating fuel - secondary | 0.0000 | (309) |
| Water heating fuel - community heating | 4646.6981 | (310) |
| Efficiency of water heater | 0.0000 | (311) |
| Electricity used for heat distribution | 12.1118 | (313) |
| Space cooling fuel | 59.6053 | (321) |
| | | |
| Electricity for pumps and fans: | | |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8820) | | |
| mechanical ventilation fans (SFP = 0.8820) | 194.9666 | (330a) |
| Total electricity for the above, kWh/year | 194.9666 | (331) |
| Electricity for lighting (calculated in Appendix L) | 161.3551 | (332) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -149.4669 | (333) |
| Wind generation | 0.0000 | (334) |
| Hydro-electric generation (Appendix N) | 0.0000 | (335a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (335) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (336) |
| Energy used | 0.0000 | (337) |
| Total delivered energy for all uses | 6124.3404 | (338) |

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12b. Carbon dioxide emissions - Community heating scheme

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (367) |
| Space and Water heating from Heat pump | 2092.1001 | 0.1583 | 68.4639 | (367) |
| Electrical energy for heat distribution (space & water) | 12.1118 | 0.0000 | 8.4583 | (372) |
| Overall CO2 factor for heat network | | | 0.0530 | (386) |
| Total CO2 associated with community systems | | | 310.5410 | (373) |
| Space and water heating | | | 310.5410 | (376) |
| Space cooling | 59.6053 | 0.1139 | 6.7917 | (377) |
| Pumps, fans and electric keep-hot | 194.9666 | 0.1387 | 27.0443 | (378) |
| Energy for lighting | 161.3551 | 0.1443 | 23.2885 | (379) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -149.4669 | 0.1319 | -19.7101 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -19.7101 | (380) |
| Total CO2, kg/year | | | 347.9554 | (383) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 5.6700 | (384) |

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13b. Primary energy - Community heating scheme

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| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (467a) |
| Space and Water heating from Heat pump | 2092.1001 | 1.5859 | 686.0042 | (467) |
| Electrical energy for heat distribution (space & water) | 12.1118 | 0.0000 | 89.8622 | (472) |
| Overall CO2 factor for heat network | | | 0.5632 | (486) |
| Total CO2 associated with community systems | | | 3299.2273 | (473) |
| Space and water heating | | | 3299.2273 | (476) |
| Space cooling | 59.6053 | 1.4200 | 84.6389 | (477) |
| Pumps, fans and electric keep-hot | 194.9666 | 1.5128 | 294.9455 | (478) |
| Energy for lighting | 161.3551 | 1.5338 | 247.4918 | (479) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -149.4669 | 1.4872 | -222.2886 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -222.2886 | (480) |
| Total Primary energy kWh/year | | | 3704.0149 | (483) |
| Dwelling Primary energy Rate (DPER) | | | 60.3100 | (484) |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 61.4200 | (1b) | x 2.9500 | (2b) | = 181.1890 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 61.4200 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | | = 181.1890 | (5) |

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2. Ventilation rate

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m3 per hour

| | | |
|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 (6a) |
| Number of open flues | 0 * 20 = | 0.0000 (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 (6f) |
| Number of intermittent extract fans | 2 * 10 = | 20.0000 (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 (7c) |

| | | Air changes per hour | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 20.0000 / (5) = | 0.1104 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3604 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.3604 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.4595 | 0.4505 | 0.4415 | 0.3964 | 0.3874 | 0.3424 | 0.3424 | 0.3334 | 0.3604 | 0.3874 | 0.4054 | 0.4234 | (22b) |
| Effective ac | 0.6056 | 0.6015 | 0.5974 | 0.5786 | 0.5750 | 0.5586 | 0.5586 | 0.5556 | 0.5649 | 0.5750 | 0.5822 | 0.5897 | (25) |

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## 3. Heat losses and heat loss parameter

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| Element | Gross | Openings | NetArea | U-value | A x U | K-value | A x K | |
|---|---|---|---|---|---|---|---|---|
| | m2 | m2 | m2 | W/m2K | W/K | kJ/m2K | kJ/K | |
| Main dwelling | | | | | | | | |
| TER Opaque door | | | 1.8900 | 1.0000 | 1.8900 | | | (26) |
| TER Opening Type | | | 7.5600 | 1.1450 | 8.6565 | | | (27) |
| External Walls | 30.2600 | 7.5600 | 22.7000 | 0.1800 | 4.0860 | | | (29a) |
| Wall to Communal Corridor | 14.8900 | 1.8900 | 13.0000 | 0.1800 | 2.3400 | | | (29a) |
| External Roof | 61.4300 | | 61.4300 | 0.1100 | 6.7573 | | | (30) |
| Total net area of external elements Aum(A, m2) | | | 106.5800 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 23.7298 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 42 | | | 26.6100 | 0.0000 | 0.0000 | | | (32) |
| Party Wall to Unit 44 | | | 23.1500 | 0.0000 | 0.0000 | | | (32) |

| | | |
|---|---|---|
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | 251.5262 | (35) |

List of Thermal Bridges

| K1 Element | Length | Psi-value | Total |
|---|---|---|---|
| E1 Steel lintel with perforated steel base plate | 4.7700 | 0.0500 | 0.2385 |
| E3 Sill | 1.3600 | 0.0500 | 0.0680 |
| E4 Jamb | 11.4600 | 0.0500 | 0.5730 |
| E23 Balcony within or between dwellings, balcony support penetrates wall insulation | 3.9400 | 0.0200 | 0.0788 |
| E18 Party wall between dwellings | 5.9000 | 0.0600 | 0.3540 |
| E7 Party floor between dwellings (in blocks of flats) | 5.0500 | 0.0700 | 0.3535 |
| E24 Eaves (insulation at ceiling level - inverted) | 3.1070 | 0.2400 | 0.7457 |
| E15 Flat roof with parapet | 7.0725 | 0.5600 | 3.9606 |
| E25 Staggered party wall between dwellings | 2.9500 | 0.0600 | 0.1770 |
| E17 Corner (inverted - internal area greater than external area) | 2.9500 | -0.0900 | -0.2655 |

| | | | |
|---|---|---|---|
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | 6.2836 | (36) |
| Point Thermal bridges | (36a) = | 0.0000 | |
| Total fabric heat loss | (33) + (36) + (36a) = | 30.0134 | (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 36.2081 | 35.9630 | 35.7228 | 34.5943 | 34.3832 | 33.4004 | 33.4004 | 33.2184 | 33.7790 | 34.3832 | 34.8103 | 35.2568 | (38) |
| Heat transfer coeff | 66.2215 | 65.9764 | 65.7361 | 64.6077 | 64.3966 | 63.4138 | 63.4138 | 63.2318 | 63.7923 | 64.3966 | 64.8237 | 65.2702 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 64.6067 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.0782 | 1.0742 | 1.0703 | 1.0519 | 1.0485 | 1.0325 | 1.0325 | 1.0295 | 1.0386 | 1.0485 | 1.0554 | 1.0627 | (40) |
| HLP (average) | | | | | | | | | | | | 1.0519 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

---

## 4. Water heating energy requirements (kWh/year)

---

| | | |
|---|---|---|
| Assumed occupancy | 2.0215 | (42) |

Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 58.1132 | 57.2399 | 55.9673 | 53.5324 | 51.7355 | 49.7316 | 48.5926 | 49.8556 | 51.2400 | 53.3916 | 55.8788 | 57.8906 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 25.1138 | 24.7409 | 24.2156 | 23.2472 | 22.5221 | 21.7180 | 21.2837 | 21.8052 | 22.3731 | 23.2335 | 24.2218 | 25.0289 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 35.3320 | 34.0472 | 32.7624 | 31.4776 | 30.1928 | 28.9080 | 28.9080 | 30.1928 | 31.4776 | 32.7624 | 34.0472 | 35.3320 | (42c) |

| | | |
|---|---|---|
| Average daily hot water use (litres/day) | 108.9830 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 118.5591 | 116.0280 | 112.9454 | 108.2572 | 104.4504 | 100.3576 | 98.7843 | 101.8536 | 105.0908 | 109.3875 | 114.1479 | 118.2516 | (44) |
| Energy conte | 187.7687 | 165.2223 | 173.5928 | 148.1987 | 140.6103 | 123.4014 | 119.4710 | 126.1160 | 129.5874 | 148.4378 | 162.6246 | 185.1534 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1810.1844 | |

Distribution loss (46)m = 0.15 x (45)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 28.1653 | 24.7833 | 26.0389 | 22.2298 | 21.0915 | 18.5102 | 17.9207 | 18.9174 | 19.4381 | 22.2657 | 24.3937 | 27.7730 | (46) |

| | | |
|---|---|---|
| Water storage loss: | | |
| Store volume | 150.0000 | (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | 1.3938 | (48) |
| Temperature factor from Table 2b | 0.5400 | (49) |
| Enter (49) or (54) in (55) | 0.7527 | (55) |

Total storage loss

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (56) |

If cylinder contains dedicated solar storage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (57) |
| Primary loss 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |

Total heat required for water heating calculated for each month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 234.3636 | 207.3081 | 220.1877 | 193.2906 | 187.2052 | 168.4932 | 166.0659 | 172.7109 | 174.6792 | 195.0327 | 207.7164 | 231.7483 | (62) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WWHRS | -26.5670 | -23.4960 | -24.6037 | -20.3728 | -18.9867 | -16.2471 | -15.2291 | -16.1946 | -16.8099 | -19.8170 | -22.4502 | -26.0750 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | | | | | | | | | | | | | |
| | 207.7966 | 183.8120 | 195.5840 | 172.9177 | 168.2184 | 152.2461 | 150.8369 | 156.5164 | 157.8694 | 175.2157 | 185.2662 | 205.6733 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2111.9528 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2112 | (64) |
| Electric shower(s) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | | | | | | | | | | | | | |
| | 99.7090 | 88.6050 | 94.9955 | 85.3496 | 84.0288 | 77.1044 | 77.0000 | 79.2095 | 79.1613 | 86.6315 | 90.1462 | 98.8394 | (65) |

## 5. Internal gains (see Table 5 and 5a)

| Metabolic gains (Table 5), Watts | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 101.0743 | 101.0743 | 101.0743 | 101.0743 | 101.0743 | 101.0743 | 101.0743 | 101.0743 | 101.0743 | 101.0743 | 101.0743 | 101.0743 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 98.2663 | 108.7948 | 98.2663 | 101.5418 | 98.2663 | 101.5418 | 98.2663 | 98.2663 | 101.5418 | 98.2663 | 101.5418 | 98.2663 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 176.5135 | 178.3451 | 173.7294 | 163.9031 | 151.4991 | 139.8412 | 132.0529 | 130.2213 | 134.8370 | 144.6633 | 157.0673 | 168.7252 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 33.1074 | 33.1074 | 33.1074 | 33.1074 | 33.1074 | 33.1074 | 33.1074 | 33.1074 | 33.1074 | 33.1074 | 33.1074 | 33.1074 | (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.0000 | 3.0000 | 3.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | | | | | | | | | | | | | |
| | -80.8594 | -80.8594 | -80.8594 | -80.8594 | -80.8594 | -80.8594 | -80.8594 | -80.8594 | -80.8594 | -80.8594 | -80.8594 | -80.8594 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 134.0175 | 131.8527 | 127.6822 | 118.5410 | 112.9420 | 107.0895 | 103.4947 | 106.4644 | 109.9462 | 116.4402 | 125.2030 | 132.8487 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 465.1195 | 475.3149 | 456.0001 | 440.3082 | 419.0297 | 401.7948 | 387.1361 | 388.2742 | 399.6473 | 415.6920 | 440.1343 | 456.1625 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Southeast | 7.5600 | 36.7938 | 0.6300 | 0.7000 | 0.7700 | 85.0097 | (77) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 85.0097 | 144.8030 | 198.1258 | 245.4875 | 274.9664 | 272.9780 | 263.1800 | 241.1873 | 214.5284 | 160.0382 | 101.8221 | 72.7506 | (83) |
| Total gains | 550.1292 | 620.1179 | 654.1259 | 685.7957 | 693.9961 | 674.7728 | 650.3161 | 629.4615 | 614.1757 | 575.7302 | 541.9564 | 528.9131 | (84) |

## 7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, ni1,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 64.8025 | 65.0432 | 65.2809 | 66.4211 | 66.6389 | 67.6717 | 67.6717 | 67.8665 | 67.2701 | 66.6389 | 66.1998 | 65.7469 | |
| alpha | 5.3202 | 5.3362 | 5.3521 | 5.4281 | 5.4426 | 5.5114 | 5.5114 | 5.5244 | 5.4847 | 5.4426 | 5.4133 | 5.3831 | |
| util living area | | | | | | | | | | | | | |
| | 0.9876 | 0.9756 | 0.9540 | 0.8940 | 0.7765 | 0.5864 | 0.4267 | 0.4586 | 0.6798 | 0.9010 | 0.9736 | 0.9897 | (86) |
| MIT | 20.0099 | 20.1948 | 20.4199 | 20.7018 | 20.8938 | 20.9819 | 20.9973 | 20.9961 | 20.9598 | 20.7328 | 20.3401 | 19.9886 | (87) |
| Th 2 | 20.0187 | 20.0220 | 20.0252 | 20.0403 | 20.0431 | 20.0564 | 20.0564 | 20.0588 | 20.0513 | 20.0431 | 20.0374 | 20.0314 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9839 | 0.9685 | 0.9404 | 0.8641 | 0.7204 | 0.5064 | 0.3365 | 0.3666 | 0.6005 | 0.8669 | 0.9646 | 0.9865 | (89) |
| MIT 2 | 18.8904 | 19.1246 | 19.4056 | 19.7518 | 19.9585 | 20.0466 | 20.0555 | 20.0575 | 20.0266 | 19.7957 | 19.3210 | 18.8730 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.5557 | (91) |
| MIT | 19.5125 | 19.7193 | 19.9692 | 20.2797 | 20.4782 | 20.5663 | 20.5789 | 20.5790 | 20.5452 | 20.3164 | 19.8873 | 19.4929 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.5125 | 19.7193 | 19.9692 | 20.2797 | 20.4782 | 20.5663 | 20.5789 | 20.5790 | 20.5452 | 20.3164 | 19.8873 | 19.4929 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9814 | 0.9659 | 0.9395 | 0.8722 | 0.7471 | 0.5503 | 0.3867 | 0.4178 | 0.6430 | 0.8777 | 0.9629 | 0.9843 | (94) |
| Useful gains | 539.9143 | 598.9620 | 614.5374 | 598.1826 | 518.4727 | 371.3333 | 251.4770 | 262.9760 | 394.9054 | 505.3072 | 521.8334 | 520.6257 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | | | | | | | | | | | | | |
| | 1007.3934 | 977.7235 | 885.4148 | 735.2155 | 565.2867 | 378.3472 | 252.3153 | 264.2484 | 411.1521 | 625.7052 | 828.9201 | 998.1714 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 347.8045 | 254.5277 | 201.5328 | 98.6637 | 34.8296 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 89.5762 | 221.1024 | 355.2940 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 1603.3309 | |
| Solar heating kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | | | | | | | | | | | | | |
| | 347.8045 | 254.5277 | 201.5328 | 98.6637 | 34.8296 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 89.5762 | 221.1024 | 355.2940 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 1603.3309 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 26.1044 | (99) |

## 9a. Energy requirements - Individual heating systems, including micro-CHP

| | | |
|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | 0.0000 | (201) |
| Fraction of space heat from main system(s) | 1.0000 | (202) |
| Efficiency of main space heating system 1 (in %) | 92.3000 | (206) |
| Efficiency of main space heating system 2 (in %) | 0.0000 | (207) |
| Efficiency of secondary/supplementary heating system, % | 0.0000 | (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement | | | | | | | | | | | | | |
| | 347.8045 | 254.5277 | 201.5328 | 98.6637 | 34.8296 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 89.5762 | 221.1024 | 355.2940 | (98) |

Space heating efficiency (main heating system 1)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 92.3000 | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.3000 | 92.3000 | 92.3000 | (210) |

Space heating fuel (main heating system)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 376.8196 | 275.7614 | 218.3454 | 106.8946 | 37.7352 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 97.0489 | 239.5476 | 384.9339 | (211) |

Space heating efficiency (main heating system 2)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (212) |

Space heating fuel (main heating system 2)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (213) |

Space heating fuel (secondary)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (215) |

Water heating

Water heating requirement

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 207.7966 | 183.8120 | 195.5840 | 172.9177 | 168.2184 | 152.2461 | 150.8369 | 156.5164 | 157.8694 | 175.2157 | 185.2662 | 205.6733 | (64) |

Efficiency of water heater

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | 79.8000 | (216) |
| (217)m | 85.2059 | 84.7900 | 84.1271 | 82.8506 | 81.2119 | 79.8000 | 79.8000 | 79.8000 | 79.8000 | 82.6332 | 84.4574 | 85.2739 | (217) |

Fuel for water heating, kWh/month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 243.8757 | 216.7851 | 232.4865 | 208.7104 | 207.1353 | 190.7846 | 189.0186 | 196.1358 | 197.8313 | 212.0405 | 219.3606 | 241.1914 | (219) |

Space cooling fuel requirement

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (221) |
| Pumps and Fa | 7.3041 | 6.5973 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | (231) |
| Lighting | 20.4178 | 16.3799 | 14.7483 | 10.8052 | 8.3463 | 6.8190 | 7.6137 | 9.8966 | 12.8548 | 16.8661 | 19.0503 | 20.9853 | (232) |

Electricity generated by PVs (Appendix M) (negative quantity)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (233a)m | -13.6872 | -20.5652 | -31.4792 | -37.7678 | -42.8411 | -40.7762 | -40.2947 | -36.9934 | -31.5397 | -24.5511 | -15.4961 | -11.6911 | (233a) |

Electricity generated by wind turbines (Appendix M) (negative quantity)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234a) |

Electricity generated by hydro-electric generators (Appendix M) (negative quantity)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235a) |

Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235c) |

Electricity generated by PVs (Appendix M) (negative quantity)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (233b)m | -4.2990 | -9.2978 | -18.9637 | -29.2049 | -39.3308 | -39.7740 | -39.2920 | -32.9245 | -23.6964 | -13.5130 | -5.8087 | -3.3799 | (233b) |

Electricity generated by wind turbines (Appendix M) (negative quantity)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234b) |

Electricity generated by hydro-electric generators (Appendix M) (negative quantity)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235b) |

Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235d) |

Annual totals kWh/year

| | | |
|---|---|---|
| Space heating fuel - main system 1 | 1737.0866 | (211) |
| Space heating fuel - main system 2 | 0.0000 | (213) |
| Space heating fuel - secondary | 0.0000 | (215) |
| Efficiency of water heater | 79.8000 | |
| Water heating fuel used | 2555.3558 | (219) |
| Space cooling fuel | 0.0000 | (221) |

Electricity for pumps and fans:

| | | |
|---|---|---|
| Total electricity for the above, kWh/year | 86.0000 | (231) |
| Electricity for lighting (calculated in Appendix L) | 164.7833 | (232) |

Energy saving/generation technologies (Appendices M ,N and Q)

| | | |
|---|---|---|
| PV generation | -607.1675 | (233) |
| Wind generation | 0.0000 | (234) |
| Hydro-electric generation (Appendix N) | 0.0000 | (235a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (235) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (236) |
| Energy used | 0.0000 | (237) |
| Total delivered energy for all uses | 3936.0581 | (238) |

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12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 1737.0866 | 0.2100 | 364.7882 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2555.3558 | 0.2100 | 536.6247 | (264) |
| Space and water heating | | | 901.4129 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 164.7833 | 0.1443 | 23.7833 | (268) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -347.6827 | 0.1333 | -46.3350 | |
| PV Unit electricity exported | -259.4848 | 0.1252 | -32.4817 | |
| Total | | | -78.8167 | (269) |
| Total CO2, kg/year | | | 858.3088 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 13.9700 | (273) |

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13a. Primary energy - Individual heating systems including micro-CHP

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| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 1737.0866 | 1.1300 | 1962.9078 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2555.3558 | 1.1300 | 2887.5520 | (278) |
| Space and water heating | | | 4850.4598 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 164.7833 | 1.5338 | 252.7501 | (282) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -347.6827 | 1.4925 | -518.9029 | |
| PV Unit electricity exported | -259.4848 | 0.4595 | -119.2212 | |
| Total | | | -638.1241 | (283) |
| Total Primary energy kWh/year | | | 4595.1866 | (286) |
| Target Primary Energy Rate (TPER) | | | 74.8200 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Property Reference** | Unit 44 | **Issued on Date** | 17/05/2025 |
| **Assessment Reference** | 00001 | **Prop Type Ref** | |
| **Property** | | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 74 C | **DER** | 7.73 | **TER** | 18.24 |
| **Environmental** | 94 A | **% DER < TER** | | | 57.62 |
| **$CO_2$ Emissions (t/year)** | 0.43 | **DFEE** | 51.86 | **TFEE** | 54.14 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 4.21 |
| **% DPER < TPER** | 16.80 | **DPER** | 81.18 | **TPER** | 97.57 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Robert Arnold | **Assessor ID** | BA04-0001 |
| **Client** | | | |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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## 1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 62.8000 (1b) | x | 2.9500 (2b) | = | 185.2600 | (1b) - (3b) (4) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 62.8000 | | | | | |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = | 185.2600 | (5) |

---

## 2. Ventilation rate

---

| | | m3 per hour | |
|---|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 | (6a) |
| Number of open flues | 0 * 20 = | 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | 0 * 10 = | 0.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |

| | | Air changes per hour | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 0.0000 / (5) = | 0.0000 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 3.0000 | (17) |
| Infiltration rate | | 0.1500 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.1500 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.1912 | 0.1875 | 0.1837 | 0.1650 | 0.1612 | 0.1425 | 0.1425 | 0.1388 | 0.1500 | 0.1612 | 0.1687 | 0.1762 | (22b) |

Balanced mechanical ventilation with heat recovery

| | | |
|---|---|---|
| If mechanical ventilation | 0.5000 | (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | 0.5000 | (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | 81.0000 | (23c) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective ac | 0.2862 | 0.2825 | 0.2787 | 0.2600 | 0.2562 | 0.2375 | 0.2375 | 0.2337 | 0.2450 | 0.2562 | 0.2637 | 0.2712 | (25) |

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## 3. Heat losses and heat loss parameter

---

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| Windows | | | 16.4300 | 1.0536 | 17.3113 | | | (27) |
| Front Door | | | 2.5700 | 1.4000 | 3.5980 | | | (26) |
| External Walls | 69.2800 | 19.0000 | 50.2800 | 0.1500 | 7.5420 | 150.0000 | 7542.0000 | (29a) |
| External Roof | 62.8000 | | 62.8000 | 0.1000 | 6.2800 | 9.0000 | 565.2000 | (30) |
| Total net area of external elements Aum(A, m2) | | | 132.0800 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 34.7313 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 43 | | | 23.1500 | 0.0000 | 0.0000 | 110.0000 | 2546.5000 | (32) |
| Party Floor | | | 62.8000 | | | 80.0000 | 5024.0000 | (32d) |
| Internal Walls | | | 158.9500 | | | 9.0000 | 1430.5500 | (32c) |

| | | |
|---|---|---|
| Heat capacity Cm = Sum(A x k) | (28)...(30) + (32) + (32a)...(32e) = 17108.2500 | (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | 272.4244 | (35) |

List of Thermal Bridges

| K1 Element | Length | Psi-value | Total |
|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| E1 Steel lintel with perforated steel base plate | 10.8600 | 0.0500 | 0.5430 | |
| E3 Sill | 7.2000 | 0.0500 | 0.3600 | |
| E4 Jamb | 27.9100 | 0.0500 | 1.3955 | |
| E7 Party floor between dwellings (in blocks of flats) | 8.8600 | 0.0350 | 0.3101 | |
| E15 Flat roof with parapet | 23.4800 | 0.5600 | 13.1488 | |
| E16 Corner (normal) | 8.8500 | 0.0900 | 0.7965 | |
| E18 Party wall between dwellings | 2.9500 | 0.0300 | 0.0885 | |
| E25 Staggered party wall between dwellings | 2.9500 | 0.0300 | 0.0885 | |
| E24 Eaves (insulation at ceiling level - inverted) | 10.6550 | 0.1200 | 1.2786 | |
| E23 Balcony within or between dwellings, balcony support penetrates wall insulation | 3.9460 | 0.0200 | 0.0789 | |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 18.0884 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 52.8197 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 17.5001 | 17.2709 | 17.0416 | 15.8953 | 15.6660 | 14.5198 | 14.5198 | 14.2905 | 14.9783 | 15.6660 | 16.1246 | 16.5831 | (38) |

Heat transfer coeff

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 70.3198 | 70.0906 | 69.8613 | 68.7150 | 68.4858 | 67.3395 | 67.3395 | 67.1102 | 67.7980 | 68.4858 | 68.9443 | 69.4028 | (39) |

Average = Sum(39)m / 12 = 68.6577

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.1197 | 1.1161 | 1.1124 | 1.0942 | 1.0905 | 1.0723 | 1.0723 | 1.0686 | 1.0796 | 1.0905 | 1.0978 | 1.1051 | (40) |
| HLP (average) | | | | | | | | | | | | 1.0933 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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## 4. Water heating energy requirements (kWh/year)

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Assumed occupancy 2.0596 (42)

Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 57.2678 | 56.3911 | 55.0990 | 53.1112 | 51.3303 | 48.8388 | 46.8681 | 49.1719 | 50.3306 | 52.7984 | 55.3683 | 57.2162 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 24.8226 | 24.4479 | 23.9148 | 23.1165 | 22.3971 | 21.4067 | 20.6553 | 21.5741 | 22.0563 | 23.0377 | 24.0580 | 24.8029 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 35.7223 | 34.4233 | 33.1243 | 31.8253 | 30.5263 | 29.2273 | 29.2273 | 30.5263 | 31.8253 | 33.1243 | 34.4233 | 35.7223 | (42c) |

Average daily hot water use (litres/day) 108.2878 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 117.8128 | 115.2623 | 112.1381 | 108.0531 | 104.2537 | 99.4728 | 96.7508 | 101.2724 | 104.2123 | 108.9604 | 113.8496 | 117.7414 | (44) |
| Energy conte | 173.4407 | 152.5153 | 160.2431 | 141.1444 | 134.3415 | 115.0370 | 106.9125 | 119.1994 | 120.8810 | 140.4064 | 153.8715 | 172.9119 | (45) |

Energy content (annual) Total = Sum(45)m = 1690.9047

Distribution loss (46)m = 0.15 x (45)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 26.0161 | 22.8773 | 24.0365 | 21.1717 | 20.1512 | 17.2555 | 16.0369 | 17.8799 | 18.1322 | 21.0610 | 23.0807 | 25.9368 | (46) |

Water storage loss:

Store volume 110.0000 (47)

b) If manufacturer declared loss factor is not known :

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.0152 (51)

Volume factor from Table 2a 1.0294 (52)

Temperature factor from Table 2b 0.6000 (53)

Enter (49) or (54) in (55) 1.0327 (55)

Total storage loss

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (56) |

If cylinder contains dedicated solar storage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (57) |
| Primary loss 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |

Total heat required for water heating calculated for each month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 228.7175 | 202.4428 | 215.5199 | 194.6380 | 189.6183 | 168.5307 | 162.1893 | 174.4762 | 174.3747 | 195.6832 | 207.3652 | 228.1887 | (62) |
| WWHRS 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63a) |
| PV diverter -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |

Output from w/h

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 228.7175 | 202.4428 | 215.5199 | 194.6380 | 189.6183 | 168.5307 | 162.1893 | 174.4762 | 174.3747 | 195.6832 | 207.3652 | 228.1887 | (64) |

Total per year (kWh/year) = Sum(64)m = 2341.7445 (64)

12Total per year (kWh/year) 2342 (64)

Electric shower(s)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)

Heat gains from water heating, kWh/month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 101.8905 | 90.6533 | 97.5023 | 89.7254 | 88.8900 | 81.0447 | 79.7698 | 83.8553 | 82.9879 | 90.9066 | 93.9572 | 101.7147 | (65) |

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## 5. Internal gains (see Table 5 and 5a)

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Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 102.9797 | 102.9797 | 102.9797 | 102.9797 | 102.9797 | 102.9797 | 102.9797 | 102.9797 | 102.9797 | 102.9797 | 102.9797 | 102.9797 | (66) |

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 90.7638 | 100.4885 | 90.7638 | 93.7892 | 90.7638 | 93.7892 | 90.7638 | 90.7638 | 93.7892 | 90.7638 | 93.7892 | 90.7638 | (67) |

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 179.9493 | 181.8167 | 177.1111 | 167.0935 | 154.4481 | 142.5632 | 134.6234 | 132.7560 | 137.4616 | 147.4792 | 160.1246 | 172.0095 | (68) |

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 33.2980 | 33.2980 | 33.2980 | 33.2980 | 33.2980 | 33.2980 | 33.2980 | 33.2980 | 33.2980 | 33.2980 | 33.2980 | 33.2980 | (69) |
| Pumps, fans 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (70) |

Losses e.g. evaporation (negative values) (Table 5)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| -82.3837 | -82.3837 | -82.3837 | -82.3837 | -82.3837 | -82.3837 | -82.3837 | -82.3837 | -82.3837 | -82.3837 | -82.3837 | -82.3837 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 136.9496 | 134.9007 | 131.0514 | 124.6187 | 119.4758 | 112.5621 | 107.2175 | 112.7087 | 115.2610 | 122.1863 | 130.4961 | 136.7133 | (72) |

Total internal gains

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 461.5566 | 471.0998 | 452.8202 | 439.3953 | 418.5816 | 402.8085 | 386.4986 | 390.1224 | 400.4057 | 414.3232 | 438.3039 | 453.3804 | (73) |

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## 6. Solar gains

---

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Northeast | 6.2800 | 11.2829 | 0.4500 | 0.7000 | 0.7700 | 15.4677 | (75) |
| Southeast | 7.5700 | 36.7938 | 0.4500 | 0.7000 | 0.7700 | 60.8016 | (77) |
| Northwest | 2.5800 | 11.2829 | 0.4500 | 0.7000 | 0.7700 | 6.3546 | (81) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 82.6238 | 147.9874 | 221.7361 | 307.0131 | 373.3361 | 383.5930 | 364.4326 | 312.9718 | 250.9556 | 168.7488 | 100.2843 | 69.8546 | (83) |
| Total gains | 544.1804 | 619.0872 | 674.5563 | 746.4085 | 791.9177 | 786.4015 | 750.9312 | 703.0943 | 651.3613 | 583.0719 | 538.5882 | 523.2351 | (84) |

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| tau | 67.5811 | 67.8021 | 68.0246 | 69.1594 | 69.3909 | 70.5722 | 70.5722 | 70.8132 | 70.0949 | 69.3909 | 68.9294 | 68.4741 | |
| alpha | 5.5054 | 5.5201 | 5.5350 | 5.6106 | 5.6261 | 5.7048 | 5.7048 | 5.7209 | 5.6730 | 5.6261 | 5.5953 | 5.5649 | |
| util living area | 0.9922 | 0.9833 | 0.9622 | 0.8905 | 0.7438 | 0.5399 | 0.3934 | 0.4368 | 0.6834 | 0.9199 | 0.9822 | 0.9936 | (86) |
| MIT | 19.9835 | 20.1668 | 20.4161 | 20.7316 | 20.9228 | 20.9896 | 20.9986 | 20.9975 | 20.9635 | 20.7168 | 20.3095 | 19.9623 | (87) |
| Th 2 | 19.9847 | 19.9877 | 19.9907 | 20.0056 | 20.0086 | 20.0235 | 20.0235 | 20.0265 | 20.0175 | 20.0086 | 20.0026 | 19.9966 | (88) |
| util rest of house | 0.9895 | 0.9777 | 0.9497 | 0.8580 | 0.6831 | 0.4613 | 0.3068 | 0.3456 | 0.6002 | 0.8881 | 0.9753 | 0.9914 | (89) |
| MIT 2 | 18.8243 | 19.0575 | 19.3693 | 19.7522 | 19.9505 | 20.0184 | 20.0231 | 20.0258 | 19.9963 | 19.7471 | 19.2509 | 18.8062 | (90) |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.5739 | (91) |
| MIT | 19.4896 | 19.6941 | 19.9701 | 20.3143 | 20.5085 | 20.5758 | 20.5829 | 20.5834 | 20.5513 | 20.3036 | 19.8584 | 19.4696 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.4896 | 19.6941 | 19.9701 | 20.3143 | 20.5085 | 20.5758 | 20.5829 | 20.5834 | 20.5513 | 20.3036 | 19.8584 | 19.4696 | (93) |

8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9879 | 0.9758 | 0.9494 | 0.8689 | 0.7148 | 0.5062 | 0.3565 | 0.3980 | 0.6467 | 0.8987 | 0.9741 | 0.9899 | (94) |
| Useful gains | 537.5823 | 604.0961 | 640.4276 | 648.5816 | 566.0332 | 398.0582 | 267.7221 | 279.8645 | 421.2515 | 523.9900 | 524.6187 | 517.9674 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | 1068.1273 | 1036.9252 | 941.0377 | 784.3320 | 603.2588 | 402.4058 | 268.2076 | 280.7496 | 437.3879 | 664.5581 | 879.6201 | 1059.7564 | (97) |
| Space heating kWh | 394.7255 | 290.8612 | 223.6539 | 97.7402 | 27.6959 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 104.5827 | 255.6010 | 403.0910 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 1797.9513 | |
| Solar heating kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | 394.7255 | 290.8612 | 223.6539 | 97.7402 | 27.6959 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 104.5827 | 255.6010 | 403.0910 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 1797.9513 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 28.6298 | (99) |

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ext. temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | |
| Heat loss rate W | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 632.9911 | 498.3121 | 510.0376 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (100) |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.9500 | 0.9778 | 0.9673 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (101) |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 601.3504 | 487.2614 | 493.3346 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (102) |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 871.6515 | 832.6526 | 777.5871 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 194.6168 | 256.9710 | 211.4839 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (104) |
| Cooled fraction | | | | | | | | | fC = cooled area / (4) = | | | 0.9873 | (105) |
| Intermittency factor (Table 10b) | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | (106) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 48.0344 | 63.4244 | 52.1975 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) |
| Space cooling requirement | | | | | | | | | | | | 163.6562 | (107) |

9b. Energy requirements

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | 0.0000 | (301) |
| Fraction of space heat from community system | | | | | | | | | | | | 1.0000 | (302) |
| Fraction of heat from community Heat pump-Space and Water | | | | | | | | | | | | 1.0000 | (303a) |
| Factor for control and charging method (Table 4c(3)) for space heating | | | | | | | | | | | | 1.0000 | (305) |
| Factor for charging method (Table 4c(3)) for water heating | | | | | | | | | | | | 1.0000 | (305a) |
| Distribution loss factor (Table 12c) for community heating system | | | | | | | | | | | | 2.0000 | (306) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 | (208) |
| Space heating: | | | | | | | | | | | | | |
| Space heating requirement | 394.7255 | 290.8612 | 223.6539 | 97.7402 | 27.6959 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 104.5827 | 255.6010 | 403.0910 | (98) |
| Space heat from Heat pump = (98) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 307a | 789.4509 | 581.7224 | 447.3077 | 195.4805 | 55.3918 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 209.1653 | 511.2019 | 806.1820 | |
| Space heating requirement | 789.4509 | 581.7224 | 447.3077 | 195.4805 | 55.3918 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 209.1653 | 511.2019 | 806.1820 | (307) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | | | | | | | | | | | 0.0000 | (308) |
| Space heating fuel for secondary/supplementary system | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (309) |
| Water heating | | | | | | | | | | | | | |
| Annual water heating requirement | 228.7175 | 202.4428 | 215.5199 | 194.6380 | 189.6183 | 168.5307 | 162.1893 | 174.4762 | 174.3747 | 195.6832 | 207.3652 | 228.1887 | (64) |
| Water heat from Heat pump = (64) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 310a | 457.4351 | 404.8855 | 431.0397 | 389.2761 | 379.2365 | 337.0613 | 324.3785 | 348.9525 | 348.7494 | 391.3665 | 414.7304 | 456.3775 | |
| Water heating fuel | 457.4351 | 404.8855 | 431.0397 | 389.2761 | 379.2365 | 337.0613 | 324.3785 | 348.9525 | 348.7494 | 391.3665 | 414.7304 | 456.3775 | (310) |
| Cooling System Energy Efficiency Ratio | | | | | | | | | | | | 2.6000 | (314) |
| Space coolin | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 18.4748 | 24.3940 | 20.0759 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (315) |
| Pumps and Fa | 16.9309 | 15.2924 | 16.9309 | 16.3847 | 16.9309 | 16.3847 | 16.9309 | 16.9309 | 16.3847 | 16.9309 | 16.3847 | 16.9309 | (331) |
| Lighting | 18.6267 | 14.9430 | 13.4545 | 9.8574 | 7.6141 | 6.2208 | 6.9458 | 9.0285 | 11.7271 | 15.3866 | 17.3791 | 19.1444 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333a)m | -4.7634 | -7.7179 | -12.8267 | -16.6240 | -19.8768 | -19.2968 | -19.0236 | -16.9096 | -13.5747 | -9.6387 | -5.5566 | -3.9980 | (333a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (335a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335a) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (333b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335b) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - community heating | 3595.9026 | (307) |
| Space heating fuel - secondary | 0.0000 | (309) |
| Water heating fuel - community heating | 4683.4890 | (310) |
| Efficiency of water heater | 0.0000 | (311) |
| Electricity used for heat distribution | 35.9590 | (313) |
| Space cooling fuel | 62.9447 | (321) |
| | | |
| Electricity for pumps and fans: | | |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8820) | | |
| mechanical ventilation fans (SFP = 0.8820) | 199.3472 | (330a) |
| Total electricity for the above, kWh/year | 199.3472 | (331) |
| Electricity for lighting (calculated in Appendix L) | 150.3280 | (332) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -149.8068 | (333) |
| Wind generation | 0.0000 | (334) |
| Hydro-electric generation (Appendix N) | 0.0000 | (335a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (335) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (336) |
| Energy used | 0.0000 | (337) |
| Total delivered energy for all uses | 8542.2046 | (338) |

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12b. Carbon dioxide emissions - Community heating scheme

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (367) |
| Space and Water heating from Heat pump | 2956.9256 | 0.1564 | 200.8947 | (367) |
| Electrical energy for heat distribution (space & water) | 35.9590 | 0.0000 | 12.2185 | (372) |
| Overall CO2 factor for heat network | | | 0.0542 | (386) |
| Total CO2 associated with community systems | | | 448.5923 | (373) |
| Space and water heating | | | 448.5923 | (376) |
| Space cooling | 62.9447 | 0.1140 | 7.1732 | (377) |
| Pumps, fans and electric keep-hot | 199.3472 | 0.1387 | 27.6519 | (378) |
| Energy for lighting | 150.3280 | 0.1443 | 21.6970 | (379) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -149.8068 | 0.1319 | -19.7536 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -19.7536 | (380) |
| Total CO2, kg/year | | | 485.3608 | (383) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 7.7300 | (384) |

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13b. Primary energy - Community heating scheme

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| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (467a) |
| Space and Water heating from Heat pump | 2956.9256 | 1.5791 | 2027.9888 | (467) |
| Electrical energy for heat distribution (space & water) | 35.9590 | 0.0000 | 127.9983 | (472) |
| Overall CO2 factor for heat network | | | 0.5676 | (486) |
| Total CO2 associated with community systems | | | 4699.3666 | (473) |
| Space and water heating | | | 4699.3666 | (476) |
| Space cooling | 62.9447 | 1.4201 | 89.3850 | (477) |
| Pumps, fans and electric keep-hot | 199.3472 | 1.5128 | 301.5724 | (478) |
| Energy for lighting | 150.3280 | 1.5338 | 230.5781 | (479) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -149.8068 | 1.4872 | -222.7889 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -222.7889 | (480) |
| Total Primary energy kWh/year | | | 5098.1131 | (483) |
| Dwelling Primary energy Rate (DPER) | | | 81.1800 | (484) |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

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| | | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | |
| Ground floor | | 62.8000 | (1b) | x 2.9500 | (2b) = | 185.2600 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 62.8000 | | | | | | (4) |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = | 185.2600 | (5) |

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2. Ventilation rate

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| | m3 per hour | |
|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 (6a) |
| Number of open flues | 0 * 20 = | 0.0000 (6b) |

| | | |
|---|---|---|
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 (6f) |
| Number of intermittent extract fans | 2 * 10 = | 20.0000 (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 (7c) |

| | | Air changes per hour | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 20.0000 / (5) = | 0.1080 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3580 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.3580 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.4564 | 0.4474 | 0.4385 | 0.3938 | 0.3848 | 0.3401 | 0.3401 | 0.3311 | 0.3580 | 0.3848 | 0.4027 | 0.4206 | (22b) |
| Effective ac | 0.6041 | 0.6001 | 0.5961 | 0.5775 | 0.5740 | 0.5578 | 0.5578 | 0.5548 | 0.5641 | 0.5740 | 0.5811 | 0.5885 | (25) |

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## 3. Heat losses and heat loss parameter

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| Element | Gross | Openings | NetArea | U-value | A x U | K-value | A x K | |
|---|---|---|---|---|---|---|---|---|
| | m2 | m2 | m2 | W/m2K | W/K | kJ/m2K | kJ/K | |
| Main dwelling | | | | | | | | |
| TER Opaque door | | | 2.5700 | 1.0000 | 2.5700 | | | (26) |
| TER Opening Type | | | 13.1300 | 1.1450 | 15.0344 | | | (27) |
| External Walls | 69.2800 | 15.7000 | 53.5800 | 0.1800 | 9.6444 | | | (29a) |
| External Roof | 62.8000 | | 62.8000 | 0.1100 | 6.9080 | | | (30) |
| Total net area of external elements Aum(A, m2) | | | 132.0800 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 34.1568 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 43 | | | 23.1500 | 0.0000 | 0.0000 | | | (32) |

| | | |
|---|---|---|
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | 272.4244 | (35) |
| List of Thermal Bridges | | |

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E1 Steel lintel with perforated steel base plate | 10.8600 | 0.0500 | 0.5430 |
| E3 Sill | 7.2000 | 0.0500 | 0.3600 |
| E4 Jamb | 27.9100 | 0.0500 | 1.3955 |
| E7 Party floor between dwellings (in blocks of flats) | 8.8600 | 0.0700 | 0.6202 |
| E15 Flat roof with parapet | 23.4800 | 0.5600 | 13.1488 |
| E16 Corner (normal) | 8.8500 | 0.0900 | 0.7965 |
| E18 Party wall between dwellings | 2.9500 | 0.0600 | 0.1770 |
| E25 Staggered party wall between dwellings | 2.9500 | 0.0600 | 0.1770 |
| E24 Eaves (insulation at ceiling level - inverted) | 10.6550 | 0.2400 | 2.5572 |
| E23 Balcony within or between dwellings, balcony support penetrates wall insulation | 3.9460 | 0.0200 | 0.0789 |

| | | |
|---|---|---|
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | 19.8541 | (36) |
| Point Thermal bridges | (36a) = 0.0000 | |
| Total fabric heat loss | (33) + (36) + (36a) = 54.0109 | (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 36.9351 | 36.6878 | 36.4455 | 35.3072 | 35.0942 | 34.1028 | 34.1028 | 33.9192 | 34.4846 | 35.0942 | 35.5250 | 35.9755 | (38) |
| Heat transfer coeff | 90.9459 | 90.6987 | 90.4563 | 89.3180 | 89.1051 | 88.1136 | 88.1136 | 87.9300 | 88.4955 | 89.1051 | 89.5359 | 89.9863 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 89.3170 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.4482 | 1.4442 | 1.4404 | 1.4223 | 1.4189 | 1.4031 | 1.4031 | 1.4002 | 1.4092 | 1.4189 | 1.4257 | 1.4329 | (40) |
| HLP (average) | | | | | | | | | | | | 1.4222 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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## 4. Water heating energy requirements (kWh/year)

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| | | |
|---|---|---|
| Assumed occupancy | 2.0596 | (42) |

Hot water usage for mixer showers

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 58.7522 | 57.8693 | 56.5827 | 54.1210 | 52.3043 | 50.2784 | 49.1269 | 50.4037 | 51.8034 | 53.9786 | 56.4932 | 58.5271 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 25.3886 | 25.0115 | 24.4806 | 23.5015 | 22.7685 | 21.9556 | 21.5165 | 22.0438 | 22.6179 | 23.4877 | 24.4869 | 25.3028 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 35.7223 | 34.4233 | 33.1243 | 31.8253 | 30.5263 | 29.2273 | 29.2273 | 30.5263 | 31.8253 | 33.1243 | 34.4233 | 35.7223 | (42c) |

| | | |
|---|---|---|
| Average daily hot water use (litres/day) | 110.1816 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 119.8631 | 117.3041 | 114.1876 | 109.4479 | 105.5991 | 101.4613 | 99.8707 | 102.9738 | 106.2466 | 110.5906 | 115.4034 | 119.5522 | (44) |
| Energy conte | 189.8339 | 167.0395 | 175.5020 | 149.8286 | 142.1567 | 124.7585 | 120.7850 | 127.5031 | 131.0127 | 150.0704 | 164.4133 | 187.1898 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1830.0936 | |
| Distribution loss (46)m = 0.15 x (45)m | 28.4751 | 25.0559 | 26.3253 | 22.4743 | 21.3235 | 18.7138 | 18.1177 | 19.1255 | 19.6519 | 22.5106 | 24.6620 | 28.0785 | (46) |

| | | |
|---|---|---|
| Water storage loss: | | |
| Store volume | 150.0000 | (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | 1.3938 | (48) |
| Temperature factor from Table 2b | 0.5400 | (49) |
| Enter (49) or (54) in (55) | 0.7527 | (55) |

Total storage loss

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (56) |

If cylinder contains dedicated solar storage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (57) |
| Primary loss 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |

Total heat required for water heating calculated for each month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 236.4288 | 209.1252 | 222.0969 | 194.9205 | 188.7516 | 169.8504 | 167.3799 | 174.0980 | 176.1045 | 196.6653 | 209.5051 | 233.7847 | (62) |
| WWHRS -26.8591 | -23.7544 | -24.8742 | -20.5968 | -19.1955 | -16.4257 | -15.3965 | -16.3726 | -16.9947 | -20.0349 | -22.6971 | -26.3617 | (63a) |
| PV diverter -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |

Output from w/h

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 209.5697 | 185.3709 | 197.2227 | 174.3237 | 169.5561 | 153.4247 | 151.9834 | 157.7254 | 159.1098 | 176.6305 | 186.8080 | 207.4230 (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2129.1479 (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2129 (64) |

Electric shower(s)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (64a) |
| | | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | 0.0000 (64a) |

Heat gains from water heating, kWh/month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 100.3957 | 89.2092 | 95.6303 | 85.8915 | 84.5430 | 77.5557 | 77.4369 | 79.6707 | 79.6352 | 87.1743 | 90.7409 | 99.5165 (65) |

## 5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 102.9797 | 102.9797 | 102.9797 | 102.9797 | 102.9797 | 102.9797 | 102.9797 | 102.9797 | 102.9797 | 102.9797 | 102.9797 | 102.9797 | (66) |

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 91.0415 | 100.7960 | 91.0415 | 94.0763 | 91.0415 | 94.0763 | 91.0415 | 91.0415 | 94.0763 | 91.0415 | 94.0763 | 91.0415 | (67) |

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 179.9493 | 181.8167 | 177.1111 | 167.0935 | 154.4481 | 142.5632 | 134.6234 | 132.7560 | 137.4616 | 147.4792 | 160.1246 | 172.0095 | (68) |

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 33.2980 | 33.2980 | 33.2980 | 33.2980 | 33.2980 | 33.2980 | 33.2980 | 33.2980 | 33.2980 | 33.2980 | 33.2980 | 33.2980 | (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.0000 | 3.0000 | 3.0000 | (70) |

Losses e.g. evaporation (negative values) (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | -82.3837 | -82.3837 | -82.3837 | -82.3837 | -82.3837 | -82.3837 | -82.3837 | -82.3837 | -82.3837 | -82.3837 | -82.3837 | -82.3837 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 134.9404 | 132.7518 | 128.5354 | 119.2937 | 113.6331 | 107.7162 | 104.0819 | 107.0843 | 110.6044 | 117.1698 | 126.0290 | 133.7588 | (72) |

Total internal gains

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 462.8252 | 472.2584 | 453.5819 | 437.3574 | 416.0166 | 398.2496 | 383.6407 | 384.7758 | 396.0362 | 412.5845 | 437.1238 | 453.7037 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Northeast | 5.0200 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 17.3100 | (75) |
| Southeast | 6.0500 | 36.7938 | 0.6300 | 0.7000 | 0.7700 | 68.0303 | (77) |
| Northwest | 2.0600 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 7.1033 | (81) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 92.4436 | 165.5748 | 248.0860 | 343.4937 | 417.6949 | 429.1694 | 407.7329 | 350.1595 | 280.7767 | 188.8030 | 112.2029 | 78.1569 | (83) |
| Total gains | 555.2688 | 637.8332 | 701.6679 | 780.8511 | 833.7115 | 827.4190 | 791.3736 | 734.9353 | 676.8129 | 601.3875 | 549.3267 | 531.8606 | (84) |

## 7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 52.2540 | 52.3965 | 52.5369 | 53.2064 | 53.3336 | 53.9337 | 53.9337 | 54.0463 | 53.7009 | 53.3336 | 53.0769 | 52.8113 | |
| alpha | 4.4836 | 4.4931 | 4.5025 | 4.5471 | 4.5556 | 4.5956 | 4.5956 | 4.6031 | 4.5801 | 4.5556 | 4.5385 | 4.5208 | |
| util living area | | | | | | | | | | | | | |
| | 0.9930 | 0.9862 | 0.9713 | 0.9242 | 0.8175 | 0.6393 | 0.4803 | 0.5339 | 0.7761 | 0.9462 | 0.9862 | 0.9942 | (86) |
| MIT | 19.5324 | 19.7383 | 20.0429 | 20.4530 | 20.7758 | 20.9466 | 20.9884 | 20.9816 | 20.8698 | 20.4548 | 19.9300 | 19.5051 | (87) |
| Th 2 | 19.7266 | 19.7296 | 19.7325 | 19.7463 | 19.7489 | 19.7610 | 19.7610 | 19.7632 | 19.7563 | 19.7489 | 19.7437 | 19.7382 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9905 | 0.9813 | 0.9605 | 0.8957 | 0.7534 | 0.5332 | 0.3501 | 0.3987 | 0.6802 | 0.9196 | 0.9803 | 0.9921 | (89) |
| MIT 2 | 18.0661 | 18.3288 | 18.7132 | 19.2198 | 19.5746 | 19.7344 | 19.7580 | 19.7579 | 19.6775 | 19.2361 | 18.5840 | 18.0394 | (90) |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.5739 | (91) |
| MIT | 18.9076 | 19.1377 | 19.4763 | 19.9275 | 20.2640 | 20.4301 | 20.4641 | 20.4602 | 20.3617 | 19.9355 | 19.3564 | 18.8805 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 18.9076 | 19.1377 | 19.4763 | 19.9275 | 20.2640 | 20.4301 | 20.4641 | 20.4602 | 20.3617 | 19.9355 | 19.3564 | 18.8805 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9883 | 0.9783 | 0.9579 | 0.9005 | 0.7819 | 0.5926 | 0.4251 | 0.4766 | 0.7304 | 0.9243 | 0.9779 | 0.9902 | (94) |
| Useful gains | 548.7459 | 623.9770 | 672.0968 | 703.1233 | 651.9013 | 490.2958 | 336.4240 | 350.2776 | 494.3635 | 555.8717 | 537.1967 | 526.6284 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | | | | | | | | | | | | | |
| | 1328.5037 | 1291.3394 | 1173.7887 | 984.9539 | 763.0917 | 513.7088 | 340.4826 | 357.0092 | 554.1359 | 831.8385 | 1097.3918 | 1321.0482 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 580.1398 | 448.4675 | 373.2588 | 202.9181 | 82.7256 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 205.3193 | 403.3405 | 591.0483 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 2887.2180 | |
| Solar heating kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | | | | | | | | | | | | | |
| | 580.1398 | 448.4675 | 373.2588 | 202.9181 | 82.7256 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 205.3193 | 403.3405 | 591.0483 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 2887.2180 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 45.9748 | (99) |

## 9a. Energy requirements - Individual heating systems, including micro-CHP

| | | |
|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | 0.0000 | (201) |
| Fraction of space heat from main system(s) | 1.0000 | (202) |
| Efficiency of main space heating system 1 (in %) | 92.3000 | (206) |
| Efficiency of main space heating system 2 (in %) | 0.0000 | (207) |
| Efficiency of secondary/supplementary heating system, % | 0.0000 | (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement | | | | | | | | | | | | | |
| | 580.1398 | 448.4675 | 373.2588 | 202.9181 | 82.7256 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 205.3193 | 403.3405 | 591.0483 | (98) |
| Space heating efficiency (main heating system 1) | | | | | | | | | | | | | |
| | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.3000 | 92.3000 | 92.3000 | (210) |

Space heating fuel (main heating system)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 628.5372 | 485.8803 | 404.3974 | 219.8462 | 89.6269 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 222.4478 | 436.9886 | 640.3557 | (211) |

Space heating efficiency (main heating system 2)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (212) |

Space heating fuel (main heating system 2)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (213) |

Space heating fuel (secondary)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (215) |

Water heating

Water heating requirement

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 209.5697 | 185.3709 | 197.2227 | 174.3237 | 169.5561 | 153.4247 | 151.9834 | 157.7254 | 159.1098 | 176.6305 | 186.8080 | 207.4230 | (64) |

Efficiency of water heater

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | 79.8000 | (216) |
| (217)m | 86.2195 | 85.9646 | 85.4676 | 84.4013 | 82.5433 | 79.8000 | 79.8000 | 79.8000 | 79.8000 | 84.3982 | 85.7391 | 86.2724 | (217) |

Fuel for water heating, kWh/month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 243.0654 | 215.6364 | 230.7573 | 206.5415 | 205.4149 | 192.2615 | 190.4554 | 197.6509 | 199.3858 | 209.2823 | 217.8797 | 240.4281 | (219) |

Space cooling fuel requirement

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (221) |
| Pumps and Fa | 7.3041 | 6.5973 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | (231) |
| Lighting | 18.9166 | 15.1756 | 13.6640 | 10.0108 | 7.7326 | 6.3176 | 7.0540 | 9.1690 | 11.9096 | 15.6261 | 17.6496 | 19.4424 | (232) |

Electricity generated by PVs (Appendix M) (negative quantity)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (233a)m | -13.9707 | -20.9815 | -32.1060 | -38.5107 | -43.6785 | -41.5708 | -41.0722 | -37.7004 | -32.1427 | -25.0326 | -15.8110 | -11.9338 | (233a) |

Electricity generated by wind turbines (Appendix M) (negative quantity)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234a) |

Electricity generated by hydro-electric generators (Appendix M) (negative quantity)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235a) |

Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235c) |

Electricity generated by PVs (Appendix M) (negative quantity)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (233b)m | -4.4196 | -9.5525 | -19.4703 | -29.9668 | -40.3397 | -40.7893 | -40.3026 | -33.7884 | -24.3344 | -13.8868 | -5.9726 | -3.4758 | (233b) |

Electricity generated by wind turbines (Appendix M) (negative quantity)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234b) |

Electricity generated by hydro-electric generators (Appendix M) (negative quantity)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235b) |

Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235d) |

Annual totals kWh/year

| | | |
|---|---|---|
| Space heating fuel - main system 1 | 3128.0801 | (211) |
| Space heating fuel - main system 2 | 0.0000 | (213) |
| Space heating fuel - secondary | 0.0000 | (215) |
| Efficiency of water heater | 79.8000 | |
| Water heating fuel used | 2548.7589 | (219) |
| Space cooling fuel | 0.0000 | (221) |
| | | |
| Electricity for pumps and fans: | | |
| Total electricity for the above, kWh/year | 86.0000 | (231) |
| Electricity for lighting (calculated in Appendix L) | 152.6681 | (232) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -620.8095 | (233) |
| Wind generation | 0.0000 | (234) |
| Hydro-electric generation (Appendix N) | 0.0000 | (235a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (235) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (236) |
| Energy used | 0.0000 | (237) |
| Total delivered energy for all uses | 5294.6977 | (238) |

---

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

---

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 3128.0801 | 0.2100 | 656.8968 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2548.7589 | 0.2100 | 535.2394 | (264) |
| Space and water heating | | | 1192.1362 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 152.6681 | 0.1443 | 22.0347 | (268) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -354.5108 | 0.1333 | -47.2475 | |
| PV Unit electricity exported | -266.2987 | 0.1252 | -33.3383 | |
| Total | | | -80.5859 | (269) |
| Total CO2, kg/year | | | 1145.5143 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 18.2400 | (273) |

---

13a. Primary energy - Individual heating systems including micro-CHP

---

| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 3128.0801 | 1.1300 | 3534.7305 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2548.7589 | 1.1300 | 2880.0976 | (278) |
| Space and water heating | | | 6414.8281 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 152.6681 | 1.5338 | 234.1674 | (282) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -354.5108 | 1.4925 | -529.1031 | |
| PV Unit electricity exported | -266.2987 | 0.4595 | -122.3656 | |
| Total | | | -651.4687 | (283) |
| Total Primary energy kWh/year | | | 6127.6276 | (286) |
| Target Primary Energy Rate (TPER) | | | 97.5700 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Property Reference** | Unit 45 | **Issued on Date** | 18/05/2025 |
| **Assessment Reference** | 00001 | **Prop Type Ref** | Unit 45 |
| **Property** | | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 73 C | **DER** | 8.58 | **TER** | 20.67 |
| **Environmental** | 94 A | **% DER < TER** | | | 58.49 |
| **$CO_2$ Emissions (t/year)** | 0.38 | **DFEE** | 57.22 | **TFEE** | 60.05 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 4.71 |
| **% DPER < TPER** | 18.71 | **DPER** | 90.15 | **TPER** | 110.89 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Robert Arnold | **Assessor ID** | BA04-0001 |
| **Client** | | | |

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SAP 10 WORKSHEET FOR New Build (As Designed)  (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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## 1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 50.1900 | (1b) | x 2.9500 | (2b) = | 148.0605 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 50.1900 | | | | | (4) |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | 148.0605 | (5) |

---

## 2. Ventilation rate

---

| | | m3 per hour | |
|---|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 | (6a) |
| Number of open flues | 0 * 20 = | 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | 0 * 10 = | 0.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |

| | Air changes per hour | | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 0.0000 / (5) = | 0.0000 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 3.0000 | (17) |
| Infiltration rate | | 0.1500 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.1500 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.1912 | 0.1875 | 0.1837 | 0.1650 | 0.1612 | 0.1425 | 0.1425 | 0.1388 | 0.1500 | 0.1612 | 0.1687 | 0.1762 | (22b) |

Balanced mechanical ventilation with heat recovery

| | |
|---|---|
| If mechanical ventilation | 0.5000 (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | 0.5000 (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | 81.0000 (23c) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective ac | 0.2862 | 0.2825 | 0.2787 | 0.2600 | 0.2562 | 0.2375 | 0.2375 | 0.2337 | 0.2450 | 0.2562 | 0.2637 | 0.2712 | (25) |

---

## 3. Heat losses and heat loss parameter

---

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| Windows | | | 11.9300 | 1.0536 | 12.5699 | | | (27) |
| Front Door | | | 1.8900 | 1.4000 | 2.6460 | | | (26) |
| Glass Door | | | 2.4000 | 1.3258 | 3.1818 | | | (27) |
| External Walls | 41.9100 | 14.3300 | 27.5800 | 0.1500 | 4.1370 | 150.0000 | 4137.0000 | (29a) |
| Wall to Communal Corridor | 44.7100 | 1.8900 | 42.8200 | 0.1400 | 5.9948 | 150.0000 | 6423.0000 | (29a) |
| External Roof | 50.1900 | | 50.1900 | 0.1000 | 5.0190 | 9.0000 | 451.7100 | (30) |
| Total net area of external elements Aum(A, m2) | | | 136.8100 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 33.5485 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Floor | | | 50.1900 | | | 80.0000 | 4015.2000 | (32d) |
| Internal Walls | | | 98.9100 | | | 9.0000 | 890.1900 | (32c) |

| | |
|---|---|
| Heat capacity Cm = Sum(A x k) | (28)...(30) + (32) + (32a)...(32e) = 15917.1000 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | 317.1369 (35) |
| List of Thermal Bridges | |

| | Length | Psi-value | Total | |
|---|---|---|---|---|
| K1 Element | | | | |
| E1 Steel lintel with perforated steel base plate | 6.3400 | 0.0500 | 0.3170 | |
| E4 Jamb | 18.0800 | 0.0500 | 0.9040 | |
| E7 Party floor between dwellings (in blocks of flats) | 3.0200 | 0.0450 | 0.1359 | |
| E15 Flat roof with parapet | 14.2000 | 0.5600 | 7.9520 | |
| E24 Eaves (insulation at ceiling level - inverted) | 8.7400 | 0.1200 | 1.0488 | |
| E23 Balcony within or between dwellings, balcony support penetrates wall insulation | 2.3000 | 0.0200 | 0.0460 | |
| E16 Corner (normal) | 2.9500 | 0.0900 | 0.2655 | |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | | 10.6692 | (36) |
| Point Thermal bridges | | (36a) = | 0.0000 | |
| Total fabric heat loss | | (33) + (36) + (36a) = | 44.2177 | (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 13.9862 | 13.8029 | 13.6197 | 12.7036 | 12.5204 | 11.6042 | 11.6042 | 11.4210 | 11.9707 | 12.5204 | 12.8868 | 13.2533 | (38) |
| Heat transfer coeff | 58.2039 | 58.0207 | 57.8375 | 56.9213 | 56.7381 | 55.8220 | 55.8220 | 55.6388 | 56.1884 | 56.7381 | 57.1046 | 57.4710 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 56.8755 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.1597 | 1.1560 | 1.1524 | 1.1341 | 1.1305 | 1.1122 | 1.1122 | 1.1086 | 1.1195 | 1.1305 | 1.1378 | 1.1451 | (40) |
| HLP (average) | | | | | | | | | | | | 1.1332 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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## 4. Water heating energy requirements (kWh/year)

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| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Assumed occupancy | | | | | | | | | | | 1.6957 | (42) |
| Hot water usage for mixer showers | 51.3205 | 50.5348 | 49.3769 | 47.5956 | 45.9996 | 43.7668 | 42.0008 | 44.0654 | 45.1038 | 47.3152 | 49.6183 | 51.2742 | (42a) |
| Hot water usage for baths | 22.2573 | 21.9213 | 21.4433 | 20.7275 | 20.0824 | 19.1944 | 18.5206 | 19.3445 | 19.7769 | 20.6568 | 21.5716 | 22.2396 | (42b) |
| Hot water usage for other uses | 31.9956 | 30.8321 | 29.6687 | 28.5052 | 27.3417 | 26.1782 | 26.1782 | 27.3417 | 28.5052 | 29.6687 | 30.8321 | 31.9956 | (42c) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 97.0383 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 105.5734 | 103.2883 | 100.4889 | 96.8283 | 93.4237 | 89.1394 | 86.6997 | 90.7516 | 93.3858 | 97.6407 | 102.0221 | 105.5095 | (44) |
| Energy conte | 155.4223 | 136.6712 | 143.5965 | 126.4820 | 120.3859 | 103.0868 | 95.8057 | 106.8163 | 108.3229 | 125.8199 | 137.8862 | 154.9484 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1515.2443 | |
| Distribution loss (46)m = 0.15 x (45)m | 23.3133 | 20.5007 | 21.5395 | 18.9723 | 18.0579 | 15.4630 | 14.3709 | 16.0224 | 16.2484 | 18.8730 | 20.6829 | 23.2423 | (46) |
| Water storage loss: | | | | | | | | | | | | | |
| Store volume | | | | | | | | | | | | 110.0000 | (47) |
| b) If manufacturer declared loss factor is not known : | | | | | | | | | | | | | |
| Hot water storage loss factor from Table 2 (kWh/litre/day) | | | | | | | | | | | | 0.0152 | (51) |
| Volume factor from Table 2a | | | | | | | | | | | | 1.0294 | (52) |
| Temperature factor from Table 2b | | | | | | | | | | | | 0.6000 | (53) |
| Enter (49) or (54) in (55) | | | | | | | | | | | | 1.0327 | (55) |
| Total storage loss | 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (56) |
| If cylinder contains dedicated solar storage | 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (57) |
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | 210.6991 | 186.5987 | 198.8733 | 179.9756 | 175.6627 | 156.5805 | 151.0825 | 162.0931 | 161.8166 | 181.0967 | 191.3799 | 210.2252 | (62) |
| WWHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | 210.6991 | 186.5987 | 198.8733 | 179.9756 | 175.6627 | 156.5805 | 151.0825 | 162.0931 | 161.8166 | 181.0967 | 191.3799 | 210.2252 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2166.0840 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2166 | (64) |
| Electric shower(s) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | 95.8994 | 85.3851 | 91.9673 | 84.8502 | 84.2498 | 77.0713 | 76.0769 | 79.7379 | 78.8123 | 86.0566 | 88.6421 | 95.7418 | (65) |

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## 5. Internal gains (see Table 5 and 5a)

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Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 84.7848 | 84.7848 | 84.7848 | 84.7848 | 84.7848 | 84.7848 | 84.7848 | 84.7848 | 84.7848 | 84.7848 | 84.7848 | 84.7848 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 74.5115 | 82.4949 | 74.5115 | 76.9952 | 74.5115 | 76.9952 | 74.5115 | 74.5115 | 76.9952 | 74.5115 | 76.9952 | 74.5115 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 147.7274 | 149.2604 | 145.3974 | 137.1735 | 126.7924 | 117.0357 | 110.5175 | 108.9846 | 112.8476 | 121.0714 | 131.4525 | 141.2093 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 31.4785 | 31.4785 | 31.4785 | 31.4785 | 31.4785 | 31.4785 | 31.4785 | 31.4785 | 31.4785 | 31.4785 | 31.4785 | 31.4785 | (69) |
| Pumps, fans | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | -67.8278 | -67.8278 | -67.8278 | -67.8278 | -67.8278 | -67.8278 | -67.8278 | -67.8278 | -67.8278 | -67.8278 | -67.8278 | -67.8278 | (71) |
| Water heating gains (Table 5) | 128.8970 | 127.0612 | 123.6120 | 117.8475 | 113.2389 | 107.0435 | 102.2538 | 107.1745 | 109.4615 | 115.6674 | 123.1140 | 128.6852 | (72) |
| Total internal gains | 399.5714 | 407.2519 | 391.9563 | 380.4517 | 362.9783 | 349.5098 | 335.7183 | 339.1061 | 347.7398 | 359.6858 | 379.9972 | 392.8414 | (73) |

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## 6. Solar gains

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| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Northeast | 3.2200 | 11.2829 | 0.4500 | 0.7000 | 0.7700 | 7.9309 | (75) |
| Northwest | 8.7100 | 11.2829 | 0.4500 | 0.7000 | 0.7700 | 21.4528 | (81) |
| Northeast | 2.4000 | 11.2829 | 0.4500 | 0.7000 | 0.7700 | 5.9112 | (75) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 35.2949 | 71.8438 | 129.4398 | 212.5773 | 285.7456 | 304.6350 | 284.9798 | 227.1892 | 157.7244 | 87.7989 | 44.4102 | 28.8236 | (83) |
| Total gains | 434.8663 | 479.0957 | 521.3960 | 593.0290 | 648.7239 | 654.1448 | 620.6981 | 566.2953 | 505.4641 | 447.4846 | 424.4074 | 421.6651 | (84) |

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7. Mean internal temperature (heating season)

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Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| tau | 75.9643 | 76.2041 | 76.4456 | 77.6759 | 77.9268 | 79.2057 | 79.2057 | 79.4665 | 78.6891 | 77.9268 | 77.4267 | 76.9330 | |
| alpha | 6.0643 | 6.0803 | 6.0964 | 6.1784 | 6.1951 | 6.2804 | 6.2804 | 6.2978 | 6.2459 | 6.1951 | 6.1618 | 6.1289 | |
| util living area | 0.9958 | 0.9915 | 0.9784 | 0.9163 | 0.7588 | 0.5405 | 0.3950 | 0.4503 | 0.7271 | 0.9496 | 0.9901 | 0.9965 | (86) |
| MIT | 20.0518 | 20.1919 | 20.4214 | 20.7433 | 20.9375 | 20.9935 | 20.9992 | 20.9983 | 20.9643 | 20.7082 | 20.3406 | 20.0385 | (87) |
| Th 2 | 19.9524 | 19.9553 | 19.9583 | 19.9731 | 19.9760 | 19.9909 | 19.9909 | 19.9938 | 19.9849 | 19.9760 | 19.9701 | 19.9642 | (88) |
| util rest of house | 0.9941 | 0.9881 | 0.9695 | 0.8855 | 0.6939 | 0.4581 | 0.3048 | 0.3528 | 0.6374 | 0.9236 | 0.9854 | 0.9951 | (89) |
| MIT 2 | 18.8717 | 19.0516 | 19.3416 | 19.7347 | 19.9320 | 19.9880 | 19.9907 | 19.9934 | 19.9657 | 19.7069 | 19.2527 | 18.8638 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.5957 | (91) |
| MIT | 19.5747 | 19.7309 | 19.9849 | 20.3355 | 20.5310 | 20.5870 | 20.5915 | 20.5921 | 20.5606 | 20.3034 | 19.9008 | 19.5636 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.5747 | 19.7309 | 19.9849 | 20.3355 | 20.5310 | 20.5870 | 20.5915 | 20.5921 | 20.5606 | 20.3034 | 19.9008 | 19.5636 | (93) |

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8. Space heating requirement

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| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9933 | 0.9872 | 0.9698 | 0.8974 | 0.7303 | 0.5072 | 0.3586 | 0.4110 | 0.6900 | 0.9331 | 0.9850 | 0.9943 | (94) |
| Useful gains | 431.9417 | 472.9638 | 505.6520 | 532.1921 | 473.7773 | 331.7810 | 222.5847 | 232.7271 | 348.7781 | 417.5520 | 418.0336 | 419.2770 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | 889.0485 | 860.4998 | 779.9321 | 650.9267 | 501.0539 | 334.2075 | 222.8141 | 233.2421 | 363.0103 | 550.5523 | 730.9863 | 882.9619 | (97) |
| Space heating kWh | 340.0875 | 260.4242 | 204.0644 | 85.4889 | 20.2938 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 98.9522 | 225.3259 | 344.9816 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 1579.6185 | |
| Solar heating kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | 340.0875 | 260.4242 | 204.0644 | 85.4889 | 20.2938 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 98.9522 | 225.3259 | 344.9816 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 1579.6185 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 31.4728 | (99) |

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8c. Space cooling requirement

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Calculated for June, July and August. See Table 10b

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ext. temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | |
| Heat loss rate W | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 524.7266 | 413.0827 | 422.8546 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (100) |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.9597 | 0.9833 | 0.9705 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (101) |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 503.6035 | 406.1741 | 410.3831 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (102) |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 724.2542 | 687.2198 | 624.1453 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 158.8685 | 209.0980 | 159.0391 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (104) |
| Cooled fraction | | | | | | | | | | fC = cooled area / (4) = | | 0.9962 | (105) |
| Intermittency factor (Table 10b) | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | (106) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 39.5668 | 52.0766 | 39.6093 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) |
| Space cooling requirement | | | | | | | | | | | | 131.2526 | (107) |

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9b. Energy requirements

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | 0.0000 | (301) |
| Fraction of space heat from community system | | | | | | | | | | | | 1.0000 | (302) |
| Fraction of heat from community Heat pump-Space and Water | | | | | | | | | | | | 1.0000 | (303a) |
| Factor for control and charging method (Table 4c(3)) for space heating | | | | | | | | | | | | 1.0000 | (305) |
| Factor for charging method (Table 4c(3)) for water heating | | | | | | | | | | | | 1.0000 | (305a) |
| Distribution loss factor (Table 12c) for community heating system | | | | | | | | | | | | 2.0000 | (306) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 | (208) |
| Space heating: | | | | | | | | | | | | | |
| Space heating requirement | 340.0875 | 260.4242 | 204.0644 | 85.4889 | 20.2938 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 98.9522 | 225.3259 | 344.9816 | (98) |
| Space heat from Heat pump = (98) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 307a | 680.1750 | 520.8484 | 408.1288 | 170.9779 | 40.5876 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 197.9044 | 450.6518 | 689.9632 | |
| Space heating requirement | 680.1750 | 520.8484 | 408.1288 | 170.9779 | 40.5876 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 197.9044 | 450.6518 | 689.9632 | (307) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | | | | | | | | | | | 0.0000 | (308) |
| Space heating fuel for secondary/supplementary system | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (309) |
| Water heating | | | | | | | | | | | | | |
| Annual water heating requirement | 210.6991 | 186.5987 | 198.8733 | 179.9756 | 175.6627 | 156.5805 | 151.0825 | 162.0931 | 161.8166 | 181.0967 | 191.3799 | 210.2252 | (64) |
| Water heat from Heat pump = (64) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 310a | 421.3983 | 373.1974 | 397.7467 | 359.9513 | 351.3255 | 313.1609 | 302.1651 | 324.1862 | 323.6331 | 362.1934 | 382.7598 | 420.4505 | |
| Water heating fuel | 421.3983 | 373.1974 | 397.7467 | 359.9513 | 351.3255 | 313.1609 | 302.1651 | 324.1862 | 323.6331 | 362.1934 | 382.7598 | 420.4505 | (310) |
| Cooling System Energy Efficiency Ratio | | | | | | | | | | | | 2.6000 | (314) |
| Space coolin | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 15.2180 | 20.0295 | 15.2343 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (315) |
| Pumps and Fa | 13.5312 | 12.2217 | 13.5312 | 13.0947 | 13.5312 | 13.0947 | 13.5312 | 13.5312 | 13.0947 | 13.5312 | 13.0947 | 13.5312 | (331) |
| Lighting | 14.4061 | 11.5571 | 10.4059 | 7.6238 | 5.8888 | 4.8112 | 5.3720 | 6.9827 | 9.0699 | 11.9002 | 13.4412 | 14.8065 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333a)m | -4.6920 | -7.5582 | -12.4870 | -16.0850 | -19.1441 | -18.5561 | -18.2962 | -16.3065 | -13.1506 | -9.4049 | -5.4596 | -3.9425 | (333a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335a) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (333b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (333b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335b) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - community heating | 3159.2369 | (307) |
| Space heating fuel - secondary | 0.0000 | (309) |
| Water heating fuel - community heating | 4332.1681 | (310) |
| Efficiency of water heater | 0.0000 | (311) |
| Electricity used for heat distribution | 31.5924 | (313) |
| Space cooling fuel | 50.4818 | (321) |
| | | |
| Electricity for pumps and fans: | | |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8820) | | |
| mechanical ventilation fans (SFP = 0.8820) | 159.3190 | (330a) |
| Total electricity for the above, kWh/year | 159.3190 | (331) |
| Electricity for lighting (calculated in Appendix L) | 116.2655 | (332) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -145.0825 | (333) |
| Wind generation | 0.0000 | (334) |
| Hydro-electric generation (Appendix N) | 0.0000 | (335a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (335) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (336) |
| Energy used | 0.0000 | (337) |
| Total delivered energy for all uses | 7672.3888 | (338) |

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12b. Carbon dioxide emissions - Community heating scheme

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (367) |
| Space and Water heating from Heat pump | 2675.5018 | 0.1563 | 176.3867 | (367) |
| Electrical energy for heat distribution (space & water) | 31.5924 | 0.0000 | 11.0349 | (372) |
| Overall CO2 factor for heat network | | | 0.0541 | (386) |
| Total CO2 associated with community systems | | | 405.1369 | (373) |
| Space and water heating | | | 405.1369 | (376) |
| Space cooling | 50.4818 | 0.1140 | 5.7557 | (377) |
| Pumps, fans and electric keep-hot | 159.3190 | 0.1387 | 22.0995 | (378) |
| Energy for lighting | 116.2655 | 0.1443 | 16.7807 | (379) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -145.0825 | 0.1320 | -19.1462 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -19.1462 | (380) |
| Total CO2, kg/year | | | 430.6266 | (383) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 8.5800 | (384) |

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13b. Primary energy - Community heating scheme

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| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (467a) |
| Space and Water heating from Heat pump | 2675.5018 | 1.5788 | 1781.3258 | (467) |
| Electrical energy for heat distribution (space & water) | 31.5924 | 0.0000 | 115.7393 | (472) |
| Overall CO2 factor for heat network | | | 0.5672 | (486) |
| Total CO2 associated with community systems | | | 4249.2847 | (473) |
| Space and water heating | | | 4249.2847 | (476) |
| Space cooling | 50.4818 | 1.4203 | 71.6968 | (477) |
| Pumps, fans and electric keep-hot | 159.3190 | 1.5128 | 241.0178 | (478) |
| Energy for lighting | 116.2655 | 1.5338 | 178.3320 | (479) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -145.0825 | 1.4876 | -215.8216 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -215.8216 | (480) |
| Total Primary energy kWh/year | | | 4524.5097 | (483) |
| Dwelling Primary energy Rate (DPER) | | | 90.1500 | (484) |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 50.1900 | (1b) | x 2.9500 | (2b) = | 148.0605 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 50.1900 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = | 148.0605 | (5) |

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2. Ventilation rate

---

| | m3 per hour | |
|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 (6a) |
| Number of open flues | 0 * 20 = | 0.0000 (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 (6d) |

| | | | |
|---|---|---|---|
| Number of flues attached to other heater | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | 2 * 10 = | 20.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |

| | | Air changes per hour | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 20.0000 / (5) = | 0.1351 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3851 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.3851 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.4910 | 0.4813 | 0.4717 | 0.4236 | 0.4140 | 0.3658 | 0.3658 | 0.3562 | 0.3851 | 0.4140 | 0.4332 | 0.4525 | (22b) |
| Effective ac | 0.6205 | 0.6158 | 0.6113 | 0.5897 | 0.5857 | 0.5669 | 0.5669 | 0.5634 | 0.5741 | 0.5857 | 0.5938 | 0.6024 | (25) |

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## 3. Heat losses and heat loss parameter

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| Element | Gross | Openings | NetArea | U-value | A x U | K-value | A x K | |
|---|---|---|---|---|---|---|---|---|
| | m2 | m2 | m2 | W/m2K | W/K | kJ/m2K | kJ/K | |
| Main dwelling | | | | | | | | |
| TER Opaque door | | | 1.8900 | 1.0000 | 1.8900 | | | (26) |
| TER Opening Type | | | 10.6400 | 1.1450 | 12.1832 | | | (27) |
| External Walls | 41.9100 | 10.6400 | 31.2700 | 0.1800 | 5.6286 | | | (29a) |
| Wall to Communal Corridor | 44.7100 | 1.8900 | 42.8200 | 0.1800 | 7.7076 | | | (29a) |
| External Roof | 50.1900 | | 50.1900 | 0.1100 | 5.5209 | | | (30) |
| Total net area of external elements Aum(A, m2) | | | 136.8100 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 32.9303 | | | (33) |

| | | |
|---|---|---|
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | 317.1369 | (35) |

List of Thermal Bridges

| | Length | Psi-value | Total | |
|---|---|---|---|---|
| K1 Element | | | | |
| E1 Steel lintel with perforated steel base plate | 6.3400 | 0.0500 | 0.3170 | |
| E4 Jamb | 18.0800 | 0.0500 | 0.9040 | |
| E7 Party floor between dwellings (in blocks of flats) | 3.0200 | 0.0700 | 0.2114 | |
| E15 Flat roof with parapet | 14.2000 | 0.5600 | 7.9520 | |
| E24 Eaves (insulation at ceiling level - inverted) | 8.7400 | 0.2400 | 2.0976 | |
| E23 Balcony within or between dwellings, balcony support penetrates wall insulation | 2.3000 | 0.0200 | 0.0460 | |
| E16 Corner (normal) | 2.9500 | 0.0900 | 0.2655 | |

| | | | |
|---|---|---|---|
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | 11.7935 | (36) |
| Point Thermal bridges | (36a) = | 0.0000 | |
| Total fabric heat loss | (33) + (36) + (36a) = | 44.7238 | (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 30.3190 | 30.0904 | 29.8662 | 28.8134 | 28.6164 | 27.6994 | 27.6994 | 27.5296 | 28.0526 | 28.6164 | 29.0149 | 29.4315 | (38) |
| Heat transfer coeff | 75.0428 | 74.8142 | 74.5900 | 73.5372 | 73.3402 | 72.4232 | 72.4232 | 72.2534 | 72.7764 | 73.3402 | 73.7387 | 74.1553 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 73.5362 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.4952 | 1.4906 | 1.4862 | 1.4652 | 1.4613 | 1.4430 | 1.4430 | 1.4396 | 1.4500 | 1.4613 | 1.4692 | 1.4775 | (40) |
| HLP (average) | | | | | | | | | | | | 1.4652 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

---

## 4. Water heating energy requirements (kWh/year)

---

| | | |
|---|---|---|
| Assumed occupancy | 1.6957 | (42) |

Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 52.6507 | 51.8595 | 50.7065 | 48.5005 | 46.8725 | 45.0569 | 44.0250 | 45.1693 | 46.4236 | 48.3729 | 50.6263 | 52.4490 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 22.7648 | 22.4267 | 21.9506 | 21.0727 | 20.4154 | 19.6866 | 19.2929 | 19.7656 | 20.2804 | 21.0603 | 21.9562 | 22.6878 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 31.9956 | 30.8321 | 29.6687 | 28.5052 | 27.3417 | 26.1782 | 26.1782 | 27.3417 | 28.5052 | 29.6687 | 30.8321 | 31.9956 | (42c) |

| | | |
|---|---|---|
| Average daily hot water use (litres/day) | 98.7357 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 107.4111 | 105.1183 | 102.3258 | 98.0784 | 94.6296 | 90.9217 | 89.4961 | 92.2766 | 95.2092 | 99.1019 | 103.4147 | 107.1324 | (44) |
| Energy conte | 170.1130 | 149.6871 | 157.2709 | 134.2644 | 127.3896 | 111.7989 | 108.2378 | 114.2577 | 117.4024 | 134.4803 | 147.3332 | 167.7435 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1639.9788 | |
| Distribution loss (46)m = 0.15 x (45)m | 25.5169 | 22.4531 | 23.5906 | 20.1397 | 19.1084 | 16.7698 | 16.2357 | 17.1387 | 17.6104 | 20.1720 | 22.1000 | 25.1615 | (46) |

| | | |
|---|---|---|
| Water storage loss: | | |
| Store volume | 150.0000 | (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | 1.3938 | (48) |
| Temperature factor from Table 2b | 0.5400 | (49) |
| Enter (49) or (54) in (55) | 0.7527 | (55) |

Total storage loss

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (56) |

If cylinder contains dedicated solar storage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (57) |
| Primary loss 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |

Total heat required for water heating calculated for each month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 216.7079 | 191.7728 | 203.8658 | 179.3563 | 173.9845 | 156.8907 | 154.8327 | 160.8526 | 162.4943 | 181.0752 | 192.4250 | 214.3384 | (62) |
| WWHRS -24.0697 | -21.2875 | -22.2910 | -18.4578 | -17.2020 | -14.7199 | -13.7976 | -14.6723 | -15.2298 | -17.9542 | -20.3400 | -23.6240 | (63a) |
| PV diverter -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |

Output from w/h

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 192.6382 | 170.4854 | 181.5748 | 160.8984 | 156.7825 | 142.1708 | 141.0351 | 146.1803 | 147.2645 | 163.1210 | 172.0851 | 190.7144 | (64) |
| | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 1964.9505 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | 1965 | (64) |

Electric shower(s)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)

Heat gains from water heating, kWh/month

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 93.8385 | 83.4395 | 89.5685 | 80.7164 | 79.6330 | 73.2466 | 73.2650 | 75.2666 | 75.1098 | 81.9906 | 85.0618 | 93.0506 | (65) |

## 5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 84.7848 | 84.7848 | 84.7848 | 84.7848 | 84.7848 | 84.7848 | 84.7848 | 84.7848 | 84.7848 | 84.7848 | 84.7848 | 84.7848 | (66)m |

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 74.6689 | 82.6692 | 74.6689 | 77.1579 | 74.6689 | 77.1579 | 74.6689 | 74.6689 | 77.1579 | 74.6689 | 77.1579 | 74.6689 | (67) |

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 147.7274 | 149.2604 | 145.3974 | 137.1735 | 126.7924 | 117.0357 | 110.5175 | 108.9846 | 112.8476 | 121.0714 | 131.4525 | 141.2093 | (68) |

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 31.4785 | 31.4785 | 31.4785 | 31.4785 | 31.4785 | 31.4785 | 31.4785 | 31.4785 | 31.4785 | 31.4785 | 31.4785 | 31.4785 | (69) |
| 3.0000 | 3.0000 | 3.0000 | 3.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.0000 | 3.0000 | 3.0000 | | (70) |

Pumps, fans

Losses e.g. evaporation (negative values) (Table 5)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| -67.8278 | -67.8278 | -67.8278 | -67.8278 | -67.8278 | -67.8278 | -67.8278 | -67.8278 | -67.8278 | -67.8278 | -67.8278 | -67.8278 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 126.1270 | 124.1660 | 120.3878 | 112.1061 | 107.0336 | 101.7314 | 98.4744 | 101.1648 | 104.3191 | 110.2025 | 118.1413 | 125.0681 | (72) |

Total internal gains

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 399.9588 | 407.5309 | 391.8895 | 377.8730 | 359.9304 | 344.3604 | 332.0963 | 333.2537 | 342.7600 | 357.3782 | 378.1872 | 392.3817 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Northeast | 4.1700 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 14.3791 | (75) |
| Northwest | 6.4700 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 22.3099 | (81) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 36.6890 | 74.6815 | 134.5523 | 220.9736 | 297.0318 | 316.6674 | 296.2358 | 236.1626 | 163.9541 | 91.2667 | 46.1642 | 29.9621 | (83) |
| 436.6477 | 482.2124 | 526.4418 | 598.8465 | 656.9622 | 661.0277 | 628.3322 | 569.4164 | 506.7141 | 448.6449 | 424.3514 | 422.3438 | (84) |

Solar gains

Total gains

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 58.9186 | 59.0987 | 59.2763 | 60.1249 | 60.2864 | 61.0497 | 61.0497 | 61.1932 | 60.7534 | 60.2864 | 59.9606 | 59.6238 | |
| 4.9279 | 4.9399 | 4.9518 | 5.0083 | 5.0191 | 5.0700 | 5.0700 | 5.0795 | 5.0502 | 5.0191 | 4.9974 | 4.9749 | |
| 0.9964 | 0.9935 | 0.9853 | 0.9504 | 0.8491 | 0.6620 | 0.4990 | 0.5673 | 0.8309 | 0.9701 | 0.9928 | 0.9970 | (86) |
| 19.6297 | 19.7841 | 20.0560 | 20.4606 | 20.7909 | 20.9563 | 20.9914 | 20.9842 | 20.8633 | 20.4488 | 19.9851 | 19.6151 | (87) |
| 19.6911 | 19.6945 | 19.6979 | 19.7137 | 19.7167 | 19.7305 | 19.7305 | 19.7331 | 19.7252 | 19.7167 | 19.7107 | 19.7044 | (88) |
| 0.9948 | 0.9906 | 0.9785 | 0.9271 | 0.7844 | 0.5484 | 0.3595 | 0.4198 | 0.7350 | 0.9512 | 0.9891 | 0.9956 | (89) |
| 18.1424 | 18.3415 | 18.6879 | 19.1956 | 19.5599 | 19.7110 | 19.7287 | 19.7293 | 19.6453 | 19.1943 | 18.6101 | 18.1332 | (90) |
| | | | | | | | | fLA = Living area / (4) = | | | 0.5957 | (91) |
| 19.0284 | 19.2009 | 19.5030 | 19.9492 | 20.2932 | 20.4528 | 20.4809 | 20.4769 | 20.3709 | 19.9416 | 19.4293 | 19.0160 | (92) |
| | | | | | | | | | | | 0.0000 | |
| 19.0284 | 19.2009 | 19.5030 | 19.9492 | 20.2932 | 20.4528 | 20.4809 | 20.4769 | 20.3709 | 19.9416 | 19.4293 | 19.0160 | (93) |

Living area fraction

MIT

Temperature adjustment

adjusted MIT

## 8. Space heating requirement

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.9937 | 0.9892 | 0.9772 | 0.9321 | 0.8161 | 0.6153 | 0.4431 | 0.5084 | 0.7882 | 0.9553 | 0.9880 | 0.9947 | (94) |
| 433.9186 | 476.9989 | 514.4467 | 558.1855 | 536.1289 | 406.7435 | 278.4202 | 289.4787 | 399.3861 | 428.5784 | 419.2756 | 420.1011 | (95) |
| 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| 1105.2607 | 1069.9102 | 969.8909 | 812.5278 | 630.2293 | 423.8817 | 281.0704 | 294.5702 | 456.3715 | 685.1160 | 909.1444 | 1098.6849 | (97) |
| 499.4785 | 398.4364 | 338.8505 | 183.1265 | 70.0106 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 190.8640 | 352.7055 | 504.8664 | (98a) |
| | | | | | | | | | | | 2538.3384 | |
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| | | | | | | | | | | | 0.0000 | |
| 499.4785 | 398.4364 | 338.8505 | 183.1265 | 70.0106 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 190.8640 | 352.7055 | 504.8664 | (98c) |
| | | | | | | | | | | | 2538.3384 | |
| | | | | | | | | | (98c) / (4) = | | 50.5746 | (99) |

Space heating kWh

Space heating requirement - total per year (kWh/year)

Solar heating kWh

Solar heating contribution - total per year (kWh/year)

Space heating kWh

Space heating requirement after solar contribution - total per year (kWh/year)

Space heating per m2

## 9a. Energy requirements - Individual heating systems, including micro-CHP

| | |
|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | 0.0000 (201) |
| Fraction of space heat from main system(s) | 1.0000 (202) |
| Efficiency of main space heating system 1 (in %) | 92.3000 (206) |
| Efficiency of main space heating system 2 (in %) | 0.0000 (207) |
| Efficiency of secondary/supplementary heating system, % | 0.0000 (208) |

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 499.4785 | 398.4364 | 338.8505 | 183.1265 | 70.0106 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 190.8640 | 352.7055 | 504.8664 | (98) |
| 92.3000 | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.3000 | 92.3000 | 92.3000 | (210) |
| 541.1468 | 431.6754 | 367.1186 | 198.4036 | 75.8512 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 206.7865 | 382.1295 | 546.9841 | (211) |
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (212) |
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (213) |

Space heating requirement

Space heating efficiency (main heating system 1)

Space heating fuel (main heating system)

Space heating efficiency (main heating system 2)

Space heating fuel (main heating system 2)

Space heating fuel (secondary)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (215) |
| Water heating | | | | | | | | | | | | | |
| Water heating requirement | | | | | | | | | | | | | |
| | 192.6382 | 170.4854 | 181.5748 | 160.8984 | 156.7825 | 142.1708 | 141.0351 | 146.1803 | 147.2645 | 163.1210 | 172.0851 | 190.7144 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 | (216) |
| (217)m | 86.0973 | 85.8970 | 85.4381 | 84.3507 | 82.3773 | 79.8000 | 79.8000 | 79.8000 | 79.8000 | 84.4129 | 85.6331 | 86.1364 | (217) |
| Fuel for water heating, kWh/month | | | | | | | | | | | | | |
| | 223.7446 | 198.4766 | 212.5221 | 190.7494 | 190.3224 | 178.1589 | 176.7357 | 183.1833 | 184.5420 | 193.2417 | 200.9563 | 221.4097 | (219) |
| Space cooling fuel requirement | | | | | | | | | | | | | |
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (221) |
| Pumps and Fa | 7.3041 | 6.5973 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | (231) |
| Lighting | 15.5147 | 12.4465 | 11.2067 | 8.2105 | 6.3420 | 5.1815 | 5.7854 | 7.5201 | 9.7679 | 12.8160 | 14.4756 | 15.9459 | (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233a)m | -11.2335 | -16.9083 | -25.9335 | -31.1882 | -35.4551 | -33.7857 | -33.3917 | -30.6166 | -26.0460 | -20.2169 | -12.7296 | -9.5924 | (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233b)m | -3.4641 | -7.4946 | -15.2864 | -23.5393 | -31.6925 | -32.0368 | -31.6434 | -26.5175 | -19.0907 | -10.8876 | -4.6799 | -2.7231 | (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235d) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - main system 1 | 2750.0958 | (211) |
| Space heating fuel - main system 2 | 0.0000 | (213) |
| Space heating fuel - secondary | 0.0000 | (215) |
| Efficiency of water heater | 79.8000 | |
| Water heating fuel used | 2354.0427 | (219) |
| Space cooling fuel | 0.0000 | (221) |
| | | |
| Electricity for pumps and fans: | | |
| Total electricity for the above, kWh/year | 86.0000 | (231) |
| Electricity for lighting (calculated in Appendix L) | 125.2127 | (232) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -496.1533 | (233) |
| Wind generation | 0.0000 | (234) |
| Hydro-electric generation (Appendix N) | 0.0000 | (235a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (235) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (236) |
| Energy used | 0.0000 | (237) |
| Total delivered energy for all uses | 4819.1979 | (238) |

---

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

---

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 2750.0958 | 0.2100 | 577.5201 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2354.0427 | 0.2100 | 494.3490 | (264) |
| Space and water heating | | | 1071.8691 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 125.2127 | 0.1443 | 18.0721 | (268) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -287.0975 | 0.1332 | -38.2469 | |
| PV Unit electricity exported | -209.0558 | 0.1252 | -26.1709 | |
| Total | | | -64.4178 | (269) |
| Total CO2, kg/year | | | 1037.4526 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 20.6700 | (273) |

---

13a. Primary energy - Individual heating systems including micro-CHP

---

| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 2750.0958 | 1.1300 | 3107.6083 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2354.0427 | 1.1300 | 2660.0682 | (278) |
| Space and water heating | | | 5767.6765 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 125.2127 | 1.5338 | 192.0555 | (282) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -287.0975 | 1.4923 | -428.4289 | |
| PV Unit electricity exported | -209.0558 | 0.4595 | -96.0584 | |
| Total | | | -524.4873 | (283) |
| Total Primary energy kWh/year | | | 5565.3455 | (286) |
| Target Primary Energy Rate (TPER) | | | 110.8900 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Property Reference** | Unit 46 | **Issued on Date** | 17/05/2025 |
| **Assessment Reference** | 00001 | **Prop Type Ref** | Unit 46 |
| **Property** | | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 71 C | **DER** | 8.91 | **TER** | 20.89 |
| **Environmental** | 94 A | **% DER < TER** | | | 57.35 |
| **$CO_2$ Emissions (t/year)** | 0.43 | **DFEE** | 60.72 | **TFEE** | 62.79 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 3.30 |
| **% DPER < TPER** | 16.55 | **DPER** | 93.43 | **TPER** | 111.96 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Robert Arnold | **Assessor ID** | BA04-0001 |
| **Client** | | | |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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## 1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 54.3100 | (1b) | x 3.0000 | (2b) = | 162.9300 | (1b) - (3b) (4) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 54.3100 | | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | 162.9300 | (5) |

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## 2. Ventilation rate

---

| | | m3 per hour | |
|---|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 | (6a) |
| Number of open flues | 0 * 20 = | 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | 0 * 10 = | 0.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |

| | Air changes per hour | | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 0.0000 / (5) = | 0.0000 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 3.0000 | (17) |
| Infiltration rate | | 0.1500 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.1500 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.1912 | 0.1875 | 0.1837 | 0.1650 | 0.1612 | 0.1425 | 0.1425 | 0.1388 | 0.1500 | 0.1612 | 0.1687 | 0.1762 | (22b) |

Balanced mechanical ventilation with heat recovery

| | | |
|---|---|---|
| If mechanical ventilation | 0.5000 | (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | 0.5000 | (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | 81.0000 | (23c) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective ac | 0.2862 | 0.2825 | 0.2787 | 0.2600 | 0.2562 | 0.2375 | 0.2375 | 0.2337 | 0.2450 | 0.2562 | 0.2637 | 0.2712 | (25) |

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## 3. Heat losses and heat loss parameter

---

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| Windows | | | 15.9200 | 1.0536 | 16.7739 | | | (27) |
| Glass Door | | | 4.7400 | 1.3258 | 6.2841 | | | (27) |
| Front Door | | | 1.8900 | 1.4000 | 2.6460 | | | (26) |
| External Walls | 70.0000 | 20.6600 | 49.3400 | 0.1500 | 7.4010 | 150.0000 | 7401.0000 | (29a) |
| Wall to Communal Corridor | 13.4700 | 1.8900 | 11.5800 | 0.1400 | 1.6212 | 150.0000 | 1737.0000 | (29a) |
| External Roof | 54.3100 | | 54.3100 | 0.1000 | 5.4310 | 9.0000 | 488.7900 | (30) |
| Total net area of external elements Aum(A, m2) | | | 137.7800 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 40.1572 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 47 | | | 27.6400 | 0.0000 | 0.0000 | 110.0000 | 3040.4000 | (32) |
| Party Floor | | | 54.3100 | | | 80.0000 | 4344.8000 | (32d) |
| Internal Walls | | | 114.4800 | | | 9.0000 | 1030.3200 | (32c) |

| | | |
|---|---|---|
| Heat capacity Cm = Sum(A x k) | (28)...(30) + (32) + (32a)...(32e) = 18042.3100 | (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | 332.2097 | (35) |

List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E1 Steel lintel with perforated steel base plate | 10.3000 | 0.0500 | 0.5150 |
| E3 Sill | 1.0225 | 0.0500 | 0.0511 |
| E4 Jamb | 43.7100 | 0.0500 | 2.1855 |
| E7 Party floor between dwellings (in blocks of flats) | 2.7000 | 0.0350 | 0.0945 |
| E15 Flat roof with parapet | 23.3300 | 0.5600 | 13.0648 |
| E16 Corner (normal) | 9.0000 | 0.0900 | 0.8100 |
| E18 Party wall between dwellings | 6.0000 | 0.0300 | 0.1800 |
| E7 Party floor between dwellings (in blocks of flats) | 4.4900 | 0.0350 | 0.1572 |
| E24 Eaves (insulation at ceiling level - inverted) | 20.6360 | 0.1200 | 2.4763 |
| E17 Corner (inverted - internal area greater than external area) | 3.0000 | -0.0900 | -0.2700 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 19.2644 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 59.4216 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 15.3908 | 15.1891 | 14.9875 | 13.9794 | 13.7778 | 12.7696 | 12.7696 | 12.5680 | 13.1729 | 13.7778 | 14.1810 | 14.5843 | (38) |
| Heat transfer coeff | 74.8124 | 74.6108 | 74.4092 | 73.4010 | 73.1994 | 72.1913 | 72.1913 | 71.9896 | 72.5945 | 73.1994 | 73.6027 | 74.0059 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 73.3506 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.3775 | 1.3738 | 1.3701 | 1.3515 | 1.3478 | 1.3292 | 1.3292 | 1.3255 | 1.3367 | 1.3478 | 1.3552 | 1.3627 | (40) |
| HLP (average) | | | | | | | | | | | | 1.3506 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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4. Water heating energy requirements (kWh/year)

---

Assumed occupancy 1.8171 (42)
Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 53.3049 | 52.4888 | 51.2861 | 49.4359 | 47.7783 | 45.4591 | 43.6249 | 45.7692 | 46.8478 | 49.1447 | 51.5368 | 53.2568 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.1132 | 22.7643 | 22.2680 | 21.5246 | 20.8547 | 19.9325 | 19.2329 | 20.0884 | 20.5374 | 21.4512 | 22.4012 | 23.0949 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 33.2391 | 32.0304 | 30.8217 | 29.6130 | 28.4043 | 27.1956 | 27.1956 | 28.4043 | 29.6130 | 30.8217 | 32.0304 | 33.2391 | (42c) |

Average daily hot water use (litres/day) 100.7918 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 109.6572 | 107.2835 | 104.3758 | 100.5736 | 97.0373 | 92.5873 | 90.0534 | 94.2620 | 96.9982 | 101.4176 | 105.9684 | 109.5908 | (44) |
| Energy conte | 161.4344 | 141.9578 | 149.1508 | 131.3742 | 125.0424 | 107.0741 | 99.5116 | 110.9481 | 112.5130 | 130.6869 | 143.2199 | 160.9422 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1573.8553 | |

Distribution loss (46)m = 0.15 x (45)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 24.2152 | 21.2937 | 22.3726 | 19.7061 | 18.7564 | 16.0611 | 14.9267 | 16.6422 | 16.8770 | 19.6030 | 21.4830 | 24.1413 | (46) |

Water storage loss:
Store volume 110.0000 (47)
b) If manufacturer declared loss factor is not known :
Hot water storage loss factor from Table 2 (kWh/litre/day) 0.0152 (51)
Volume factor from Table 2a 1.0294 (52)
Temperature factor from Table 2b 0.6000 (53)
Enter (49) or (54) in (55) 1.0327 (55)
Total storage loss

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (56) |

If cylinder contains dedicated solar storage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (57) |
| Primary loss 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |

Total heat required for water heating calculated for each month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 216.7112 | 191.8852 | 204.4276 | 184.8679 | 180.3192 | 160.5678 | 154.7884 | 166.2249 | 166.0067 | 185.9637 | 196.7136 | 216.2190 | (62) |
| WWHRS 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63a) |
| PV diverter -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | | | | | | | | | | | | | |
| 216.7112 | 191.8852 | 204.4276 | 184.8679 | 180.3192 | 160.5678 | 154.7884 | 166.2249 | 166.0067 | 185.9637 | 196.7136 | 216.2190 | (64) |
| | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2224.6951 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | 2225 | (64) | |
| Electric shower(s) | | | | | | | | | | | | | |
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) | |
| | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | 0.0000 | (64a) | |

Heat gains from water heating, kWh/month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 97.8984 | 87.1429 | 93.8141 | 86.4769 | 85.7980 | 78.3971 | 77.3091 | 81.1117 | 80.2055 | 87.6748 | 90.4156 | 97.7347 | (65) |

---

5. Internal gains (see Table 5 and 5a)

---

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 90.8557 | 90.8557 | 90.8557 | 90.8557 | 90.8557 | 90.8557 | 90.8557 | 90.8557 | 90.8557 | 90.8557 | 90.8557 | 90.8557 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| 79.8975 | 88.4579 | 79.8975 | 82.5607 | 79.8975 | 82.5607 | 79.8975 | 79.8975 | 82.5607 | 79.8975 | 82.5607 | 79.8975 | (67) | |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| 158.4056 | 160.0494 | 155.9072 | 147.0889 | 135.9574 | 125.4954 | 118.5061 | 116.8624 | 121.0046 | 129.8228 | 140.9543 | 151.4164 | (68) | |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| 32.0856 | 32.0856 | 32.0856 | 32.0856 | 32.0856 | 32.0856 | 32.0856 | 32.0856 | 32.0856 | 32.0856 | 32.0856 | 32.0856 | (69) | |
| Pumps, fans 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (70) | |
| Losses e.g. evaporation (negative values) (Table 5) | | | | | | | | | | | | | |
| -72.6846 | -72.6846 | -72.6846 | -72.6846 | -72.6846 | -72.6846 | -72.6846 | -72.6846 | -72.6846 | -72.6846 | -72.6846 | -72.6846 | (71) | |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| 131.5838 | 129.6770 | 126.0942 | 120.1068 | 115.3199 | 108.8848 | 103.9100 | 109.0211 | 111.3966 | 117.8425 | 125.5772 | 131.3639 | (72) | |
| Total internal gains | | | | | | | | | | | | | |
| 420.1436 | 428.4410 | 412.1556 | 400.0131 | 381.4315 | 367.1976 | 352.5703 | 356.0376 | 365.2186 | 377.8195 | 399.3489 | 412.9344 | (73) | |

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6. Solar gains

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| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Southeast | 1.6800 | 36.7938 | 0.4500 | 0.7000 | 0.7700 | 13.4936 | (77) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southwest | | | | 8.6000 | 36.7938 | 0.4500 | 0.7000 | 0.7700 | | | | 69.0744 | (79) |
| Northwest | | | | 5.6400 | 11.2829 | 0.4500 | 0.7000 | 0.7700 | | | | 13.8914 | (81) |
| Southeast | | | | 2.3800 | 36.7938 | 0.4500 | 0.7000 | 0.7700 | | | | 19.1159 | (77) |
| Southwest | | | | 2.3600 | 36.7938 | 0.4500 | 0.7000 | 0.7700 | | | | 18.9553 | (79) |
| Solar gains | 134.5307 | 233.7696 | 332.1098 | 432.0431 | 502.6750 | 507.2877 | 485.6471 | 431.6916 | 366.5193 | 261.6698 | 161.9770 | 114.5865 | (83) |
| Total gains | 554.6743 | 662.2106 | 744.2654 | 832.0562 | 884.1065 | 874.4853 | 838.2174 | 787.7292 | 731.7379 | 639.4893 | 561.3259 | 527.5209 | (84) |

7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, ni1,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 66.9909 | 67.1720 | 67.3540 | 68.2791 | 68.4671 | 69.4233 | 69.4233 | 69.6177 | 69.0376 | 68.4671 | 68.0920 | 67.7210 | |
| alpha | 5.4661 | 5.4781 | 5.4903 | 5.5519 | 5.5645 | 5.6282 | 5.6282 | 5.6412 | 5.6025 | 5.5645 | 5.5395 | 5.5147 | |
| util living area | 0.9934 | 0.9824 | 0.9556 | 0.8736 | 0.7196 | 0.5214 | 0.3779 | 0.4185 | 0.6564 | 0.9110 | 0.9834 | 0.9949 | (86) |
| MIT | 19.9408 | 20.1644 | 20.4418 | 20.7545 | 20.9321 | 20.9907 | 20.9987 | 20.9978 | 20.9686 | 20.7279 | 20.2833 | 19.9080 | (87) |
| Th 2 | 19.7806 | 19.7835 | 19.7863 | 19.8007 | 19.8036 | 19.8180 | 19.8180 | 19.8209 | 19.8122 | 19.8036 | 19.7978 | 19.7921 | (88) |
| util rest of house | 0.9906 | 0.9754 | 0.9382 | 0.8303 | 0.6451 | 0.4286 | 0.2770 | 0.3123 | 0.5563 | 0.8688 | 0.9754 | 0.9927 | (89) |
| MIT 2 | 18.5960 | 18.8789 | 19.2207 | 19.5873 | 19.7589 | 19.8143 | 19.8178 | 19.8204 | 19.7973 | 19.5728 | 19.0422 | 18.5630 | (90) |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.6590 | (91) |
| MIT | 19.4822 | 19.7260 | 20.0254 | 20.3565 | 20.5320 | 20.5895 | 20.5960 | 20.5963 | 20.5692 | 20.3340 | 19.8601 | 19.4494 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.4822 | 19.7260 | 20.0254 | 20.3565 | 20.5320 | 20.5895 | 20.5960 | 20.5963 | 20.5692 | 20.3340 | 19.8601 | 19.4494 | (93) |

8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9897 | 0.9750 | 0.9421 | 0.8518 | 0.6918 | 0.4897 | 0.3436 | 0.3824 | 0.6215 | 0.8895 | 0.9759 | 0.9919 | (94) |
| Useful gains | 548.9750 | 645.6239 | 701.2071 | 708.7668 | 611.5813 | 428.2024 | 288.0088 | 301.2528 | 454.8111 | 568.8420 | 547.8114 | 523.2522 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | 1135.8196 | 1106.1819 | 1006.4108 | 840.9178 | 646.4999 | 432.3924 | 288.4766 | 302.0898 | 469.6261 | 712.5220 | 939.1767 | 1128.5432 | (97) |
| Space heating kWh | 436.6124 | 309.4949 | 227.0716 | 95.1487 | 25.9795 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 106.8980 | 281.7830 | 450.3365 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 1933.3246 | |
| Solar heating kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | 436.6124 | 309.4949 | 227.0716 | 95.1487 | 25.9795 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 106.8980 | 281.7830 | 450.3365 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 1933.3246 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 35.5979 | (99) |

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ext. temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | |
| Heat loss rate W | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 678.5979 | 534.2154 | 547.1213 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (100) |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.9573 | 0.9815 | 0.9730 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (101) |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 649.6079 | 524.3534 | 532.3605 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (102) |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 979.2776 | 939.0674 | 880.6335 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 237.3622 | 308.5472 | 259.1151 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (104) |
| Cooled fraction | | | | | | | | | fC = cooled area / (4) = | | | 0.9943 | (105) |
| Intermittency factor (Table 10b) | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | (106) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 59.0018 | 76.6965 | 64.4090 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) |
| Space cooling requirement | | | | | | | | | | | | 200.1074 | (107) |

9b. Energy requirements

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | 0.0000 | (301) |
| Fraction of space heat from community system | | | | | | | | | | | | 1.0000 | (302) |
| Fraction of heat from community Heat pump-Space and Water | | | | | | | | | | | | 1.0000 | (303a) |
| Factor for control and charging method (Table 4c(3)) for space heating | | | | | | | | | | | | 1.0000 | (305) |
| Factor for charging method (Table 4c(3)) for water heating | | | | | | | | | | | | 1.0000 | (305a) |
| Distribution loss factor (Table 12c) for community heating system | | | | | | | | | | | | 2.0000 | (306) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 | (208) |
| Space heating: | | | | | | | | | | | | | |
| Space heating requirement | | | | | | | | | | | | | |
| | 436.6124 | 309.4949 | 227.0716 | 95.1487 | 25.9795 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 106.8980 | 281.7830 | 450.3365 | (98) |
| Space heat from Heat pump = (98) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 307a | 873.2249 | 618.9899 | 454.1432 | 190.2974 | 51.9590 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 213.7960 | 563.5660 | 900.6729 | |
| Space heating requirement | | | | | | | | | | | | | |
| | 873.2249 | 618.9899 | 454.1432 | 190.2974 | 51.9590 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 213.7960 | 563.5660 | 900.6729 | (307) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | | | | | | | | | | | 0.0000 | (308) |
| Space heating fuel for secondary/supplementary system | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (309) |
| Water heating | | | | | | | | | | | | | |
| Annual water heating requirement | | | | | | | | | | | | | |
| | 216.7112 | 191.8852 | 204.4276 | 184.8679 | 180.3192 | 160.5678 | 154.7884 | 166.2249 | 166.0067 | 185.9637 | 196.7136 | 216.2190 | (64) |
| Water heat from Heat pump = (64) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 310a | 433.4223 | 383.7705 | 408.8553 | 369.7358 | 360.6383 | 321.1355 | 309.5768 | 332.4497 | 332.0135 | 371.9273 | 393.4271 | 432.4379 | |
| Water heating fuel | | | | | | | | | | | | | |
| | 433.4223 | 383.7705 | 408.8553 | 369.7358 | 360.6383 | 321.1355 | 309.5768 | 332.4497 | 332.0135 | 371.9273 | 393.4271 | 432.4379 | (310) |
| Cooling System Energy Efficiency Ratio | | | | | | | | | | | | 2.6000 | (314) |
| Space coolin | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 22.6930 | 29.4987 | 24.7727 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (315) |
| Pumps and Fa | 14.8901 | 13.4491 | 14.8901 | 14.4098 | 14.8901 | 14.4098 | 14.8901 | 14.8901 | 14.4098 | 14.8901 | 14.4098 | 14.8901 | (331) |
| Lighting | 15.4474 | 12.3925 | 11.1581 | 8.1749 | 6.3145 | 5.1590 | 5.7603 | 7.4875 | 9.7255 | 12.7604 | 14.4128 | 15.8768 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (333a)m | -4.7177 | -7.6157 | -12.6095 | -16.2798 | -19.4094 | -18.8247 | -18.5598 | -16.5245 | -13.3034 | -9.4890 | -5.4945 | -3.9624 | (333a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335a) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (333b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335b) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - community heating | 3866.6492 | (307) |
| Space heating fuel - secondary | 0.0000 | (309) |
| Water heating fuel - community heating | 4449.3902 | (310) |
| Efficiency of water heater | 0.0000 | (311) |
| Electricity used for heat distribution | 38.6665 | (313) |
| Space cooling fuel | 76.9644 | (321) |
| | | |
| Electricity for pumps and fans: | | |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8820) | | |
| mechanical ventilation fans (SFP = 0.8820) | 175.3192 | (330a) |
| Total electricity for the above, kWh/year | 175.3192 | (331) |
| Electricity for lighting (calculated in Appendix L) | 124.6696 | (332) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -146.7904 | (333) |
| Wind generation | 0.0000 | (334) |
| Hydro-electric generation (Appendix N) | 0.0000 | (335a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (335) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (336) |
| Energy used | 0.0000 | (337) |
| Total delivered energy for all uses | 8546.2022 | (338) |

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12b. Carbon dioxide emissions - Community heating scheme

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (367) |
| Space and Water heating from Heat pump | 2970.0141 | 0.1567 | 216.3977 | (367) |
| Electrical energy for heat distribution (space & water) | 38.6665 | 0.0000 | 12.3211 | (372) |
| Overall CO2 factor for heat network | | | 0.0544 | (386) |
| Total CO2 associated with community systems | | | 452.3612 | (373) |
| Space and water heating | | | 452.3612 | (376) |
| Space cooling | 76.9644 | 0.1140 | 8.7721 | (377) |
| Pumps, fans and electric keep-hot | 175.3192 | 0.1387 | 24.3189 | (378) |
| Energy for lighting | 124.6696 | 0.1443 | 17.9937 | (379) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -146.7904 | 0.1319 | -19.3657 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -19.3657 | (380) |
| Total CO2, kg/year | | | 484.0802 | (383) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 8.9100 | (384) |

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13b. Primary energy - Community heating scheme

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| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (467a) |
| Space and Water heating from Heat pump | 2970.0141 | 1.5801 | 2182.0486 | (467) |
| Electrical energy for heat distribution (space & water) | 38.6665 | 0.0000 | 128.7454 | (472) |
| Overall CO2 factor for heat network | | | 0.5684 | (486) |
| Total CO2 associated with community systems | | | 4726.7963 | (473) |
| Space and water heating | | | 4726.7963 | (476) |
| Space cooling | 76.9644 | 1.4201 | 109.2976 | (477) |
| Pumps, fans and electric keep-hot | 175.3192 | 1.5128 | 265.2229 | (478) |
| Energy for lighting | 124.6696 | 1.5338 | 191.2224 | (479) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -146.7904 | 1.4874 | -218.3402 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -218.3402 | (480) |
| Total Primary energy kWh/year | | | 5074.1989 | (483) |
| Dwelling Primary energy Rate (DPER) | | | 93.4300 | (484) |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 54.3100 | (1b) | x 3.0000 | (2b) = | 162.9300 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 54.3100 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = | 162.9300 | (5) |

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2. Ventilation rate

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| | | | |
|---|---|---|---|
| | | m3 per hour | |
| Number of open chimneys | 0 * 80 = | 0.0000 | (6a) |
| Number of open flues | 0 * 20 = | 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | 2 * 10 = | 20.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |
| | | Air changes per hour | |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 20.0000 / (5) = | 0.1228 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3728 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.3728 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.4753 | 0.4659 | 0.4566 | 0.4100 | 0.4007 | 0.3541 | 0.3541 | 0.3448 | 0.3728 | 0.4007 | 0.4193 | 0.4380 | (22b) |
| Effective ac | 0.6129 | 0.6086 | 0.6043 | 0.5841 | 0.5803 | 0.5627 | 0.5627 | 0.5594 | 0.5695 | 0.5803 | 0.5879 | 0.5959 | (25) |

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3. Heat losses and heat loss parameter

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| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| TER Opaque door | | | 1.8900 | 1.0000 | 1.8900 | | | (26) |
| TER Opening Type | | | 11.6900 | 1.1450 | 13.3855 | | | (27) |
| External Walls | 70.0000 | 11.6900 | 58.3100 | 0.1800 | 10.4958 | | | (29a) |
| Wall to Communal Corridor | 13.4700 | 1.8900 | 11.5800 | 0.1800 | 2.0844 | | | (29a) |
| External Roof | 54.3100 | | 54.3100 | 0.1100 | 5.9741 | | | (30) |
| Total net area of external elements Aum(A, m2) | | | 137.7800 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 33.8298 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 47 | | | 27.6400 | 0.0000 | 0.0000 | | | (32) |

| | | |
|---|---|---|
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | 332.2097 | (35) |

List of Thermal Bridges

| K1 Element | Length | Psi-value | Total |
|---|---|---|---|
| E1 Steel lintel with perforated steel base plate | 10.3000 | 0.0500 | 0.5150 |
| E3 Sill | 1.0225 | 0.0500 | 0.0511 |
| E4 Jamb | 43.7100 | 0.0500 | 2.1855 |
| E7 Party floor between dwellings (in blocks of flats) | 2.7000 | 0.0700 | 0.1890 |
| E15 Flat roof with parapet | 23.3300 | 0.5600 | 13.0648 |
| E16 Corner (normal) | 9.0000 | 0.0900 | 0.8100 |
| E18 Party wall between dwellings | 6.0000 | 0.0600 | 0.3600 |
| E7 Party floor between dwellings (in blocks of flats) | 4.4900 | 0.0700 | 0.3143 |
| E24 Eaves (insulation at ceiling level - inverted) | 20.6360 | 0.2400 | 4.9526 |
| E17 Corner (inverted - internal area greater than external area) | 3.0000 | -0.0900 | -0.2700 |

| | | | |
|---|---|---|---|
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | 22.1724 | (36) |
| Point Thermal bridges | (36a) = | 0.0000 | |
| Total fabric heat loss | (33) + (36) + (36a) = | 56.0022 | (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 32.9556 | 32.7199 | 32.4887 | 31.4032 | 31.2001 | 30.2546 | 30.2546 | 30.0795 | 30.6187 | 31.2001 | 31.6109 | 32.0405 | (38) |
| Heat transfer coeff | 88.9578 | 88.7220 | 88.4909 | 87.4053 | 87.2022 | 86.2567 | 86.2567 | 86.0816 | 86.6209 | 87.2022 | 87.6131 | 88.0427 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 87.4043 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.6380 | 1.6336 | 1.6294 | 1.6094 | 1.6056 | 1.5882 | 1.5882 | 1.5850 | 1.5949 | 1.6056 | 1.6132 | 1.6211 | (40) |
| HLP (average) | | | | | | | | | | | | 1.6094 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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4. Water heating energy requirements (kWh/year)

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| | | | |
|---|---|---|---|
| Assumed occupancy | 1.8171 | (42) | |
| Hot water usage for mixer showers | 54.6866 | 53.8647 | 52.6672 | 50.3758 | 48.6849 | 46.7991 | 45.7273 | 46.9158 | 48.2186 | 50.2433 | 52.5839 | 54.4770 | (42a) |
| Hot water usage for baths | 23.6402 | 23.2891 | 22.7947 | 21.8831 | 21.2005 | 20.4436 | 20.0348 | 20.5258 | 21.0603 | 21.8702 | 22.8006 | 23.5603 | (42b) |
| Hot water usage for other uses | 33.2391 | 32.0304 | 30.8217 | 29.6130 | 28.4043 | 27.1956 | 27.1956 | 28.4043 | 29.6130 | 30.8217 | 32.0304 | 33.2391 | (42c) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 102.5547 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 111.5659 | 109.1843 | 106.2836 | 101.8719 | 98.2897 | 94.4384 | 92.9577 | 95.8459 | 98.8919 | 102.9352 | 107.4148 | 111.2764 | (44) |
| Energy conte | 176.6931 | 155.4769 | 163.3539 | 139.4576 | 132.3168 | 116.1230 | 112.4243 | 118.6772 | 121.9436 | 139.6821 | 153.0321 | 174.2320 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1703.4127 | |
| Distribution loss (46)m = 0.15 x (45)m | 26.5040 | 23.3215 | 24.5031 | 20.9186 | 19.8475 | 17.4185 | 16.8636 | 17.8016 | 18.2915 | 20.9523 | 22.9548 | 26.1348 | (46) |

| | | |
|---|---|---|
| Water storage loss: | | |
| Store volume | 150.0000 | (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | 1.3938 | (48) |
| Temperature factor from Table 2b | 0.5400 | (49) |
| Enter (49) or (54) in (55) | 0.7527 | (55) |

Total storage loss

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (56) |
| If cylinder contains dedicated solar storage | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (57) |
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |

Total heat required for water heating calculated for each month

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 223.2880 | 197.5626 | 209.9488 | 184.5494 | 178.9117 | 161.2149 | 159.0192 | 165.2721 | 167.0355 | 186.2770 | 198.1240 | 220.8269 | (62) |
| WWHRS | -25.0004 | -22.1106 | -23.1529 | -19.1715 | -17.8672 | -15.2891 | -14.3311 | -15.2396 | -15.8187 | -18.6485 | -21.1264 | -24.5374 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | | | | | | | | | | | | | |
| | 198.2876 | 175.4521 | 186.7959 | 165.3779 | 161.0446 | 145.9258 | 144.6881 | 150.0324 | 151.2168 | 167.6286 | 176.9976 | 196.2894 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2019.7368 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2020 | (64) |
| Electric shower(s) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | | | | | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | | | | | | | | | | | | | |
| | 96.0264 | 85.3647 | 91.5911 | 82.4431 | 81.2713 | 74.6844 | 74.6570 | 76.7361 | 76.6197 | 83.7202 | 86.9567 | 95.2081 | (65) |

## 5. Internal gains (see Table 5 and 5a)

| Metabolic gains (Table 5), Watts | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 90.8557 | 90.8557 | 90.8557 | 90.8557 | 90.8557 | 90.8557 | 90.8557 | 90.8557 | 90.8557 | 90.8557 | 90.8557 | 90.8557 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 79.9971 | 88.5682 | 79.9971 | 82.6637 | 79.9971 | 82.6637 | 79.9971 | 79.9971 | 82.6637 | 79.9971 | 82.6637 | 79.9971 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 158.4056 | 160.0494 | 155.9072 | 147.0889 | 135.9574 | 125.4954 | 118.5061 | 116.8624 | 121.0046 | 129.8228 | 140.9543 | 151.4164 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 32.0856 | 32.0856 | 32.0856 | 32.0856 | 32.0856 | 32.0856 | 32.0856 | 32.0856 | 32.0856 | 32.0856 | 32.0856 | 32.0856 | (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.0000 | 3.0000 | 3.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | | | | | | | | | | | | | |
| | -72.6846 | -72.6846 | -72.6846 | -72.6846 | -72.6846 | -72.6846 | -72.6846 | -72.6846 | -72.6846 | -72.6846 | -72.6846 | -72.6846 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 129.0677 | 127.0307 | 123.1063 | 114.5043 | 109.2356 | 103.7283 | 100.3454 | 103.1399 | 106.4163 | 112.5272 | 120.7731 | 127.9678 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 420.7272 | 428.9051 | 412.2673 | 397.5136 | 378.4468 | 362.1441 | 349.1054 | 350.2561 | 360.3413 | 375.6039 | 397.6479 | 412.6380 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Southeast | 2.3000 | 36.7938 | 0.6300 | 0.7000 | 0.7700 | 25.8627 | (77) |
| Southwest | 6.2000 | 36.7938 | 0.6300 | 0.7000 | 0.7700 | 69.7170 | (79) |
| Northwest | 3.1900 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 10.9998 | (81) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 106.5795 | 185.1980 | 263.1009 | 342.2616 | 398.2091 | 401.8604 | 384.7184 | 341.9806 | 290.3579 | 207.3000 | 128.3231 | 90.7793 | (83) |
| Total gains | 527.3067 | 614.1031 | 675.3682 | 739.7752 | 776.6559 | 764.0045 | 733.8238 | 692.2367 | 650.6992 | 582.9038 | 525.9710 | 503.4173 | (84) |

## 7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 56.3385 | 56.4883 | 56.6358 | 57.3392 | 57.4728 | 58.1028 | 58.1028 | 58.2209 | 57.8585 | 57.4728 | 57.2032 | 56.9241 | |
| alpha | 4.7559 | 4.7659 | 4.7757 | 4.8226 | 4.8315 | 4.8735 | 4.8735 | 4.8814 | 4.8572 | 4.8315 | 4.8135 | 4.7949 | |
| util living area | | | | | | | | | | | | | |
| | 0.9953 | 0.9897 | 0.9773 | 0.9387 | 0.8459 | 0.6743 | 0.5069 | 0.5554 | 0.7922 | 0.9543 | 0.9899 | 0.9962 | (86) |
| MIT | 19.5941 | 19.7984 | 20.0872 | 20.4665 | 20.7737 | 20.9456 | 20.9889 | 20.9830 | 20.8790 | 20.4847 | 19.9764 | 19.5662 | (87) |
| Th 2 | 19.5856 | 19.5888 | 19.5919 | 19.6065 | 19.6092 | 19.6220 | 19.6220 | 19.6243 | 19.6170 | 19.6092 | 19.6037 | 19.5979 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9932 | 0.9852 | 0.9668 | 0.9096 | 0.7759 | 0.5510 | 0.3537 | 0.3982 | 0.6823 | 0.9260 | 0.9846 | 0.9945 | (89) |
| MIT 2 | 18.0157 | 18.2769 | 18.6415 | 19.1108 | 19.4450 | 19.5988 | 19.6199 | 19.6207 | 19.5530 | 19.1455 | 18.5154 | 17.9888 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.6590 | (91) |
| MIT | 19.0559 | 19.2796 | 19.5942 | 20.0042 | 20.3206 | 20.4864 | 20.5221 | 20.5185 | 20.4269 | 20.0280 | 19.4782 | 19.0283 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.0559 | 19.2796 | 19.5942 | 20.0042 | 20.3206 | 20.4864 | 20.5221 | 20.5185 | 20.4269 | 20.0280 | 19.4782 | 19.0283 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9921 | 0.9839 | 0.9669 | 0.9192 | 0.8147 | 0.6311 | 0.4552 | 0.5024 | 0.7512 | 0.9362 | 0.9839 | 0.9936 | (94) |
| Useful gains | 523.1618 | 604.1896 | 652.9875 | 679.9850 | 632.7661 | 482.1700 | 334.0728 | 347.7952 | 488.8273 | 545.6923 | 517.5267 | 500.1985 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | | | | | | | | | | | | | |
| | 1312.6488 | 1275.7859 | 1158.7189 | 970.5693 | 751.7339 | 507.7384 | 338.3057 | 354.5238 | 548.0380 | 822.1434 | 1084.4931 | 1305.5212 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 587.3784 | 451.3127 | 376.2642 | 209.2207 | 88.5120 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 205.6796 | 408.2158 | 599.1601 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 2925.7435 | |
| Solar heating kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | | | | | | | | | | | | | |
| | 587.3784 | 451.3127 | 376.2642 | 209.2207 | 88.5120 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 205.6796 | 408.2158 | 599.1601 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 2925.7435 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 53.8712 | (99) |

## 9a. Energy requirements - Individual heating systems, including micro-CHP

| | | |
|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | 0.0000 | (201) |
| Fraction of space heat from main system(s) | 1.0000 | (202) |
| Efficiency of main space heating system 1 (in %) | 92.3000 | (206) |
| Efficiency of main space heating system 2 (in %) | 0.0000 | (207) |
| Efficiency of secondary/supplementary heating system, % | 0.0000 | (208) |

# Full SAP Calculation Printout

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement | | | | | | | | | | | | | |
| | 587.3784 | 451.3127 | 376.2642 | 209.2207 | 88.5120 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 205.6796 | 408.2158 | 599.1601 | (98) |
| Space heating efficiency (main heating system 1) | | | | | | | | | | | | | |
| | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.3000 | 92.3000 | 92.3000 | (210) |
| Space heating fuel (main heating system) | | | | | | | | | | | | | |
| | 636.3796 | 488.9629 | 407.6535 | 226.6746 | 95.8960 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 222.8381 | 442.2707 | 649.1442 | (211) |
| Space heating efficiency (main heating system 2) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (212) |
| Space heating fuel (main heating system 2) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (213) |
| Space heating fuel (secondary) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (215) |
| | | | | | | | | | | | | | |
| Water heating | | | | | | | | | | | | | |
| Water heating requirement | | | | | | | | | | | | | |
| | 198.2876 | 175.4521 | 186.7959 | 165.3779 | 161.0446 | 145.9258 | 144.6881 | 150.0324 | 151.2168 | 167.6286 | 176.9976 | 196.2894 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 | (216) |
| (217)m | 86.3423 | 86.0823 | 85.5973 | 84.5883 | 82.7755 | 79.8000 | 79.8000 | 79.8000 | 79.8000 | 84.5197 | 85.8709 | 86.3956 | (217) |
| Fuel for water heating, kWh/month | | | | | | | | | | | | | |
| | 229.6527 | 203.8191 | 218.2263 | 195.5093 | 194.5558 | 182.8644 | 181.3134 | 188.0106 | 189.4948 | 198.3309 | 206.1206 | 227.1986 | (219) |
| Space cooling fuel requirement | | | | | | | | | | | | | |
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (221) |
| Pumps and Fa | 7.3041 | 6.5973 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | (231) |
| Lighting | 16.6218 | 13.3346 | 12.0064 | 8.7964 | 6.7946 | 5.5512 | 6.1982 | 8.0567 | 10.4649 | 13.7305 | 15.5085 | 17.0838 | (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233a)m | -12.1296 | -18.2428 | -27.9575 | -33.5914 | -38.1560 | -36.3435 | -35.9152 | -32.9430 | -28.0469 | -21.7957 | -13.7388 | -10.3588 | (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233b)m | -3.7745 | -8.1632 | -16.6461 | -25.6285 | -34.5037 | -34.8823 | -34.4585 | -28.8811 | -20.7951 | -11.8622 | -5.0998 | -2.9675 | (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235d) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - main system 1 | 3169.8196 | (211) |
| Space heating fuel - main system 2 | 0.0000 | (213) |
| Space heating fuel - secondary | 0.0000 | (215) |
| Efficiency of water heater | 79.8000 | |
| Water heating fuel used | 2415.0964 | (219) |
| Space cooling fuel | 0.0000 | (221) |
| | | |
| Electricity for pumps and fans: | | |
| Total electricity for the above, kWh/year | 86.0000 | (231) |
| Electricity for lighting (calculated in Appendix L) | 134.1476 | (232) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -536.8816 | (233) |
| Wind generation | 0.0000 | (234) |
| Hydro-electric generation (Appendix N) | 0.0000 | (235a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (235) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (236) |
| Energy used | 0.0000 | (237) |
| Total delivered energy for all uses | 5268.1820 | (238) |

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12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 3169.8196 | 0.2100 | 665.6621 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2415.0964 | 0.2100 | 507.1702 | (264) |
| Space and water heating | | | 1172.8323 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 134.1476 | 0.1443 | 19.3616 | (268) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -309.2192 | 0.1332 | -41.2000 | |
| PV Unit electricity exported | -227.6623 | 0.1252 | -28.5006 | |
| Total | | | -69.7006 | (269) |
| Total CO2, kg/year | | | 1134.4227 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 20.8900 | (273) |

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13a. Primary energy - Individual heating systems including micro-CHP

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| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 3169.8196 | 1.1300 | 3581.8961 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2415.0964 | 1.1300 | 2729.0589 | (278) |
| Space and water heating | | | 6310.9550 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 134.1476 | 1.5338 | 205.7601 | (282) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -309.2192 | 1.4924 | -461.4637 | |
| PV Unit electricity exported | -227.6623 | 0.4595 | -104.6090 | |
| Total | | | -566.0728 | (283) |
| Total Primary energy kWh/year | | | 6080.7431 | (286) |
| Target Primary Energy Rate (TPER) | | | 111.9600 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Property Reference** | Unit 47 | **Issued on Date** | 17/05/2025 |
| **Assessment Reference** | 00001 | **Prop Type Ref** | Unit 47 |
| **Property** | | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 74 C | **DER** | 8.26 | **TER** | 20.32 |
| **Environmental** | 94 A | **% DER < TER** | | | 59.35 |
| **$CO_2$ Emissions (t/year)** | 0.37 | **DFEE** | 54.97 | **TFEE** | 58.53 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 6.08 |
| **% DPER < TPER** | 20.33 | **DPER** | 86.84 | **TPER** | 109.00 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Robert Arnold | **Assessor ID** | BA04-0001 |
| **Client** | | | |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

## 1. Overall dwelling characteristics

| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 50.2300 | (1b) | x 3.0000 | (2b) = | 150.6900 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 50.2300 | | | | | (4) |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | 150.6900 | (5) |

## 2. Ventilation rate

| | m3 per hour | |
|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 (6a) |
| Number of open flues | 0 * 20 = | 0.0000 (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 (6f) |
| Number of intermittent extract fans | 0 * 10 = | 0.0000 (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 (7c) |

| | Air changes per hour | |
|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 0.0000 / (5) = | 0.0000 (8) |
| Pressure test | | Yes |
| Pressure Test Method | | Blower Door |
| Measured/design AP50 | | 3.0000 (17) |
| Infiltration rate | | 0.1500 (18) |
| Number of sides sheltered | | 0 (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.1500 (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.1912 | 0.1875 | 0.1837 | 0.1650 | 0.1612 | 0.1425 | 0.1425 | 0.1388 | 0.1500 | 0.1612 | 0.1687 | 0.1762 | (22b) |
| Balanced mechanical ventilation with heat recovery | | | | | | | | | | | | | |
| If mechanical ventilation | | | | | | | | | | | | 0.5000 | (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | | | | | | | | | | | | 0.5000 | (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | | | | | | | | | | | | 81.0000 | (23c) |
| Effective ac | 0.2862 | 0.2825 | 0.2787 | 0.2600 | 0.2562 | 0.2375 | 0.2375 | 0.2337 | 0.2450 | 0.2562 | 0.2637 | 0.2712 | (25) |

## 3. Heat losses and heat loss parameter

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| Windows | | | 10.3700 | 1.0536 | 10.9262 | | | (27) |
| Glass Door | | | 2.5700 | 1.3258 | 3.4072 | | | (27) |
| Front Door | | | 1.8900 | 1.4000 | 2.6460 | | | (26) |
| External Walls | 40.7300 | 12.9400 | 27.7900 | 0.1500 | 4.1685 | 150.0000 | 4168.5000 | (29a) |
| Wall to Communal | 30.0800 | 1.8900 | 28.1900 | 0.1400 | 3.9466 | 150.0000 | 4228.5000 | (29a) |
| External Roof | 50.2300 | | 50.2300 | 0.1000 | 5.0230 | 9.0000 | 452.0700 | (30) |
| Total net area of external elements Aum(A, m2) | | | 121.0400 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 30.1175 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 46 | | | 25.8100 | 0.0000 | 0.0000 | 110.0000 | 2839.1000 | (32) |
| Party Wall to Unit 48 | | | 8.9800 | 0.0000 | 0.0000 | 110.0000 | 987.8000 | (32) |
| Party Floor | | | 50.2300 | | | 80.0000 | 4018.4000 | (32d) |
| Internal Walls | | | 96.8800 | | | 9.0000 | 871.9200 | (32c) |
| Heat capacity Cm = Sum(A x k) | | | | | (28)...(30) + (32) + (32a)...(32e) = | | 17566.2900 | (34) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 349.7171 (35)
List of Thermal Bridges

| | K1 Element | Length | Psi-value | Total |
|---|---|---|---|---|
| E1 | Steel lintel with perforated steel base plate | 7.4900 | 0.0500 | 0.3745 |
| E3 | Sill | 3.6200 | 0.0500 | 0.1810 |
| E4 | Jamb | 20.0600 | 0.0500 | 1.0030 |
| E7 | Party floor between dwellings (in blocks of flats) | 6.3630 | 0.0350 | 0.2227 |
| E15 | Flat roof with parapet | 13.5700 | 0.5600 | 7.5992 |
| E18 | Party wall between dwellings | 6.0000 | 0.0300 | 0.1800 |
| E7 | Party floor between dwellings (in blocks of flats) | 10.0275 | 0.0340 | 0.3409 |
| E24 | Eaves (insulation at ceiling level - inverted) | 7.2100 | 0.1200 | 0.8652 |
| E16 | Corner (normal) | 3.0000 | 0.0900 | 0.2700 |
| E17 | Corner (inverted - internal area greater than external area) | 3.0000 | -0.0900 | -0.2700 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 10.7665 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 40.8841 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 14.2346 | 14.0481 | 13.8616 | 12.9292 | 12.7427 | 11.8103 | 11.8103 | 11.6238 | 12.1833 | 12.7427 | 13.1157 | 13.4886 | (38) |
| Heat transfer coeff | 55.1186 | 54.9322 | 54.7457 | 53.8133 | 53.6268 | 52.6944 | 52.6944 | 52.5079 | 53.0674 | 53.6268 | 53.9998 | 54.3727 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 53.7667 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.0973 | 1.0936 | 1.0899 | 1.0713 | 1.0676 | 1.0491 | 1.0491 | 1.0454 | 1.0565 | 1.0676 | 1.0751 | 1.0825 | (40) |
| HLP (average) | | | | | | | | | | | | 1.0704 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

---
4. Water heating energy requirements (kWh/year)
---

Assumed occupancy 1.6969 (42)
Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 51.3398 | 50.5538 | 49.3954 | 47.6134 | 46.0169 | 43.7832 | 42.0166 | 44.0819 | 45.1207 | 47.3330 | 49.6369 | 51.2935 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 22.2656 | 21.9295 | 21.4513 | 20.7353 | 20.0899 | 19.2015 | 18.5275 | 19.3517 | 19.7843 | 20.6645 | 21.5797 | 22.2479 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.0077 | 30.8438 | 29.6799 | 28.5159 | 27.3520 | 26.1881 | 26.1881 | 27.3520 | 28.5159 | 29.6799 | 30.8438 | 32.0077 | (42c) |

Average daily hot water use (litres/day) 97.0747 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 105.6131 | 103.3270 | 100.5266 | 96.8646 | 93.4588 | 89.1729 | 86.7323 | 90.7857 | 93.4209 | 97.6773 | 102.0604 | 105.5491 | (44) |
| Energy conte | 155.4807 | 136.7225 | 143.6504 | 126.5294 | 120.4311 | 103.1255 | 95.8417 | 106.8564 | 108.3635 | 125.8671 | 137.9380 | 155.0066 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1515.8130 | |

Distribution loss (46)m = 0.15 x (45)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.3221 | 20.5084 | 21.5476 | 18.9794 | 18.0647 | 15.4688 | 14.3763 | 16.0285 | 16.2545 | 18.8801 | 20.6907 | 23.2510 | (46) |

Water storage loss:
Store volume 110.0000 (47)
b) If manufacturer declared loss factor is not known :
Hot water storage loss factor from Table 2 (kWh/litre/day) 0.0152 (51)
Volume factor from Table 2a 1.0294 (52)
Temperature factor from Table 2b 0.6000 (53)
Enter (49) or (54) in (55) 1.0327 (55)
Total storage loss

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (56) |

If cylinder contains dedicated solar storage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (57) |
| Primary loss 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |

Total heat required for water heating calculated for each month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 210.7575 | 186.6500 | 198.9272 | 180.0231 | 175.7079 | 156.6192 | 151.1185 | 162.1332 | 161.8572 | 181.1439 | 191.4316 | 210.2834 | (62) |
| WWHRS 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63a) |
| PV diverter -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | | | | | | | | | | | | | |
| 210.7575 | 186.6500 | 198.9272 | 180.0231 | 175.7079 | 156.6192 | 151.1185 | 162.1332 | 161.8572 | 181.1439 | 191.4316 | 210.2834 | (64) |
| | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | | 2166.6528 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | 2167 | (64) | |

Electric shower(s)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)

Heat gains from water heating, kWh/month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 95.9188 | 85.4022 | 91.9852 | 84.8660 | 84.2648 | 77.0842 | 76.0888 | 79.7512 | 78.8258 | 86.0723 | 88.6593 | 95.7611 | (65) |

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5. Internal gains (see Table 5 and 5a)
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Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 84.8437 | 84.8437 | 84.8437 | 84.8437 | 84.8437 | 84.8437 | 84.8437 | 84.8437 | 84.8437 | 84.8437 | 84.8437 | 84.8437 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 74.5639 | 82.5529 | 74.5639 | 77.0494 | 74.5639 | 77.0494 | 74.5639 | 74.5639 | 77.0494 | 74.5639 | 77.0494 | 74.5639 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 147.8313 | 149.3653 | 145.4996 | 137.2700 | 126.8816 | 117.1180 | 110.5953 | 109.0612 | 112.9269 | 121.1565 | 131.5449 | 141.3086 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 31.4844 | 31.4844 | 31.4844 | 31.4844 | 31.4844 | 31.4844 | 31.4844 | 31.4844 | 31.4844 | 31.4844 | 31.4844 | 31.4844 | (69) |
| Pumps, fans 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (70) | |
| Losses e.g. evaporation (negative values) (Table 5) | -67.8750 | -67.8750 | -67.8750 | -67.8750 | -67.8750 | -67.8750 | -67.8750 | -67.8750 | -67.8750 | -67.8750 | -67.8750 | -67.8750 | (71) |
| Water heating gains (Table 5) | 128.9231 | 127.0866 | 123.6360 | 117.8694 | 113.2591 | 107.0613 | 102.2699 | 107.1925 | 109.4803 | 115.6885 | 123.1379 | 128.7112 | (72) |
| Total internal gains | 399.7714 | 407.4579 | 392.1527 | 380.6419 | 363.1578 | 349.6818 | 335.8822 | 339.2707 | 347.9097 | 359.8621 | 380.1854 | 393.0368 | (73) |

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6. Solar gains
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| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W |
|---|---|---|---|---|---|---|

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northwest | | | 10.3700 | | 11.2829 | | 0.4500 | | 0.7000 | | 0.7700 | | 25.5414 (81) |
| Northeast | | | 2.5700 | | 11.2829 | | 0.4500 | | 0.7000 | | 0.7700 | | 6.3299 (75) |
| Solar gains | 31.8713 | 64.8750 | 116.8842 | 191.9574 | 258.0284 | 275.0856 | 257.3370 | 205.1520 | 142.4252 | 79.2824 | 40.1024 | 26.0277 (83) | |
| Total gains | 431.6427 | 472.3330 | 509.0369 | 572.5993 | 621.1862 | 624.7674 | 593.2192 | 544.4227 | 490.3349 | 439.1445 | 420.2878 | 419.0646 (84) | |

## 7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 (85) | |
| Utilisation factor for gains for living area, nil,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 88.5277 | 88.8282 | 89.1308 | 90.6751 | 90.9904 | 92.6004 | 92.6004 | 92.9293 | 91.9496 | 90.9904 | 90.3620 | 89.7422 | |
| alpha | 6.9018 | 6.9219 | 6.9421 | 7.0450 | 7.0660 | 7.1734 | 7.1734 | 7.1953 | 7.1300 | 7.0660 | 7.0241 | 6.9828 | |
| util living area | 0.9971 | 0.9939 | 0.9831 | 0.9243 | 0.7624 | 0.5368 | 0.3906 | 0.4429 | 0.7208 | 0.9540 | 0.9924 | 0.9976 (86) | |
| MIT | 20.1990 | 20.3214 | 20.5200 | 20.8001 | 20.9588 | 20.9969 | 20.9997 | 20.9994 | 20.9790 | 20.7723 | 20.4532 | 20.1886 (87) | |
| Th 2 | 20.0030 | 20.0061 | 20.0091 | 20.0243 | 20.0274 | 20.0426 | 20.0426 | 20.0457 | 20.0365 | 20.0274 | 20.0213 | 20.0152 (88) | |
| util rest of house | 0.9959 | 0.9912 | 0.9754 | 0.8943 | 0.6978 | 0.4581 | 0.3058 | 0.3515 | 0.6324 | 0.9285 | 0.9885 | 0.9966 (89) | |
| MIT 2 | 19.0893 | 19.2472 | 19.4988 | 19.8421 | 19.9998 | 20.0414 | 20.0426 | 20.0456 | 20.0261 | 19.8213 | 19.4274 | 19.0857 (90) | |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.6251 (91) | |
| MIT | 19.7830 | 19.9187 | 20.1372 | 20.4410 | 20.5993 | 20.6387 | 20.6409 | 20.6418 | 20.6218 | 20.4158 | 20.0687 | 19.7752 (92) | |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.7830 | 19.9187 | 20.1372 | 20.4410 | 20.5993 | 20.6387 | 20.6409 | 20.6418 | 20.6218 | 20.4158 | 20.0687 | 19.7752 (93) | |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9955 | 0.9909 | 0.9766 | 0.9082 | 0.7369 | 0.5073 | 0.3588 | 0.4087 | 0.6874 | 0.9400 | 0.9887 | 0.9963 (94) | |
| Useful gains | 429.7024 | 468.0289 | 497.1238 | 520.0621 | 457.7448 | 316.9670 | 212.8461 | 222.5164 | 337.0714 | 412.8115 | 415.5542 | 417.5021 (95) | |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 (96) | |
| Heat loss rate W | 853.4020 | 825.0109 | 746.5770 | 621.0565 | 477.2397 | 318.2069 | 212.9339 | 222.7286 | 346.0953 | 526.3894 | 700.3050 | 846.8644 (97) | |
| Space heating kWh | 315.2325 | 239.8919 | 185.5932 | 72.7160 | 14.5042 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 84.5019 | 205.0206 | 319.4456 (98a) | |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 1436.9058 | |
| Solar heating kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (98b) | |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | 315.2325 | 239.8919 | 185.5932 | 72.7160 | 14.5042 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 84.5019 | 205.0206 | 319.4456 (98c) | |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 1436.9058 | |
| Space heating per m2 | | | | | | | | | | (98c) / (4) = | | 28.6065 (99) | |

## 8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ext. temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | |
| Heat loss rate W | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 495.3275 | 389.9386 | 399.0603 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (100) | |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.9719 | 0.9901 | 0.9813 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (101) | |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 481.4288 | 386.0630 | 391.5964 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (102) | |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 689.8925 | 655.0782 | 598.5573 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (103) | |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 150.0939 | 200.1473 | 153.9789 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (104) | |
| Cooled fraction | | | | | | | | | fC = cooled area / (4) = | | | 0.9954 (105) | |
| Intermittency factor (Table 10b) | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 (106) | |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 37.3516 | 49.8077 | 38.3185 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (107) | |
| Space cooling requirement | | | | | | | | | | | | 125.4778 (107) | |

## 9b. Energy requirements

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | 0.0000 (301) | |
| Fraction of space heat from community system | | | | | | | | | | | | 1.0000 (302) | |
| Fraction of heat from community Heat pump-Space and Water | | | | | | | | | | | | 1.0000 (303a) | |
| Factor for control and charging method (Table 4c(3)) for space heating | | | | | | | | | | | | 1.0000 (305) | |
| Factor for charging method (Table 4c(3)) for water heating | | | | | | | | | | | | 1.0000 (305a) | |
| Distribution loss factor (Table 12c) for community heating system | | | | | | | | | | | | 2.0000 (306) | |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 (208) | |
| Space heating: | | | | | | | | | | | | | |
| Space heating requirement | 315.2325 | 239.8919 | 185.5932 | 72.7160 | 14.5042 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 84.5019 | 205.0206 | 319.4456 (98) | |
| Space heat from Heat pump = (98) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 307a | 630.4651 | 479.7838 | 371.1864 | 145.4319 | 29.0084 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 169.0038 | 410.0411 | 638.8911 | |
| Space heating requirement | 630.4651 | 479.7838 | 371.1864 | 145.4319 | 29.0084 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 169.0038 | 410.0411 | 638.8911 (307) | |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | | | | | | | | | | | 0.0000 (308) | |
| Space heating fuel for secondary/supplementary system | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (309) | |
| Water heating | | | | | | | | | | | | | |
| Annual water heating requirement | 210.7575 | 186.6500 | 198.9272 | 180.0231 | 175.7079 | 156.6192 | 151.1185 | 162.1332 | 161.8572 | 181.1439 | 191.4316 | 210.2834 (64) | |
| Water heat from Heat pump = (64) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 310a | 421.5149 | 373.3000 | 397.8545 | 360.0462 | 351.4159 | 313.2383 | 302.2370 | 324.2664 | 323.7144 | 362.2879 | 382.8633 | 420.5668 | |
| Water heating fuel | 421.5149 | 373.3000 | 397.8545 | 360.0462 | 351.4159 | 313.2383 | 302.2370 | 324.2664 | 323.7144 | 362.2879 | 382.8633 | 420.5668 (310) | |
| Cooling System Energy Efficiency Ratio | | | | | | | | | | | | 2.6000 (314) | |
| Space coolin | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 14.3660 | 19.1568 | 14.7379 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (315) | |
| Pumps and Fa | 13.7715 | 12.4388 | 13.7715 | 13.3273 | 13.7715 | 13.3273 | 13.7715 | 13.7715 | 13.3273 | 13.7715 | 13.3273 | 13.7715 (331) | |
| Lighting | 14.4162 | 11.5652 | 10.4132 | 7.6292 | 5.8930 | 4.8146 | 5.3758 | 6.9876 | 9.0763 | 11.9085 | 13.4507 | 14.8169 (332) | |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333a)m | -4.6927 | -7.5597 | -12.4903 | -16.0905 | -19.1519 | -18.5644 | -18.3046 | -16.3134 | -13.1553 | -9.4074 | -5.4606 | -3.9430 (333a) | |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (334a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335a) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (333b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335b) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - community heating | 2873.8116 | (307) |
| Space heating fuel - secondary | 0.0000 | (309) |
| Water heating fuel - community heating | 4333.3056 | (310) |
| Efficiency of water heater | 0.0000 | (311) |
| Electricity used for heat distribution | 28.7381 | (313) |
| Space cooling fuel | 48.2607 | (321) |
| | | |
| Electricity for pumps and fans: | | |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8820) | | |
| mechanical ventilation fans (SFP = 0.8820) | 162.1485 | (330a) |
| Total electricity for the above, kWh/year | 162.1485 | (331) |
| Electricity for lighting (calculated in Appendix L) | 116.3473 | (332) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -145.1338 | (333) |
| Wind generation | 0.0000 | (334) |
| Hydro-electric generation (Appendix N) | 0.0000 | (335a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (335) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (336) |
| Energy used | 0.0000 | (337) |
| Total delivered energy for all uses | 7388.7399 | (338) |

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12b. Carbon dioxide emissions - Community heating scheme

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (367) |
| Space and Water heating from Heat pump | 2573.9704 | 0.1566 | 160.7102 | (367) |
| Electrical energy for heat distribution (space & water) | 28.7381 | 0.0000 | 10.5975 | (372) |
| Overall CO2 factor for heat network | | | 0.0540 | (386) |
| Total CO2 associated with community systems | | | 389.0806 | (373) |
| Space and water heating | | | 389.0806 | (376) |
| Space cooling | 48.2607 | 0.1140 | 5.5010 | (377) |
| Pumps, fans and electric keep-hot | 162.1485 | 0.1387 | 22.4920 | (378) |
| Energy for lighting | 116.3473 | 0.1443 | 16.7925 | (379) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -145.1338 | 0.1320 | -19.1527 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -19.1527 | (380) |
| Total CO2, kg/year | | | 414.7133 | (383) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 8.2600 | (384) |

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13b. Primary energy - Community heating scheme

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| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (467a) |
| Space and Water heating from Heat pump | 2573.9704 | 1.5797 | 1621.3480 | (467) |
| Electrical energy for heat distribution (space & water) | 28.7381 | 0.0000 | 111.2772 | (472) |
| Overall CO2 factor for heat network | | | 0.5669 | (486) |
| Total CO2 associated with community systems | | | 4085.4638 | (473) |
| Space and water heating | | | 4085.4638 | (476) |
| Space cooling | 48.2607 | 1.4201 | 68.5372 | (477) |
| Pumps, fans and electric keep-hot | 162.1485 | 1.5128 | 245.2982 | (478) |
| Energy for lighting | 116.3473 | 1.5338 | 178.4574 | (479) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -145.1338 | 1.4876 | -215.8970 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -215.8970 | (480) |
| Total Primary energy kWh/year | | | 4361.8596 | (483) |
| Dwelling Primary energy Rate (DPER) | | | 86.8400 | (484) |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

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| | | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | |
| Ground floor | | 50.2300 | (1b) | x 3.0000 | (2b) = | 150.6900 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 50.2300 | | | | | | (4) |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | | 150.6900 | (5) |

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2. Ventilation rate

---

| | m3 per hour |
|---|---|

| | | |
|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 (6a) |
| Number of open flues | 0 * 20 = | 0.0000 (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 (6f) |
| Number of intermittent extract fans | 2 * 10 = | 20.0000 (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 (7c) |

| | | Air changes per hour | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 20.0000 / (5) = | 0.1327 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3827 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.3827 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.4880 | 0.4784 | 0.4688 | 0.4210 | 0.4114 | 0.3636 | 0.3636 | 0.3540 | 0.3827 | 0.4114 | 0.4306 | 0.4497 | (22b) |
| Effective ac | 0.6191 | 0.6144 | 0.6099 | 0.5886 | 0.5846 | 0.5661 | 0.5661 | 0.5627 | 0.5732 | 0.5846 | 0.5927 | 0.6011 | (25) |

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## 3. Heat losses and heat loss parameter

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| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| TER Opaque door | | | 1.8900 | 1.0000 | 1.8900 | | | (26) |
| TER Opening Type | | | 10.6700 | 1.1450 | 12.2176 | | | (27) |
| External Walls | 40.7300 | 10.6700 | 30.0600 | 0.1800 | 5.4108 | | | (29a) |
| Wall to Communal | 30.0800 | 1.8900 | 28.1900 | 0.1800 | 5.0742 | | | (29a) |
| External Roof | 50.2300 | | 50.2300 | 0.1100 | 5.5253 | | | (30) |
| Total net area of external elements Aum(A, m2) | | | 121.0400 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 30.1179 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 46 | | | 25.8100 | 0.0000 | 0.0000 | | | (32) |
| Party Wall to Unit 48 | | | 8.9800 | 0.0000 | 0.0000 | | | (32) |

| | | |
|---|---|---|
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | 349.7171 | (35) |

List of Thermal Bridges

| K1 Element | Length | Psi-value | Total |
|---|---|---|---|
| E1 Steel lintel with perforated steel base plate | 7.4900 | 0.0500 | 0.3745 |
| E3 Sill | 3.6200 | 0.0500 | 0.1810 |
| E4 Jamb | 20.0600 | 0.0500 | 1.0030 |
| E7 Party floor between dwellings (in blocks of flats) | 6.3630 | 0.0700 | 0.4454 |
| E15 Flat roof with parapet | 13.5700 | 0.5600 | 7.5992 |
| E18 Party wall between dwellings | 6.0000 | 0.0600 | 0.3600 |
| E7 Party floor between dwellings (in blocks of flats) | 10.0275 | 0.0700 | 0.7019 |
| E24 Eaves (insulation at ceiling level - inverted) | 7.2100 | 0.2400 | 1.7304 |
| E16 Corner (normal) | 3.0000 | 0.0900 | 0.2700 |
| E17 Corner (inverted - internal area greater than external area) | 3.0000 | -0.0900 | -0.2700 |

| | | | |
|---|---|---|---|
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | 12.3954 | (36) |
| Point Thermal bridges | (36a) = | 0.0000 | |
| Total fabric heat loss | (33) + (36) + (36a) = | 42.5133 | (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 30.7843 | 30.5544 | 30.3291 | 29.2706 | 29.0726 | 28.1507 | 28.1507 | 27.9800 | 28.5058 | 29.0726 | 29.4732 | 29.8921 | (38) |
| Heat transfer coeff | 73.2976 | 73.0677 | 72.8424 | 71.7839 | 71.5859 | 70.6640 | 70.6640 | 70.4933 | 71.0191 | 71.5859 | 71.9865 | 72.4053 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 71.7830 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.4592 | 1.4547 | 1.4502 | 1.4291 | 1.4252 | 1.4068 | 1.4068 | 1.4034 | 1.4139 | 1.4252 | 1.4331 | 1.4415 | (40) |
| HLP (average) | | | | | | | | | | | | 1.4291 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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## 4. Water heating energy requirements (kWh/year)

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| | | |
|---|---|---|
| Assumed occupancy | 1.6969 | (42) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hot water usage for mixer showers | 52.6705 | 51.8790 | 50.7255 | 48.5187 | 46.8901 | 45.0738 | 44.0415 | 45.1862 | 46.4410 | 48.3911 | 50.6453 | 52.4687 | (42a) |
| Hot water usage for baths | 22.7733 | 22.4350 | 21.9588 | 21.0806 | 20.4230 | 19.6939 | 19.3001 | 19.7730 | 20.2880 | 21.0682 | 21.9644 | 22.6963 | (42b) |
| Hot water usage for other uses | 32.0077 | 30.8438 | 29.6799 | 28.5159 | 27.3520 | 26.1881 | 26.1881 | 27.3520 | 28.5159 | 29.6799 | 30.8438 | 32.0077 | (42c) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 98.7727 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 107.4514 | 105.1578 | 102.3642 | 98.1152 | 94.6651 | 90.9559 | 89.5297 | 92.3112 | 95.2449 | 99.1391 | 103.4535 | 107.1727 | (44) |
| Energy conte | 170.1768 | 149.7433 | 157.3299 | 134.3148 | 127.4374 | 111.8408 | 108.2784 | 114.3006 | 117.4465 | 134.5308 | 147.3885 | 167.8065 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1640.5944 | |
| Distribution loss (46)m = 0.15 x (45)m | 25.5265 | 22.4615 | 23.5995 | 20.1472 | 19.1156 | 16.7761 | 16.2418 | 17.1451 | 17.6170 | 20.1796 | 22.1083 | 25.1710 | (46) |

| | | |
|---|---|---|
| Water storage loss: | | |
| Store volume | 150.0000 | (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | 1.3938 | (48) |
| Temperature factor from Table 2b | 0.5400 | (49) |
| Enter (49) or (54) in (55) | 0.7527 | (55) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total storage loss | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (56) |
| If cylinder contains dedicated solar storage | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (57) |
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | 216.7717 | 191.8290 | 203.9248 | 179.4067 | 174.0324 | 156.9327 | 154.8733 | 160.8955 | 162.5383 | 181.1257 | 192.4803 | 214.4014 | (62) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WWHRS | -24.0787 | -21.2954 | -22.2994 | -18.4648 | -17.2085 | -14.7254 | -13.8027 | -14.6778 | -15.2355 | -17.9610 | -20.3476 | -23.6328 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | | | | | | | | | | | | | |
| | 192.6930 | 170.5335 | 181.6254 | 160.9419 | 156.8239 | 142.2073 | 141.0706 | 146.2177 | 147.3028 | 163.1647 | 172.1327 | 190.7685 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 1965.4821 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 1965 | (64) |
| Electric shower(s) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | | | | | | | | | | | | | |
| | 93.8597 | 83.4582 | 89.5881 | 80.7332 | 79.6489 | 73.2606 | 73.2785 | 75.2809 | 75.1244 | 82.0074 | 85.0801 | 93.0716 | (65) |

## 5. Internal gains (see Table 5 and 5a)

| Metabolic gains (Table 5), Watts | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 84.8437 | 84.8437 | 84.8437 | 84.8437 | 84.8437 | 84.8437 | 84.8437 | 84.8437 | 84.8437 | 84.8437 | 84.8437 | 84.8437 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 74.7121 | 82.7169 | 74.7121 | 77.2025 | 74.7121 | 77.2025 | 74.7121 | 74.7121 | 77.2025 | 74.7121 | 77.2025 | 74.7121 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 147.8313 | 149.3653 | 145.4996 | 137.2700 | 126.8816 | 117.1180 | 110.5953 | 109.0612 | 112.9269 | 121.1565 | 131.5449 | 141.3086 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 31.4844 | 31.4844 | 31.4844 | 31.4844 | 31.4844 | 31.4844 | 31.4844 | 31.4844 | 31.4844 | 31.4844 | 31.4844 | 31.4844 | (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.0000 | 3.0000 | 3.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | | | | | | | | | | | | | |
| | -67.8750 | -67.8750 | -67.8750 | -67.8750 | -67.8750 | -67.8750 | -67.8750 | -67.8750 | -67.8750 | -67.8750 | -67.8750 | -67.8750 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 126.1555 | 124.1938 | 120.4141 | 112.1294 | 107.0549 | 101.7508 | 98.4926 | 101.1840 | 104.3395 | 110.2250 | 118.1669 | 125.0962 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 400.1520 | 407.7291 | 392.0789 | 378.0550 | 360.1017 | 344.5243 | 332.2530 | 333.4104 | 342.9220 | 357.5467 | 378.3674 | 392.5700 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Northeast | 2.1200 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 7.3102 | (75) |
| Northwest | 8.5500 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 29.4822 | (81) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 36.7924 | 74.8921 | 134.9317 | 221.5966 | 297.8693 | 317.5602 | 297.0711 | 236.8285 | 164.4164 | 91.5240 | 46.2944 | 30.0466 | (83) |
| Total gains | 436.9444 | 482.6212 | 527.0106 | 599.6516 | 657.9710 | 662.0845 | 629.3241 | 570.2389 | 507.3384 | 449.0708 | 424.6618 | 422.6165 | (84) |

## 7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 66.5714 | 66.7808 | 66.9874 | 67.9752 | 68.1632 | 69.0525 | 69.0525 | 69.2197 | 68.7072 | 68.1632 | 67.7839 | 67.3918 | |
| alpha | 5.4381 | 5.4521 | 5.4658 | 5.5317 | 5.5442 | 5.6035 | 5.6035 | 5.6146 | 5.5805 | 5.5442 | 5.5189 | 5.4928 | |
| util living area | | | | | | | | | | | | | |
| | 0.9976 | 0.9954 | 0.9887 | 0.9562 | 0.8521 | 0.6552 | 0.4892 | 0.5581 | 0.8329 | 0.9750 | 0.9949 | 0.9980 | (86) |
| MIT | 19.7737 | 19.9165 | 20.1663 | 20.5389 | 20.8358 | 20.9711 | 20.9952 | 20.9906 | 20.8944 | 20.5207 | 20.0974 | 19.7607 | (87) |
| Th 2 | 19.7182 | 19.7217 | 19.7251 | 19.7411 | 19.7441 | 19.7581 | 19.7581 | 19.7607 | 19.7527 | 19.7441 | 19.7380 | 19.7317 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9965 | 0.9932 | 0.9829 | 0.9336 | 0.7856 | 0.5416 | 0.3539 | 0.4137 | 0.7344 | 0.9575 | 0.9920 | 0.9971 | (89) |
| MIT 2 | 18.3312 | 18.5158 | 18.8349 | 19.3034 | 19.6258 | 19.7463 | 19.7572 | 19.7587 | 19.6947 | 19.2937 | 18.7593 | 18.3245 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.6251 | (91) |
| MIT | 19.2330 | 19.3914 | 19.6672 | 20.0757 | 20.3822 | 20.5120 | 20.5311 | 20.5288 | 20.4447 | 20.0607 | 19.5958 | 19.2223 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.2330 | 19.3914 | 19.6672 | 20.0757 | 20.3822 | 20.5120 | 20.5311 | 20.5288 | 20.4447 | 20.0607 | 19.5958 | 19.2223 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9959 | 0.9924 | 0.9826 | 0.9407 | 0.8221 | 0.6125 | 0.4389 | 0.5046 | 0.7936 | 0.9629 | 0.9916 | 0.9966 | (94) |
| Useful gains | 435.1597 | 478.9761 | 517.8220 | 564.0675 | 540.8857 | 405.4989 | 276.1949 | 287.7472 | 402.6112 | 432.4321 | 421.0738 | 421.1773 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | | | | | | | | | | | | | |
| | 1094.5506 | 1058.8521 | 959.1296 | 802.2381 | 621.5231 | 417.7632 | 277.7895 | 291.0504 | 450.5932 | 677.2554 | 899.5278 | 1087.6956 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 490.5868 | 389.6766 | 328.3329 | 171.4829 | 59.9942 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 182.1485 | 344.4869 | 495.8896 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 2462.5984 | |
| Solar heating kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | | | | | | | | | | | | | |
| | 490.5868 | 389.6766 | 328.3329 | 171.4829 | 59.9942 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 182.1485 | 344.4869 | 495.8896 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 2462.5984 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 49.0264 | (99) |

## 9a. Energy requirements - Individual heating systems, including micro-CHP

| | | |
|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | 0.0000 | (201) |
| Fraction of space heat from main system(s) | 1.0000 | (202) |
| Efficiency of main space heating system 1 (in %) | 92.3000 | (206) |
| Efficiency of main space heating system 2 (in %) | 0.0000 | (207) |
| Efficiency of secondary/supplementary heating system, % | 0.0000 | (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement | | | | | | | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 490.5868 | 389.6766 | 328.3329 | 171.4829 | 59.9942 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 182.1485 | 344.4869 | 495.8896 (98) |
| Space heating efficiency (main heating system 1) | | | | | | | | | | | | |
| | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.3000 | 92.3000 | 92.3000 (210) |
| Space heating fuel (main heating system) | | | | | | | | | | | | |
| | 531.5133 | 422.1849 | 355.7236 | 185.7886 | 64.9991 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 197.3440 | 373.2252 | 537.2585 (211) |
| Space heating efficiency (main heating system 2) | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (212) |
| Space heating fuel (main heating system 2) | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (213) |
| Space heating fuel (secondary) | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (215) |
| Water heating | | | | | | | | | | | | |
| Water heating requirement | | | | | | | | | | | | |
| | 192.6930 | 170.5335 | 181.6254 | 160.9419 | 156.8239 | 142.2073 | 141.0706 | 146.2177 | 147.3028 | 163.1647 | 172.1327 | 190.7685 (64) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 (216) |
| (217)m | 86.0627 | 85.8525 | 85.3708 | 84.2023 | 82.1025 | 79.8000 | 79.8000 | 79.8000 | 79.8000 | 84.3072 | 85.5839 | 86.1021 (217) |
| Fuel for water heating, kWh/month | | | | | | | | | | | | |
| | 223.8984 | 198.6355 | 212.7489 | 191.1372 | 191.0099 | 178.2046 | 176.7802 | 183.2302 | 184.5900 | 193.5359 | 201.1274 | 221.5607 (219) |
| Space cooling fuel requirement | | | | | | | | | | | | |
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (221) |
| Pumps and Fa | 7.3041 | 6.5973 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 (231) |
| Lighting | 15.5237 | 12.4537 | 11.2132 | 8.2152 | 6.3457 | 5.1845 | 5.7887 | 7.5244 | 9.7735 | 12.8234 | 14.4840 | 15.9551 (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (233a)m | -11.2422 | -16.9212 | -25.9532 | -31.2115 | -35.4813 | -33.8105 | -33.4162 | -30.6392 | -26.0654 | -20.2322 | -12.7394 | -9.5998 (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | |
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (233b)m | -3.4671 | -7.5011 | -15.2996 | -23.5596 | -31.7198 | -32.0645 | -31.6708 | -26.5405 | -19.1072 | -10.8971 | -4.6840 | -2.7254 (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | |
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235d) |

| | |
|---|---|
| Annual totals kWh/year | |
| Space heating fuel - main system 1 | 2668.0373 (211) |
| Space heating fuel - main system 2 | 0.0000 (213) |
| Space heating fuel - secondary | 0.0000 (215) |
| Efficiency of water heater | 79.8000 |
| Water heating fuel used | 2356.4587 (219) |
| Space cooling fuel | 0.0000 (221) |
| Electricity for pumps and fans: | |
| Total electricity for the above, kWh/year | 86.0000 (231) |
| Electricity for lighting (calculated in Appendix L) | 125.2851 (232) |
| Energy saving/generation technologies (Appendices M ,N and Q) | |
| PV generation | -496.5487 (233) |
| Wind generation | 0.0000 (234) |
| Hydro-electric generation (Appendix N) | 0.0000 (235a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 (235) |
| Appendix Q - special features | |
| Energy saved or generated | -0.0000 (236) |
| Energy used | 0.0000 (237) |
| Total delivered energy for all uses | 4739.2323 (238) |

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 2668.0373 | 0.2100 | 560.2878 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2356.4587 | 0.2100 | 494.8563 | (264) |
| Space and water heating | | | 1055.1442 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 125.2851 | 0.1443 | 18.0825 | (268) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -287.3120 | 0.1332 | -38.2755 | |
| PV Unit electricity exported | -209.2367 | 0.1252 | -26.1936 | |
| Total | | | -64.4691 | (269) |
| Total CO2, kg/year | | | 1020.6868 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 20.3200 | (273) |

13a. Primary energy - Individual heating systems including micro-CHP

| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 2668.0373 | 1.1300 | 3014.8821 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2356.4587 | 1.1300 | 2662.7984 | (278) |
| Space and water heating | | | 5677.6804 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 125.2851 | 1.5338 | 192.1664 | (282) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -287.3120 | 1.4923 | -428.7493 | |
| PV Unit electricity exported | -209.2367 | 0.4595 | -96.1415 | |
| Total | | | -524.8908 | (283) |
| Total Primary energy kWh/year | | | 5475.0569 | (286) |
| Target Primary Energy Rate (TPER) | | | 109.0000 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Property Reference** | Unit 48 | **Issued on Date** | 17/05/2025 |
| **Assessment Reference** | 00001 | **Prop Type Ref** | Unit 48 |
| **Property** | | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 75 C | **DER** | 7.03 | **TER** | 16.68 |
| **Environmental** | 95 A | **% DER < TER** | | | 57.85 |
| **$CO_2$ Emissions (t/year)** | 0.4 | **DFEE** | 45.68 | **TFEE** | 47.47 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 3.78 |
| **% DPER < TPER** | 16.92 | **DPER** | 74.05 | **TPER** | 89.13 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Robert Arnold | **Assessor ID** | BA04-0001 |
| **Client** | | | |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

## 1. Overall dwelling characteristics

| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 63.7000 | (1b) | x 3.0000 | (2b) = | 191.1000 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 63.7000 | | | | | (4) |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | 191.1000 | (5) |

## 2. Ventilation rate

| | m3 per hour | |
|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 (6a) |
| Number of open flues | 0 * 20 = | 0.0000 (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 (6f) |
| Number of intermittent extract fans | 0 * 10 = | 0.0000 (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 (7c) |
| | Air changes per hour | |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 0.0000 / (5) = | 0.0000 (8) |
| Pressure test | | Yes |
| Pressure Test Method | | Blower Door |
| Measured/design AP50 | | 3.0000 (17) |
| Infiltration rate | | 0.1500 (18) |
| Number of sides sheltered | | 0 (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.1500 (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.1912 | 0.1875 | 0.1837 | 0.1650 | 0.1612 | 0.1425 | 0.1425 | 0.1388 | 0.1500 | 0.1612 | 0.1687 | 0.1762 | (22b) |
| Balanced mechanical ventilation with heat recovery | | | | | | | | | | | | | |
| If mechanical ventilation | | | | | | | | | | | | 0.5000 | (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | | | | | | | | | | | | 0.5000 | (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | | | | | | | | | | | | 81.0000 | (23c) |
| Effective ac | 0.2862 | 0.2825 | 0.2787 | 0.2600 | 0.2562 | 0.2375 | 0.2375 | 0.2337 | 0.2450 | 0.2562 | 0.2637 | 0.2712 | (25) |

## 3. Heat losses and heat loss parameter

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| Windows | | | 12.3100 | 1.0536 | 12.9703 | | | (27) |
| Glass Door | | | 4.5400 | 1.3258 | 6.0189 | | | (27) |
| Front Door | | | 1.8900 | 1.4000 | 2.6460 | | | (26) |
| External Walls | 43.1200 | 16.8500 | 26.2700 | 0.1500 | 3.9405 | 150.0000 | 3940.5000 | (29a) |
| Wall to Communal Corridor | 5.1600 | 1.8900 | 3.2700 | 0.1400 | 0.4578 | 150.0000 | 490.5000 | (29a) |
| Wall to Stairs | 10.6800 | | 10.6800 | 0.1100 | 1.1748 | 150.0000 | 1602.0000 | (29a) |
| External Roof | 63.7000 | | 63.7000 | 0.1000 | 6.3700 | 9.0000 | 573.3000 | (30) |
| Total net area of external elements Aum(A, m2) | | | 122.6600 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | | (26)...(30) + (32) = | 33.5783 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 47 | | | 8.9800 | 0.0000 | 0.0000 | 110.0000 | 987.8000 | (32) |
| Party Wall to Unit 49 | | | 26.5900 | 0.0000 | 0.0000 | 110.0000 | 2924.9000 | (32) |
| Party Floor | | | 63.7000 | | | 80.0000 | 5096.0000 | (32d) |
| Internal Walls | | | 140.7500 | | | 9.0000 | 1266.7500 | (32c) |

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 16881.7500 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 265.0196 (35)
List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E1 Steel lintel with perforated steel base plate | 9.0500 | 0.0500 | 0.4525 |
| E3 Sill | 1.8100 | 0.0500 | 0.0905 |
| E4 Jamb | 29.5500 | 0.0500 | 1.4775 |
| E7 Party floor between dwellings (in blocks of flats) | 1.7200 | 0.0350 | 0.0602 |
| E15 Flat roof with parapet | 14.3700 | 0.5600 | 8.0472 |
| E18 Party wall between dwellings | 9.0000 | 0.0600 | 0.5400 |
| E24 Eaves (insulation at ceiling level - inverted) | 14.3750 | 0.1200 | 1.7250 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 12.3929 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 45.9712 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 18.0518 | 17.8153 | 17.5788 | 16.3964 | 16.1599 | 14.9775 | 14.9775 | 14.7410 | 15.4504 | 16.1599 | 16.6329 | 17.1058 | (38) |
| Heat transfer coeff | 64.0230 | 63.7865 | 63.5501 | 62.3676 | 62.1311 | 60.9487 | 60.9487 | 60.7122 | 61.4217 | 62.1311 | 62.6041 | 63.0771 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 62.3085 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.0051 | 1.0014 | 0.9976 | 0.9791 | 0.9754 | 0.9568 | 0.9568 | 0.9531 | 0.9642 | 0.9754 | 0.9828 | 0.9902 | (40) |
| HLP (average) | | | | | | | | | | | | 0.9782 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

---
4. Water heating energy requirements (kWh/year)
---

Assumed occupancy 2.0841 (42)
Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 57.6681 | 56.7852 | 55.4841 | 53.4825 | 51.6891 | 49.1801 | 47.1957 | 49.5156 | 50.6824 | 53.1674 | 55.7553 | 57.6161 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 24.9953 | 24.6180 | 24.0812 | 23.2773 | 22.5529 | 21.5556 | 20.7990 | 21.7242 | 22.2097 | 23.1979 | 24.2253 | 24.9754 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 35.9731 | 34.6650 | 33.3569 | 32.0488 | 30.7407 | 29.4325 | 29.4325 | 30.7407 | 32.0488 | 33.3569 | 34.6650 | 35.9731 | (42c) |

Average daily hot water use (litres/day) 109.0449 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 118.6365 | 116.0682 | 112.9221 | 108.8086 | 104.9826 | 100.1683 | 97.4272 | 101.9804 | 104.9409 | 109.7222 | 114.6456 | 118.5647 | (44) |
| Energy conte | 174.6534 | 153.5817 | 161.3634 | 142.1312 | 135.2807 | 115.8412 | 107.6600 | 120.0329 | 121.7262 | 141.3882 | 154.9474 | 174.1209 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1702.7271 | |
| Distribution loss (46)m = 0.15 x (45)m | 26.1980 | 23.0373 | 24.2045 | 21.3197 | 20.2921 | 17.3762 | 16.1490 | 18.0049 | 18.2589 | 21.2082 | 23.2421 | 26.1181 | (46) |
| Water storage loss: | | | | | | | | | | | | | |
| Store volume | | | | | | | | | | | | 110.0000 | (47) |
| b) If manufacturer declared loss factor is not known : | | | | | | | | | | | | | |
| Hot water storage loss factor from Table 2 (kWh/litre/day) | | | | | | | | | | | | 0.0152 | (51) |
| Volume factor from Table 2a | | | | | | | | | | | | 1.0294 | (52) |
| Temperature factor from Table 2b | | | | | | | | | | | | 0.6000 | (53) |
| Enter (49) or (54) in (55) | | | | | | | | | | | | 1.0327 | (55) |
| Total storage loss | 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (56) |
| If cylinder contains dedicated solar storage | 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (57) |
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | 229.9302 | 203.5091 | 216.6402 | 195.6249 | 190.5575 | 169.3349 | 162.9368 | 175.3097 | 175.2199 | 196.6650 | 208.4410 | 229.3977 | (62) |
| WWHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | 229.9302 | 203.5091 | 216.6402 | 195.6249 | 190.5575 | 169.3349 | 162.9368 | 175.3097 | 175.2199 | 196.6650 | 208.4410 | 229.3977 | (64) |
| | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | | 2353.5669 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2354 | (64) |
| Electric shower(s) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | 102.2937 | 91.0079 | 97.8748 | 90.0536 | 89.2023 | 81.3122 | 80.0184 | 84.1324 | 83.2689 | 91.2330 | 94.3149 | 102.1166 | (65) |

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5. Internal gains (see Table 5 and 5a)
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Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 104.2042 | 104.2042 | 104.2042 | 104.2042 | 104.2042 | 104.2042 | 104.2042 | 104.2042 | 104.2042 | 104.2042 | 104.2042 | 104.2042 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 91.8853 | 101.7301 | 91.8853 | 94.9481 | 91.8853 | 94.9481 | 91.8853 | 91.8853 | 94.9481 | 91.8853 | 94.9481 | 91.8853 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 182.1728 | 184.0632 | 179.2995 | 169.1581 | 156.3565 | 144.3247 | 136.2868 | 134.3964 | 139.1601 | 149.3014 | 162.1031 | 174.1348 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 33.4204 | 33.4204 | 33.4204 | 33.4204 | 33.4204 | 33.4204 | 33.4204 | 33.4204 | 33.4204 | 33.4204 | 33.4204 | 33.4204 | (69) |
| Pumps, fans | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | -83.3634 | -83.3634 | -83.3634 | -83.3634 | -83.3634 | -83.3634 | -83.3634 | -83.3634 | -83.3634 | -83.3634 | -83.3634 | -83.3634 | (71) |
| Water heating gains (Table 5) | 137.4915 | 135.4284 | 131.5521 | 125.0744 | 119.8955 | 112.9336 | 107.5516 | 113.0811 | 115.6513 | 122.6250 | 130.9930 | 137.2536 | (72) |
| Total internal gains | 465.8109 | 475.4829 | 456.9981 | 443.4419 | 422.3985 | 406.4676 | 389.9849 | 393.6240 | 404.0207 | 418.0730 | 442.3054 | 457.5349 | (73) |

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6. Solar gains
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| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Southeast | 2.6000 | 36.7938 | 0.4500 | 0.7000 | 0.7700 | 20.8830 | (77) |
| Southwest | 2.8100 | 36.7938 | 0.4500 | 0.7000 | 0.7700 | 22.5697 | (79) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northwest | | | 6.9000 | | 11.2829 | | 0.4500 | | 0.7000 | | 0.7700 | | 16.9948 (81) |
| Southeast | | | 2.2700 | | 36.7938 | | 0.4500 | | 0.7000 | | 0.7700 | | 18.2324 (77) |
| Northwest | | | 2.2700 | | 11.2829 | | 0.4500 | | 0.7000 | | 0.7700 | | 5.5910 (81) |
| Solar gains | 84.2709 | 151.0465 | 226.5954 | 314.1632 | 382.3754 | 393.0202 | 373.3328 | 320.3933 | 256.5972 | 172.3114 | 102.3033 | 71.2343 | (83) |
| Total gains | 550.0817 | 626.5294 | 683.5935 | 757.6050 | 804.7739 | 799.4878 | 763.3177 | 714.0173 | 660.6179 | 590.3844 | 544.6087 | 528.7692 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| tau | 73.2451 | 73.5167 | 73.7903 | 75.1892 | 75.4754 | 76.9397 | 76.9397 | 77.2394 | 76.3472 | 75.4754 | 74.9052 | 74.3436 | |
| alpha | 5.8830 | 5.9011 | 5.9194 | 6.0126 | 6.0317 | 6.1293 | 6.1293 | 6.1493 | 6.0898 | 6.0317 | 5.9937 | 5.9562 | |
| util living area | 0.9902 | 0.9782 | 0.9495 | 0.8557 | 0.6876 | 0.4848 | 0.3510 | 0.3904 | 0.6254 | 0.8934 | 0.9766 | 0.9920 | (86) |
| MIT | 20.1356 | 20.3171 | 20.5505 | 20.8239 | 20.9595 | 20.9959 | 20.9995 | 20.9991 | 20.9823 | 20.8034 | 20.4401 | 20.1156 | (87) |
| Th 2 | 20.0791 | 20.0822 | 20.0853 | 20.1008 | 20.1039 | 20.1195 | 20.1195 | 20.1226 | 20.1132 | 20.1039 | 20.0977 | 20.0915 | (88) |
| util rest of house | 0.9871 | 0.9716 | 0.9347 | 0.8204 | 0.6312 | 0.4196 | 0.2809 | 0.3163 | 0.5518 | 0.8579 | 0.9683 | 0.9894 | (89) |
| MIT 2 | 19.0909 | 19.3210 | 19.6102 | 19.9371 | 20.0738 | 20.1174 | 20.1193 | 20.1223 | 20.1030 | 19.9253 | 19.4897 | 19.0753 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.6009 | (91) |
| MIT | 19.7187 | 19.9196 | 20.1753 | 20.4700 | 20.6060 | 20.6453 | 20.6483 | 20.6492 | 20.6314 | 20.4529 | 20.0608 | 19.7005 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.7187 | 19.9196 | 20.1753 | 20.4700 | 20.6060 | 20.6453 | 20.6483 | 20.6492 | 20.6314 | 20.4529 | 20.0608 | 19.7005 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9855 | 0.9702 | 0.9364 | 0.8357 | 0.6634 | 0.4587 | 0.3230 | 0.3609 | 0.5955 | 0.8728 | 0.9679 | 0.9880 | (94) |
| Useful gains | 542.1312 | 607.8468 | 640.1031 | 633.1312 | 533.8941 | 366.7262 | 246.5729 | 257.6649 | 393.3904 | 515.3168 | 527.1190 | 522.4406 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | 987.1520 | 958.0466 | 869.0635 | 721.5955 | 553.3412 | 368.4550 | 246.7375 | 257.9800 | 401.1723 | 612.1750 | 811.4025 | 977.7270 | (97) |
| Space heating kWh | 331.0954 | 235.3343 | 170.3466 | 63.6943 | 14.4686 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 72.0624 | 204.6841 | 338.7330 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 1430.4188 | |
| Solar heating kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | 331.0954 | 235.3343 | 170.3466 | 63.6943 | 14.4686 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 72.0624 | 204.6841 | 338.7330 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 1430.4188 | |
| Space heating per m2 | | | | | | | | | | (98c) / (4) = | | 22.4556 | (99) |

## 8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ext. temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | |
| Heat loss rate W | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 572.9179 | 451.0204 | 461.4129 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (100) |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.9745 | 0.9900 | 0.9844 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (101) |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 558.3101 | 446.5309 | 454.2248 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (102) |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 886.4630 | 846.6749 | 789.9274 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 236.2701 | 297.7071 | 249.7627 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (104) |
| Cooled fraction | | | | | | | | | | fC = cooled area / (4) = | | 0.9890 | (105) |
| Intermittency factor (Table 10b) | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | (106) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 58.4184 | 73.6089 | 61.7545 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) |
| Space cooling requirement | | | | | | | | | | | | 193.7819 | (107) |

## 9b. Energy requirements

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | 0.0000 | (301) |
| Fraction of space heat from community system | | | | | | | | | | | | 1.0000 | (302) |
| Fraction of heat from community Heat pump-Space and Water | | | | | | | | | | | | 1.0000 | (303a) |
| Factor for control and charging method (Table 4c(3)) for space heating | | | | | | | | | | | | 1.0000 | (305) |
| Factor for charging method (Table 4c(3)) for water heating | | | | | | | | | | | | 1.0000 | (305a) |
| Distribution loss factor (Table 12c) for community heating system | | | | | | | | | | | | 2.0000 | (306) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 | (208) |
| Space heating: | | | | | | | | | | | | | |
| Space heating requirement | 331.0954 | 235.3343 | 170.3466 | 63.6943 | 14.4686 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 72.0624 | 204.6841 | 338.7330 | (98) |
| Space heat from Heat pump = (98) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 307a | 662.1908 | 470.6686 | 340.6931 | 127.3885 | 28.9372 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 144.1249 | 409.3683 | 677.4661 | |
| Space heating requirement | 662.1908 | 470.6686 | 340.6931 | 127.3885 | 28.9372 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 144.1249 | 409.3683 | 677.4661 | (307) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | | | | | | | | | | | 0.0000 | (308) |
| Space heating fuel for secondary/supplementary system | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (309) |
| Water heating | | | | | | | | | | | | | |
| Annual water heating requirement | 229.9302 | 203.5091 | 216.6402 | 195.6249 | 190.5575 | 169.3349 | 162.9368 | 175.3097 | 175.2199 | 196.6650 | 208.4410 | 229.3977 | (64) |
| Water heat from Heat pump = (64) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 310a | 459.8604 | 407.0182 | 433.2804 | 391.2497 | 381.1150 | 338.6699 | 325.8735 | 350.6193 | 350.4398 | 393.3299 | 416.8821 | 458.7954 | |
| Water heating fuel | 459.8604 | 407.0182 | 433.2804 | 391.2497 | 381.1150 | 338.6699 | 325.8735 | 350.6193 | 350.4398 | 393.3299 | 416.8821 | 458.7954 | (310) |
| Cooling System Energy Efficiency Ratio | | | | | | | | | | | | 2.6000 | (314) |
| Space coolin | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 22.4686 | 28.3111 | 23.7517 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (315) |
| Pumps and Fa | 17.4646 | 15.7745 | 17.4646 | 16.9012 | 17.4646 | 16.9012 | 17.4646 | 17.4646 | 16.9012 | 17.4646 | 16.9012 | 17.4646 | (331) |
| Lighting | 18.9588 | 15.2094 | 13.6944 | 10.0331 | 7.7499 | 6.3317 | 7.0697 | 9.1894 | 11.9362 | 15.6609 | 17.6889 | 19.4857 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333a)m | -4.7681 | -7.7285 | -12.8494 | -16.6603 | -19.9266 | -19.3476 | -19.0738 | -16.9512 | -13.6038 | -9.6545 | -5.5631 | -4.0016 | (333a) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335a) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (333b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335b) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - community heating | 2860.8376 | (307) |
| Space heating fuel - secondary | 0.0000 | (309) |
| Water heating fuel - community heating | 4707.1338 | (310) |
| Efficiency of water heater | 0.0000 | (311) |
| Electricity used for heat distribution | 28.6084 | (313) |
| Space cooling fuel | 74.5315 | (321) |
| | | |
| Electricity for pumps and fans: | | |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8820) | | |
| mechanical ventilation fans (SFP = 0.8820) | 205.6312 | (330a) |
| Total electricity for the above, kWh/year | 205.6312 | (331) |
| Electricity for lighting (calculated in Appendix L) | 153.0080 | (332) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -150.1285 | (333) |
| Wind generation | 0.0000 | (334) |
| Hydro-electric generation (Appendix N) | 0.0000 | (335a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (335) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (336) |
| Energy used | 0.0000 | (337) |
| Total delivered energy for all uses | 7851.0136 | (338) |

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12b. Carbon dioxide emissions - Community heating scheme

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (367) |
| Space and Water heating from Heat pump | 2702.8469 | 0.1570 | 160.4461 | (367) |
| Electrical energy for heat distribution (space & water) | 28.6084 | 0.0000 | 11.1194 | (372) |
| Overall CO2 factor for heat network | | | 0.0539 | (386) |
| Total CO2 associated with community systems | | | 408.2401 | (373) |
| Space and water heating | | | 408.2401 | (376) |
| Space cooling | 74.5315 | 0.1140 | 8.4990 | (377) |
| Pumps, fans and electric keep-hot | 205.6312 | 0.1387 | 28.5236 | (378) |
| Energy for lighting | 153.0080 | 0.1443 | 22.0838 | (379) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -150.1285 | 0.1319 | -19.7949 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -19.7949 | (380) |
| Total CO2, kg/year | | | 447.5516 | (383) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 7.0300 | (384) |

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13b. Primary energy - Community heating scheme

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| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (467a) |
| Space and Water heating from Heat pump | 2702.8469 | 1.5813 | 1615.7004 | (467) |
| Electrical energy for heat distribution (space & water) | 28.6084 | 0.0000 | 116.8145 | (472) |
| Overall CO2 factor for heat network | | | 0.5667 | (486) |
| Total CO2 associated with community systems | | | 4288.7598 | (473) |
| Space and water heating | | | 4288.7598 | (476) |
| Space cooling | 74.5315 | 1.4203 | 105.8572 | (477) |
| Pumps, fans and electric keep-hot | 205.6312 | 1.5128 | 311.0789 | (478) |
| Energy for lighting | 153.0080 | 1.5338 | 234.6888 | (479) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -150.1285 | 1.4871 | -223.2631 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -223.2631 | (480) |
| Total Primary energy kWh/year | | | 4717.1216 | (483) |
| Dwelling Primary energy Rate (DPER) | | | 74.0500 | (484) |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 63.7000 | (1b) | x 3.0000 | (2b) = | 191.1000 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 63.7000 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | | 191.1000 | (5) |

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2. Ventilation rate

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m3 per hour

| | | | |
|---|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 | (6a) |
| Number of open flues | 0 * 20 = | 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | 2 * 10 = | 20.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |

| | | | |
|---|---|---|---|
| | | Air changes per hour | |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 20.0000 / (5) = | 0.1047 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3547 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.3547 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.4522 | 0.4433 | 0.4345 | 0.3901 | 0.3813 | 0.3369 | 0.3369 | 0.3281 | 0.3547 | 0.3813 | 0.3990 | 0.4167 | (22b) |
| Effective ac | 0.6022 | 0.5983 | 0.5944 | 0.5761 | 0.5727 | 0.5568 | 0.5568 | 0.5538 | 0.5629 | 0.5727 | 0.5796 | 0.5868 | (25) |

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3. Heat losses and heat loss parameter

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| Element | Gross | Openings | NetArea | U-value | A x U | K-value | A x K | |
|---|---|---|---|---|---|---|---|---|
| | m2 | m2 | m2 | W/m2K | W/K | kJ/m2K | kJ/K | |
| Main dwelling | | | | | | | | |
| TER Opaque door | | | 1.8900 | 1.0000 | 1.8900 | | | (26) |
| TER Opening Type | | | 14.0400 | 1.1450 | 16.0763 | | | (27) |
| External Walls | 43.1200 | 14.0400 | 29.0800 | 0.1800 | 5.2344 | | | (29a) |
| Wall to Communal Corridor | 5.1600 | 1.8900 | 3.2700 | 0.1800 | 0.5886 | | | (29a) |
| Wall to Stairs | 10.6800 | | 10.6800 | 0.1800 | 1.9224 | | | (29a) |
| External Roof | 63.7000 | | 63.7000 | 0.1100 | 7.0070 | | | (30) |
| Total net area of external elements Aum(A, m2) | | | 122.6600 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 32.7187 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 47 | | | 8.9800 | 0.0000 | 0.0000 | | | (32) |
| Party Wall to Unit 49 | | | 26.5900 | 0.0000 | 0.0000 | | | (32) |

| | | | |
|---|---|---|---|
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | | 265.0196 | (35) |
| List of Thermal Bridges | | | |

| K1 Element | Length | Psi-value | Total |
|---|---|---|---|
| E1 Steel lintel with perforated steel base plate | 9.0500 | 0.0500 | 0.4525 |
| E3 Sill | 1.8100 | 0.0500 | 0.0905 |
| E4 Jamb | 29.5500 | 0.0500 | 1.4775 |
| E7 Party floor between dwellings (in blocks of flats) | 1.7200 | 0.0700 | 0.1204 |
| E15 Flat roof with parapet | 14.3700 | 0.5600 | 8.0472 |
| E18 Party wall between dwellings | 9.0000 | 0.0600 | 0.5400 |
| E24 Eaves (insulation at ceiling level - inverted) | 14.3750 | 0.2400 | 3.4500 |

| | | | |
|---|---|---|---|
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | 14.1781 | (36) |
| Point Thermal bridges | (36a) = | 0.0000 | |
| Total fabric heat loss | (33) + (36) + (36a) = | 46.8968 | (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 37.9789 | 37.7285 | 37.4831 | 36.3305 | 36.1148 | 35.1109 | 35.1109 | 34.9250 | 35.4976 | 36.1148 | 36.5511 | 37.0072 | (38) |
| Heat transfer coeff | 84.8757 | 84.6253 | 84.3799 | 83.2273 | 83.0116 | 82.0077 | 82.0077 | 81.8218 | 82.3944 | 83.0116 | 83.4479 | 83.9040 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 83.2263 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.3324 | 1.3285 | 1.3246 | 1.3066 | 1.3032 | 1.2874 | 1.2874 | 1.2845 | 1.2935 | 1.3032 | 1.3100 | 1.3172 | (40) |
| HLP (average) | | | | | | | | | | | | 1.3065 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

---

4. Water heating energy requirements (kWh/year)

---

| | | | |
|---|---|---|---|
| Assumed occupancy | | 2.0841 | (42) |

Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 59.1629 | 58.2737 | 56.9781 | 54.4993 | 52.6699 | 50.6298 | 49.4702 | 50.7560 | 52.1655 | 54.3559 | 56.8881 | 58.9362 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 25.5652 | 25.1855 | 24.6508 | 23.6650 | 22.9268 | 22.1083 | 21.6662 | 22.1971 | 22.7752 | 23.6510 | 24.6572 | 25.4788 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 35.9731 | 34.6650 | 33.3569 | 32.0488 | 30.7407 | 29.4325 | 29.4325 | 30.7407 | 32.0488 | 33.3569 | 34.6650 | 35.9731 | (42c) |

| | | | |
|---|---|---|---|
| Average daily hot water use (litres/day) | | 110.9520 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 120.7012 | 118.1243 | 114.9859 | 110.2130 | 106.3374 | 102.1707 | 100.5690 | 103.6938 | 106.9895 | 111.3639 | 116.2102 | 120.3880 | (44) |
| Energy conte | 191.1611 | 168.2074 | 176.7290 | 150.8761 | 143.1506 | 125.6308 | 121.6294 | 128.3946 | 131.9287 | 151.1197 | 165.5628 | 188.4986 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1842.8888 | |
| Distribution loss (46)m = 0.15 x (45)m | 28.6742 | 25.2311 | 26.5094 | 22.6314 | 21.4726 | 18.8446 | 18.2444 | 19.2592 | 19.7893 | 22.6680 | 24.8344 | 28.2748 | (46) |
| Water storage loss: | | | | | | | | | | | | | |
| Store volume | | | | | | | | | | | | 150.0000 | (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | | | | | | | | | | | | 1.3938 | (48) |
| Temperature factor from Table 2b | | | | | | | | | | | | 0.5400 | (49) |
| Enter (49) or (54) in (55) | | | | | | | | | | | | 0.7527 | (55) |
| Total storage loss | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (56) |
| If cylinder contains dedicated solar storage | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (57) |
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | 237.7560 | 210.2931 | 223.3239 | 195.9680 | 189.7455 | 170.7226 | 168.2243 | 174.9895 | 177.0205 | 197.7146 | 210.6546 | 235.0935 | (62) |
| WWHRS | -27.0468 | -23.9204 | -25.0481 | -20.7408 | -19.3297 | -16.5405 | -15.5041 | -16.4871 | -17.1135 | -20.1749 | -22.8557 | -26.5459 | (63a) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | | | | | | | | | | | | | |
| | 210.7092 | 186.3727 | 198.2759 | 175.2272 | 170.4158 | 154.1821 | 152.7202 | 158.5024 | 159.9071 | 177.5397 | 187.7989 | 208.5476 | (64) |
| | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | | 2140.1988 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2140 | (64) |
| Electric shower(s) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | | | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | | | | | | | | | | | | | |
| | 100.8370 | 89.5975 | 96.0383 | 86.2398 | 84.8735 | 77.8457 | 77.7177 | 79.9671 | 79.9398 | 87.5232 | 91.1231 | 99.9517 | (65) |

## 5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 104.2042 | 104.2042 | 104.2042 | 104.2042 | 104.2042 | 104.2042 | 104.2042 | 104.2042 | 104.2042 | 104.2042 | 104.2042 | 104.2042 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 91.9116 | 101.7593 | 91.9116 | 94.9753 | 91.9116 | 94.9753 | 91.9116 | 91.9116 | 94.9753 | 91.9116 | 94.9753 | 91.9116 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 182.1728 | 184.0632 | 179.2995 | 169.1581 | 156.3565 | 144.3247 | 136.2868 | 134.3964 | 139.1601 | 149.3014 | 162.1031 | 174.1348 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 33.4204 | 33.4204 | 33.4204 | 33.4204 | 33.4204 | 33.4204 | 33.4204 | 33.4204 | 33.4204 | 33.4204 | 33.4204 | 33.4204 | (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.0000 | 3.0000 | 3.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | | | | | | | | | | | | | |
| | -83.3634 | -83.3634 | -83.3634 | -83.3634 | -83.3634 | -83.3634 | -83.3634 | -83.3634 | -83.3634 | -83.3634 | -83.3634 | -83.3634 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 135.5336 | 133.3296 | 129.0838 | 119.7775 | 114.0773 | 108.1190 | 104.4593 | 107.4827 | 111.0275 | 117.6387 | 126.5599 | 134.3437 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 466.8793 | 476.4134 | 457.5561 | 441.1722 | 419.6066 | 401.6804 | 386.9189 | 388.0520 | 399.4242 | 416.1131 | 440.8996 | 457.6514 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Southeast | 4.0600 | 36.7938 | 0.6300 | 0.7000 | 0.7700 | 45.6534 | (77) |
| Southwest | 2.3400 | 36.7938 | 0.6300 | 0.7000 | 0.7700 | 26.3125 | (79) |
| Northwest | 7.6400 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 26.3444 | (81) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 98.3103 | 176.2093 | 264.3402 | 366.4891 | 446.0581 | 458.4740 | 435.5085 | 373.7552 | 299.3377 | 201.0157 | 119.3466 | 83.1019 | (83) |
| Total gains | 565.1895 | 652.6227 | 721.8963 | 807.6613 | 865.6647 | 860.1543 | 822.4275 | 761.8071 | 698.7619 | 617.1288 | 560.2462 | 540.7534 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| tau | 55.2499 | 55.4134 | 55.5745 | 56.3442 | 56.4906 | 57.1821 | 57.1821 | 57.3120 | 56.9137 | 56.4906 | 56.1952 | 55.8898 | |
| alpha | 4.6833 | 4.6942 | 4.7050 | 4.7563 | 4.7660 | 4.8121 | 4.8121 | 4.8208 | 4.7942 | 4.7660 | 4.7463 | 4.7260 | |
| util living area | | | | | | | | | | | | | |
| | 0.9918 | 0.9833 | 0.9640 | 0.9036 | 0.7761 | 0.5868 | 0.4340 | 0.4856 | 0.7327 | 0.9327 | 0.9834 | 0.9933 | (86) |
| MIT | 19.6658 | 19.8769 | 20.1773 | 20.5664 | 20.8433 | 20.9684 | 20.9939 | 20.9898 | 20.9114 | 20.5498 | 20.0481 | 19.6380 | (87) |
| Th 2 | 19.8155 | 19.8186 | 19.8216 | 19.8357 | 19.8384 | 19.8507 | 19.8507 | 19.8530 | 19.8459 | 19.8384 | 19.8330 | 19.8274 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9890 | 0.9777 | 0.9516 | 0.8717 | 0.7113 | 0.4915 | 0.3232 | 0.3689 | 0.6398 | 0.9029 | 0.9768 | 0.9910 | (89) |
| MIT 2 | 18.3012 | 18.5700 | 18.9470 | 19.4221 | 19.7182 | 19.8349 | 19.8491 | 19.8500 | 19.7929 | 19.4173 | 18.7994 | 18.2743 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.6009 | (91) |
| MIT | 19.1212 | 19.3554 | 19.6864 | 20.1097 | 20.3943 | 20.5161 | 20.5371 | 20.5350 | 20.4651 | 20.0979 | 19.5498 | 19.0938 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.1212 | 19.3554 | 19.6864 | 20.1097 | 20.3943 | 20.5161 | 20.5371 | 20.5350 | 20.4651 | 20.0979 | 19.5498 | 19.0938 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9869 | 0.9749 | 0.9499 | 0.8801 | 0.7440 | 0.5478 | 0.3899 | 0.4391 | 0.6922 | 0.9106 | 0.9747 | 0.9891 | (94) |
| Useful gains | 557.7694 | 636.2199 | 685.7160 | 710.8078 | 644.0726 | 471.2182 | 320.6808 | 334.5397 | 483.6586 | 561.9801 | 546.0707 | 534.8495 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | | | | | | | | | | | | | |
| | 1257.9610 | 1223.2944 | 1112.6646 | 932.9572 | 721.7295 | 485.1650 | 322.8703 | 338.3316 | 524.4447 | 788.4331 | 1038.9121 | 1249.6468 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 520.9426 | 394.5141 | 317.6497 | 159.9476 | 57.7767 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 168.4810 | 354.8458 | 531.8092 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 2505.9667 | |
| Solar heating kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | | | | | | | | | | | | | |
| | 520.9426 | 394.5141 | 317.6497 | 159.9476 | 57.7767 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 168.4810 | 354.8458 | 531.8092 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 2505.9667 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 39.3401 | (99) |

## 9a. Energy requirements - Individual heating systems, including micro-CHP

| | | |
|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | 0.0000 | (201) |
| Fraction of space heat from main system(s) | 1.0000 | (202) |
| Efficiency of main space heating system 1 (in %) | 92.3000 | (206) |
| Efficiency of main space heating system 2 (in %) | 0.0000 | (207) |
| Efficiency of secondary/supplementary heating system, % | 0.0000 | (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement | | | | | | | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 520.9426 | 394.5141 | 317.6497 | 159.9476 | 57.7767 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 168.4810 | 354.8458 | 531.8092 (98) |
| Space heating efficiency (main heating system 1) | | | | | | | | | | | | |
| | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.3000 | 92.3000 | 92.3000 (210) |
| Space heating fuel (main heating system) | | | | | | | | | | | | |
| | 564.4015 | 427.4259 | 344.1492 | 173.2910 | 62.5967 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 182.5363 | 384.4483 | 576.1747 (211) |
| Space heating efficiency (main heating system 2) | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (212) |
| Space heating fuel (main heating system 2) | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (213) |
| Space heating fuel (secondary) | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (215) |
| Water heating | | | | | | | | | | | | |
| Water heating requirement | | | | | | | | | | | | |
| | 210.7092 | 186.3727 | 198.2759 | 175.2272 | 170.4158 | 154.1821 | 152.7202 | 158.5024 | 159.9071 | 177.5397 | 187.7989 | 208.5476 (64) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 (216) |
| (217)m | 86.0065 | 85.6990 | 85.1110 | 83.8557 | 81.9017 | 79.8000 | 79.8000 | 79.8000 | 79.8000 | 83.9425 | 85.4642 | 86.0658 (217) |
| Fuel for water heating, kWh/month | | | | | | | | | | | | |
| | 244.9922 | 217.4737 | 232.9615 | 208.9627 | 208.0735 | 193.2106 | 191.3787 | 198.6246 | 200.3848 | 211.5016 | 219.7399 | 242.3119 (219) |
| Space cooling fuel requirement | | | | | | | | | | | | |
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (221) |
| Pumps and Fa | 7.3041 | 6.5973 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 (231) |
| Lighting | 19.0974 | 15.3207 | 13.7946 | 10.1065 | 7.8065 | 6.3780 | 7.1214 | 9.2566 | 12.0235 | 15.7754 | 17.8183 | 19.6282 (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (233a)m | -14.1647 | -21.2695 | -32.5416 | -39.0264 | -44.2569 | -42.1181 | -41.6119 | -38.1983 | -32.5717 | -25.3724 | -16.0290 | -12.0998 (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | |
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (233b)m | -4.4892 | -9.7020 | -19.7739 | -30.4325 | -40.9654 | -41.4223 | -40.9291 | -34.3150 | -24.7148 | -14.1048 | -6.0667 | -3.5306 (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | |
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235d) |

| | |
|---|---|
| Annual totals kWh/year | |
| Space heating fuel - main system 1 | 2715.0235 (211) |
| Space heating fuel - main system 2 | 0.0000 (213) |
| Space heating fuel - secondary | 0.0000 (215) |
| Efficiency of water heater | 79.8000 |
| Water heating fuel used | 2569.6157 (219) |
| Space cooling fuel | 0.0000 (221) |
| | |
| Electricity for pumps and fans: | |
| Total electricity for the above, kWh/year | 86.0000 (231) |
| Electricity for lighting (calculated in Appendix L) | 154.1271 (232) |
| | |
| Energy saving/generation technologies (Appendices M ,N and Q) | |
| PV generation | -629.7064 (233) |
| Wind generation | 0.0000 (234) |
| Hydro-electric generation (Appendix N) | 0.0000 (235a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 (235) |
| Appendix Q - special features | |
| Energy saved or generated | -0.0000 (236) |
| Energy used | 0.0000 (237) |
| Total delivered energy for all uses | 4895.0600 (238) |

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 2715.0235 | 0.2100 | 570.1549 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2569.6157 | 0.2100 | 539.6193 | (264) |
| Space and water heating | | | 1109.7742 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 154.1271 | 0.1443 | 22.2453 | (268) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -359.2602 | 0.1333 | -47.8818 | |
| PV Unit electricity exported | -270.4462 | 0.1252 | -33.8578 | |
| Total | | | -81.7397 | (269) |
| Total CO2, kg/year | | | 1062.2091 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 16.6800 | (273) |

13a. Primary energy - Individual heating systems including micro-CHP

| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 2715.0235 | 1.1300 | 3067.9766 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2569.6157 | 1.1300 | 2903.6658 | (278) |
| Space and water heating | | | 5971.6424 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 154.1271 | 1.5338 | 236.4053 | (282) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -359.2602 | 1.4925 | -536.1966 | |
| PV Unit electricity exported | -270.4462 | 0.4595 | -124.2724 | |
| Total | | | -660.4689 | (283) |
| Total Primary energy kWh/year | | | 5677.6795 | (286) |
| Target Primary Energy Rate (TPER) | | | 89.1300 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Property Reference** | Unit 49 | **Issued on Date** | 17/05/2025 |
| **Assessment Reference** | 00001 | **Prop Type Ref** | Unit 49 |
| **Property** | | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 76 C | **DER** | 6.70 | **TER** | 16.06 |
| **Environmental** | 95 A | **% DER < TER** | | | 58.28 |
| **$CO_2$ Emissions (t/year)** | 0.38 | **DFEE** | 42.46 | **TFEE** | 44.60 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 4.80 |
| **% DPER < TPER** | 17.56 | **DPER** | 70.76 | **TPER** | 85.83 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Robert Arnold | **Assessor ID** | BA04-0001 |
| **Client** | | | |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 63.9500 | (1b) | x 3.0000 | (2b) = | 191.8500 | (1b) - (3b) (4) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 63.9500 | | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | 191.8500 | (5) |

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2. Ventilation rate

---

| | m3 per hour | |
|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 (6a) |
| Number of open flues | 0 * 20 = | 0.0000 (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 (6f) |
| Number of intermittent extract fans | 0 * 10 = | 0.0000 (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 (7c) |
| | Air changes per hour | |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 0.0000 / (5) = | 0.0000 (8) |
| Pressure test | | Yes |
| Pressure Test Method | | Blower Door |
| Measured/design AP50 | | 3.0000 (17) |
| Infiltration rate | | 0.1500 (18) |
| Number of sides sheltered | | 0 (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.1500 (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.1912 | 0.1875 | 0.1837 | 0.1650 | 0.1612 | 0.1425 | 0.1425 | 0.1388 | 0.1500 | 0.1612 | 0.1687 | 0.1762 | (22b) |

Balanced mechanical ventilation with heat recovery

| | | |
|---|---|---|
| If mechanical ventilation | | 0.5000 (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | | 0.5000 (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | | 81.0000 (23c) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective ac | 0.2862 | 0.2825 | 0.2787 | 0.2600 | 0.2562 | 0.2375 | 0.2375 | 0.2337 | 0.2450 | 0.2562 | 0.2637 | 0.2712 | (25) |

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3. Heat losses and heat loss parameter

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| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| Windows | | | 12.1100 | 1.0536 | 12.7596 | | | (27) |
| Glass Door | | | 2.2900 | 1.3258 | 3.0360 | | | (27) |
| Front Door | | | 2.5700 | 1.4000 | 3.5980 | | | (26) |
| External Walls | 43.2900 | 16.9700 | 26.3200 | 0.1500 | 3.9480 | 150.0000 | 3948.0000 | (29a) |
| External Roof 1 | 63.9500 | | 63.9500 | 0.1000 | 6.3950 | 9.0000 | 575.5500 | (30) |
| Total net area of external elements Aum(A, m2) | | | 107.2400 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 29.7366 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Walls | | | 53.1800 | 0.0000 | 0.0000 | 70.0000 | 3722.6000 | (32) |
| Party Floor | | | 63.9500 | | | 80.0000 | 5116.0000 | (32d) |
| Partitions | | | 147.7000 | | | 9.0000 | 1329.3000 | (32c) |

| | | |
|---|---|---|
| Heat capacity Cm = Sum(A x k) | (28)...(30) + (32) + (32a)...(32e) = | 14691.4500 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | | 229.7334 (35) |
| List of Thermal Bridges | | |

| | Length | Psi-value | Total | |
|---|---|---|---|---|
| K1 Element | | | | |
| E1 Steel lintel with perforated steel base plate | 8.8300 | 0.0500 | 0.4415 | |
| E3 Sill | 3.6200 | 0.0500 | 0.1810 | |
| E4 Jamb | 23.8200 | 0.0500 | 1.1910 | |
| E18 Party wall between dwellings | 12.0000 | 0.0300 | 0.3600 | |
| E15 Flat roof with parapet | 14.4300 | 0.5600 | 8.0808 | |
| E24 Eaves (insulation at ceiling level - inverted) | 14.4300 | 0.1200 | 1.7316 | |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | | 11.9859 | (36) |
| Point Thermal bridges | | (36a) = | 0.0000 | |
| Total fabric heat loss | | (33) + (36) + (36a) = | 41.7225 | (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 18.1226 | 17.8852 | 17.6478 | 16.4607 | 16.2233 | 15.0362 | 15.0362 | 14.7988 | 15.5111 | 16.2233 | 16.6981 | 17.1730 | (38) |
| Heat transfer coeff | 59.8451 | 59.6077 | 59.3703 | 58.1832 | 57.9458 | 56.7587 | 56.7587 | 56.5213 | 57.2335 | 57.9458 | 58.4206 | 58.8954 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 58.1238 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 0.9358 | 0.9321 | 0.9284 | 0.9098 | 0.9061 | 0.8875 | 0.8875 | 0.8838 | 0.8950 | 0.9061 | 0.9135 | 0.9210 | (40) |
| HLP (average) | | | | | | | | | | | | 0.9089 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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## 4. Water heating energy requirements (kWh/year)

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Assumed occupancy | | | | | | | | | | | | 2.0908 | (42) |
| Hot water usage for mixer showers | 57.7784 | 56.8938 | 55.5902 | 53.5848 | 51.7880 | 49.2742 | 47.2860 | 49.6103 | 50.7794 | 53.2691 | 55.8620 | 57.7263 | (42a) |
| Hot water usage for baths | 25.0429 | 24.6648 | 24.1270 | 23.3216 | 22.5958 | 21.5966 | 20.8386 | 21.7655 | 22.2520 | 23.2421 | 24.2714 | 25.0230 | (42b) |
| Hot water usage for other uses | 36.0422 | 34.7316 | 33.4210 | 32.1104 | 30.7997 | 29.4891 | 29.4891 | 30.7997 | 32.1104 | 33.4210 | 34.7316 | 36.0422 | (42c) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 109.2536 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 118.8635 | 116.2903 | 113.1382 | 109.0167 | 105.1835 | 100.3599 | 97.6137 | 102.1756 | 105.1417 | 109.9322 | 114.8650 | 118.7915 | (44) |
| Energy conte | 174.9876 | 153.8755 | 161.6722 | 142.4031 | 135.5396 | 116.0629 | 107.8660 | 120.2625 | 121.9592 | 141.6587 | 155.2438 | 174.4541 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1705.9852 | |
| Distribution loss (46)m = 0.15 x (45)m | 26.2481 | 23.0813 | 24.2508 | 21.3605 | 20.3309 | 17.4094 | 16.1799 | 18.0394 | 18.2939 | 21.2488 | 23.2866 | 26.1681 | (46) |
| Water storage loss: | | | | | | | | | | | | | |
| Store volume | | | | | | | | | | | | 110.0000 | (47) |
| b) If manufacturer declared loss factor is not known : | | | | | | | | | | | | | |
| Hot water storage loss factor from Table 2 (kWh/litre/day) | | | | | | | | | | | | 0.0152 | (51) |
| Volume factor from Table 2a | | | | | | | | | | | | 1.0294 | (52) |
| Temperature factor from Table 2b | | | | | | | | | | | | 0.6000 | (53) |
| Enter (49) or (54) in (55) | | | | | | | | | | | | 1.0327 | (55) |
| Total storage loss | 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (56) |
| If cylinder contains dedicated solar storage | 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (57) |
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | 230.2644 | 203.8030 | 216.9490 | 195.8968 | 190.8164 | 169.5566 | 163.1428 | 175.5393 | 175.4528 | 196.9355 | 208.7375 | 229.7309 | (62) |
| WWHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | 230.2644 | 203.8030 | 216.9490 | 195.8968 | 190.8164 | 169.5566 | 163.1428 | 175.5393 | 175.4528 | 196.9355 | 208.7375 | 229.7309 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2356.8250 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2357 | (64) |
| Electric shower(s) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | 102.4048 | 91.1056 | 97.9774 | 90.1440 | 89.2883 | 81.3859 | 80.0869 | 84.2087 | 83.3464 | 91.3230 | 94.4135 | 102.2274 | (65) |

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## 5. Internal gains (see Table 5 and 5a)

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Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 104.5417 | 104.5417 | 104.5417 | 104.5417 | 104.5417 | 104.5417 | 104.5417 | 104.5417 | 104.5417 | 104.5417 | 104.5417 | 104.5417 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 92.1817 | 102.0583 | 92.1817 | 95.2544 | 92.1817 | 95.2544 | 92.1817 | 92.1817 | 95.2544 | 92.1817 | 95.2544 | 92.1817 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 182.7879 | 184.6846 | 179.9048 | 169.7292 | 156.8844 | 144.8120 | 136.7469 | 134.8501 | 139.6299 | 149.8055 | 162.6504 | 174.7228 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 33.4542 | 33.4542 | 33.4542 | 33.4542 | 33.4542 | 33.4542 | 33.4542 | 33.4542 | 33.4542 | 33.4542 | 33.4542 | 33.4542 | (69) |
| Pumps, fans | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | -83.6334 | -83.6334 | -83.6334 | -83.6334 | -83.6334 | -83.6334 | -83.6334 | -83.6334 | -83.6334 | -83.6334 | -83.6334 | -83.6334 | (71) |
| Water heating gains (Table 5) | 137.6409 | 135.5738 | 131.6901 | 125.2000 | 120.0112 | 113.0359 | 107.6437 | 113.1838 | 115.7588 | 122.7459 | 131.1299 | 137.4025 | (72) |
| Total internal gains | 466.9730 | 476.6792 | 458.1392 | 444.5462 | 423.4398 | 407.4649 | 390.9348 | 394.5781 | 405.0057 | 419.0957 | 443.3973 | 458.6695 | (73) |

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## 6. Solar gains

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| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Southeast | 5.2000 | 36.7938 | 0.4500 | 0.7000 | 0.7700 | 41.7659 | (77) |
| Northwest | 6.9100 | 11.2829 | 0.4500 | 0.7000 | 0.7700 | 17.0194 | (81) |
| Southwest | 2.2900 | 36.7938 | 0.4500 | 0.7000 | 0.7700 | 18.3931 | (79) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 77.1784 | 137.1165 | 202.6246 | 276.2305 | 332.3740 | 340.0755 | 323.6638 | 280.2333 | 227.8712 | 155.5916 | 93.4714 | 65.3825 | (83) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total gains | 544.1514 | 613.7957 | 660.7638 | 720.7766 | 755.8138 | 747.5403 | 714.5986 | 674.8115 | 632.8769 | 574.6873 | 536.8687 | 524.0519 | (84) |

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7. Mean internal temperature (heating season)

---

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 68.1920 | 68.4636 | 68.7374 | 70.1398 | 70.4272 | 71.9001 | 71.9001 | 72.2021 | 71.3036 | 70.4272 | 69.8548 | 69.2916 | |
| alpha | 5.5461 | 5.5642 | 5.5825 | 5.6760 | 5.6951 | 5.7933 | 5.7933 | 5.8135 | 5.7536 | 5.6951 | 5.6570 | 5.6194 | |
| util living area | | | | | | | | | | | | | |
| | 0.9841 | 0.9683 | 0.9356 | 0.8400 | 0.6797 | 0.4821 | 0.3490 | 0.3844 | 0.6078 | 0.8701 | 0.9652 | 0.9866 | (86) |
| MIT | 20.1329 | 20.3167 | 20.5458 | 20.8148 | 20.9527 | 20.9946 | 20.9993 | 20.9988 | 20.9806 | 20.8070 | 20.4483 | 20.1144 | (87) |
| Th 2 | 20.1372 | 20.1403 | 20.1434 | 20.1592 | 20.1623 | 20.1781 | 20.1781 | 20.1813 | 20.1718 | 20.1623 | 20.1560 | 20.1497 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9798 | 0.9604 | 0.9199 | 0.8068 | 0.6283 | 0.4218 | 0.2841 | 0.3164 | 0.5411 | 0.8347 | 0.9550 | 0.9830 | (89) |
| MIT 2 | 19.1429 | 19.3748 | 19.6579 | 19.9817 | 20.1249 | 20.1750 | 20.1779 | 20.1808 | 20.1595 | 19.9828 | 19.5537 | 19.1293 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.6077 | (91) |
| MIT | 19.7445 | 19.9472 | 20.1975 | 20.4880 | 20.6279 | 20.6730 | 20.6770 | 20.6779 | 20.6585 | 20.4836 | 20.0973 | 19.7279 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.7445 | 19.9472 | 20.1975 | 20.4880 | 20.6279 | 20.6730 | 20.6770 | 20.6779 | 20.6585 | 20.4836 | 20.0973 | 19.7279 | (93) |

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8. Space heating requirement

---

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9775 | 0.9583 | 0.9210 | 0.8204 | 0.6574 | 0.4583 | 0.3235 | 0.3577 | 0.5808 | 0.8492 | 0.9542 | 0.9808 | (94) |
| Useful gains | 531.9184 | 588.1962 | 608.5861 | 591.3376 | 496.8769 | 342.5916 | 231.1785 | 241.3937 | 367.5744 | 488.0087 | 512.2927 | 514.0079 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | | | | | | | | | | | | | |
| | 924.2776 | 896.9262 | 813.2224 | 674.2259 | 517.3363 | 344.6979 | 231.4064 | 241.7917 | 375.3654 | 572.7158 | 759.3099 | 914.5217 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 291.9152 | 207.4666 | 152.2494 | 59.6796 | 15.2218 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 63.0221 | 177.8524 | 297.9823 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 1265.3893 | |
| Solar heating kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | | | | | | | | | | | | | |
| | 291.9152 | 207.4666 | 152.2494 | 59.6796 | 15.2218 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 63.0221 | 177.8524 | 297.9823 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 1265.3893 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 19.7872 | (99) |

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8c. Space cooling requirement

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| Calculated for June, July and August. See Table 10b | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| Ext. temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | |
| Heat loss rate W | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 533.5318 | 420.0144 | 429.5618 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (100) |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.9703 | 0.9878 | 0.9822 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (101) |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 517.6716 | 414.8702 | 421.9302 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (102) |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 825.6266 | 789.6193 | 743.9986 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103) |
| Space cooling kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 221.7276 | 278.8133 | 239.6189 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (104) |
| Cooled fraction | | | | | | | | | | fC = cooled area / (4) = | | 0.9851 | (105) |
| Intermittency factor (Table 10b) | | | | | | | | | | | | | |
| | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | (106) |
| Space cooling kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 54.6084 | 68.6679 | 59.0148 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) |
| Space cooling requirement | | | | | | | | | | | | 182.2911 | (107) |

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9b. Energy requirements

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | 0.0000 | (301) |
| Fraction of space heat from community system | | | | | | | | | | | | 1.0000 | (302) |
| Fraction of heat from community Heat pump-Space and Water | | | | | | | | | | | | 1.0000 | (303a) |
| Factor for control and charging method (Table 4c(3)) for space heating | | | | | | | | | | | | 1.0000 | (305) |
| Factor for charging method (Table 4c(3)) for water heating | | | | | | | | | | | | 1.0000 | (305a) |
| Distribution loss factor (Table 12c) for community heating system | | | | | | | | | | | | 2.0000 | (306) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 | (208) |
| Space heating: | | | | | | | | | | | | | |
| Space heating requirement | | | | | | | | | | | | | |
| | 291.9152 | 207.4666 | 152.2494 | 59.6796 | 15.2218 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 63.0221 | 177.8524 | 297.9823 | (98) |
| Space heat from Heat pump = (98) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 307a | 583.8304 | 414.9332 | 304.4988 | 119.3591 | 30.4436 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 126.0442 | 355.7049 | 595.9645 | |
| Space heating requirement | | | | | | | | | | | | | |
| | 583.8304 | 414.9332 | 304.4988 | 119.3591 | 30.4436 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 126.0442 | 355.7049 | 595.9645 | (307) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | | | | | | | | | | | 0.0000 | (308) |
| Space heating fuel for secondary/supplementary system | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (309) |
| Water heating | | | | | | | | | | | | | |
| Annual water heating requirement | | | | | | | | | | | | | |
| | 230.2644 | 203.8030 | 216.9490 | 195.8968 | 190.8164 | 169.5566 | 163.1428 | 175.5393 | 175.4528 | 196.9355 | 208.7375 | 229.7309 | (64) |
| Water heat from Heat pump = (64) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 310a | 460.5289 | 407.6060 | 433.8980 | 391.7936 | 381.6327 | 339.1132 | 326.2855 | 351.0787 | 350.9057 | 393.8710 | 417.4751 | 459.4618 | |
| Water heating fuel | | | | | | | | | | | | | |
| | 460.5289 | 407.6060 | 433.8980 | 391.7936 | 381.6327 | 339.1132 | 326.2855 | 351.0787 | 350.9057 | 393.8710 | 417.4751 | 459.4618 | (310) |
| Cooling System Energy Efficiency Ratio | | | | | | | | | | | | 2.6000 | (314) |
| Space coolin | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 21.0032 | 26.4107 | 22.6980 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (315) |
| Pumps and Fa | 17.5331 | 15.8364 | 17.5331 | 16.9675 | 17.5331 | 16.9675 | 17.5331 | 17.5331 | 16.9675 | 17.5331 | 16.9675 | 17.5331 | (331) |
| Lighting | 19.0478 | 15.2809 | 13.7587 | 10.0802 | 7.7863 | 6.3614 | 7.1029 | 9.2326 | 11.9922 | 15.7345 | 17.7720 | 19.5772 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333a)m | -4.7693 | -7.7311 | -12.8550 | -16.6693 | -19.9389 | -19.3600 | -19.0860 | -16.9613 | -13.6108 | -9.6584 | -5.5647 | -4.0026 | (333a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335a) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (333b) |

Electricity generated by wind turbines (Appendix M) (negative quantity)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (334b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334b) |

Electricity generated by hydro-electric generators (Appendix M) (negative quantity)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (335b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335b) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - community heating | 2530.7786 | (307) |
| Space heating fuel - secondary | 0.0000 | (309) |
| Water heating fuel - community heating | 4713.6500 | (310) |
| Efficiency of water heater | 0.0000 | (311) |
| Electricity used for heat distribution | 25.3078 | (313) |
| Space cooling fuel | 70.1120 | (321) |
| | | |
| Electricity for pumps and fans: | | |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8820) | | |
| mechanical ventilation fans (SFP = 0.8820) | 206.4383 | (330a) |
| Total electricity for the above, kWh/year | 206.4383 | (331) |
| Electricity for lighting (calculated in Appendix L) | 153.7267 | (332) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -150.2073 | (333) |
| Wind generation | 0.0000 | (334) |
| Hydro-electric generation (Appendix N) | 0.0000 | (335a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (335) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (336) |
| Energy used | 0.0000 | (337) |
| Total delivered energy for all uses | 7524.4983 | (338) |

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12b. Carbon dioxide emissions - Community heating scheme

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (367) |
| Space and Water heating from Heat pump | 2587.2959 | 0.1570 | 141.8659 | (367) |
| Electrical energy for heat distribution (space & water) | 25.3078 | 0.0000 | 10.6084 | (372) |
| Overall CO2 factor for heat network | | | 0.0538 | (386) |
| Total CO2 associated with community systems | | | 389.4784 | (373) |
| Space and water heating | | | 389.4784 | (376) |
| Space cooling | 70.1120 | 0.1140 | 7.9942 | (377) |
| Pumps, fans and electric keep-hot | 206.4383 | 0.1387 | 28.6355 | (378) |
| Energy for lighting | 153.7267 | 0.1443 | 22.1875 | (379) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -150.2073 | 0.1319 | -19.8050 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -19.8050 | (380) |
| Total CO2, kg/year | | | 428.4906 | (383) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 6.7000 | (384) |

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13b. Primary energy - Community heating scheme

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| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (467a) |
| Space and Water heating from Heat pump | 2587.2959 | 1.5811 | 1429.0406 | (467) |
| Electrical energy for heat distribution (space & water) | 25.3078 | 0.0000 | 111.6873 | (472) |
| Overall CO2 factor for heat network | | | 0.5660 | (486) |
| Total CO2 associated with community systems | | | 4100.5184 | (473) |
| Space and water heating | | | 4100.5184 | (476) |
| Space cooling | 70.1120 | 1.4203 | 99.5771 | (477) |
| Pumps, fans and electric keep-hot | 206.4383 | 1.5128 | 312.2998 | (478) |
| Energy for lighting | 153.7267 | 1.5338 | 235.7912 | (479) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -150.2073 | 1.4871 | -223.3793 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -223.3793 | (480) |
| Total Primary energy kWh/year | | | 4524.8072 | (483) |
| Dwelling Primary energy Rate (DPER) | | | 70.7600 | (484) |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 63.9500 | (1b) | x 3.0000 | (2b) = | 191.8500 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 63.9500 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | | 191.8500 | (5) |

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2. Ventilation rate

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| | m3 per hour | |
|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 (6a) |
| Number of open flues | 0 * 20 = | 0.0000 (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 (6e) |

| | | |
|---|---|---|
| Number of blocked chimneys | 0 * 20 = | 0.0000 (6f) |
| Number of intermittent extract fans | 2 * 10 = | 20.0000 (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 (7c) |

| | | Air changes per hour | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 20.0000 / (5) = | 0.1042 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3542 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.3542 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.4517 | 0.4428 | 0.4340 | 0.3897 | 0.3808 | 0.3365 | 0.3365 | 0.3277 | 0.3542 | 0.3808 | 0.3985 | 0.4162 | (22b) |
| Effective ac | 0.6020 | 0.5980 | 0.5942 | 0.5759 | 0.5725 | 0.5566 | 0.5566 | 0.5537 | 0.5627 | 0.5725 | 0.5794 | 0.5866 | (25) |

## 3. Heat losses and heat loss parameter

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| TER Opaque door | | | 2.5700 | 1.0000 | 2.5700 | | | (26) |
| TER Opening Type | | | 13.4100 | 1.1450 | 15.3550 | | | (27) |
| External Walls | 43.2900 | 15.9800 | 27.3100 | 0.1800 | 4.9158 | | | (29a) |
| External Roof 1 | 63.9500 | | 63.9500 | 0.1100 | 7.0345 | | | (30) |
| Total net area of external elements Aum(A, m2) | | | 107.2400 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 29.8753 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Walls | | | 53.1800 | 0.0000 | 0.0000 | | | (32) |

| | | |
|---|---|---|
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | 229.7334 | (35) |

List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E1 Steel lintel with perforated steel base plate | 8.8300 | 0.0500 | 0.4415 |
| E3 Sill | 3.6200 | 0.0500 | 0.1810 |
| E4 Jamb | 23.8200 | 0.0500 | 1.1910 |
| E18 Party wall between dwellings | 12.0000 | 0.0600 | 0.7200 |
| E15 Flat roof with parapet | 14.4300 | 0.5600 | 8.0808 |
| E24 Eaves (insulation at ceiling level - inverted) | 14.4300 | 0.2400 | 3.4632 |

| | | |
|---|---|---|
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | 14.0775 | (36) |
| Point Thermal bridges (36a) = | 0.0000 | |
| Total fabric heat loss (33) + (36) + (36a) = | 43.9528 | (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 38.1130 | 37.8622 | 37.6164 | 36.4619 | 36.2459 | 35.2404 | 35.2404 | 35.0542 | 35.6277 | 36.2459 | 36.6829 | 37.1397 | (38) |
| Heat transfer coeff | 82.0658 | 81.8150 | 81.5692 | 80.4147 | 80.1987 | 79.1932 | 79.1932 | 79.0070 | 79.5805 | 80.1987 | 80.6357 | 81.0925 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 80.4137 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.2833 | 1.2794 | 1.2755 | 1.2575 | 1.2541 | 1.2384 | 1.2384 | 1.2354 | 1.2444 | 1.2541 | 1.2609 | 1.2681 | (40) |
| HLP (average) | | | | | | | | | | | | 1.2574 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

## 4. Water heating energy requirements (kWh/year)

| | | |
|---|---|---|
| Assumed occupancy | 2.0908 | (42) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hot water usage for mixer showers | 59.2760 | 58.3852 | 57.0871 | 54.6035 | 52.7706 | 50.7267 | 49.5649 | 50.8531 | 52.2653 | 54.4599 | 56.9969 | 59.0489 | (42a) |
| Hot water usage for baths | 25.6139 | 25.2335 | 24.6978 | 23.7101 | 22.9705 | 22.1504 | 21.7074 | 22.2394 | 22.8186 | 23.6961 | 24.7041 | 25.5273 | (42b) |
| Hot water usage for other uses | 36.0422 | 34.7316 | 33.4210 | 32.1104 | 30.7997 | 29.4891 | 29.4891 | 30.7997 | 32.1104 | 33.4210 | 34.7316 | 36.0422 | (42c) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 111.1643 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 120.9321 | 118.3503 | 115.2059 | 110.4239 | 106.5409 | 102.3662 | 100.7614 | 103.8922 | 107.1942 | 111.5769 | 116.4326 | 120.6184 | (44) |
| Energy conte | 191.5269 | 168.5292 | 177.0672 | 151.1648 | 143.4245 | 125.8711 | 121.8622 | 128.6403 | 132.1811 | 151.4089 | 165.8796 | 188.8593 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1846.4150 | |
| Distribution loss (46)m = 0.15 x (45)m | 28.7290 | 25.2794 | 26.5601 | 22.6747 | 21.5137 | 18.8807 | 18.2793 | 19.2960 | 19.8272 | 22.7113 | 24.8819 | 28.3289 | (46) |

| | | |
|---|---|---|
| Water storage loss: | | |
| Store volume | 150.0000 | (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | 1.3938 | (48) |
| Temperature factor from Table 2b | 0.5400 | (49) |
| Enter (49) or (54) in (55) | 0.7527 | (55) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total storage loss | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (56) |
| If cylinder contains dedicated solar storage | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (57) |
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | 238.1218 | 210.6149 | 223.6621 | 196.2567 | 190.0194 | 170.9630 | 168.4571 | 175.2352 | 177.2730 | 198.0038 | 210.9714 | 235.4542 | (62) |
| WWHRS | -27.0985 | -23.9662 | -25.0960 | -20.7805 | -19.3666 | -16.5722 | -15.5338 | -16.5186 | -17.1462 | -20.2135 | -22.8994 | -26.5967 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | 211.0233 | 186.6488 | 198.5661 | 175.4762 | 170.6527 | 154.3908 | 152.9233 | 158.7165 | 160.1268 | 177.7903 | 188.0720 | 208.8575 | (64) |
| | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | | 2143.2443 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2143 | (64) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Electric shower(s) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | | | | | | | | | | | 0.0000 | (64a) |

Heat gains from water heating, kWh/month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 100.9586 | 89.7045 | 96.1508 | 86.3358 | 84.9646 | 77.9256 | 77.7951 | 80.0488 | 80.0237 | 87.6194 | 91.2284 | 100.0716 (65) |

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5. Internal gains (see Table 5 and 5a)

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Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 104.5417 | 104.5417 | 104.5417 | 104.5417 | 104.5417 | 104.5417 | 104.5417 | 104.5417 | 104.5417 | 104.5417 | 104.5417 | 104.5417 | (66) |

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 92.4579 | 102.3641 | 92.4579 | 95.5398 | 92.4579 | 95.5398 | 92.4579 | 92.4579 | 95.5398 | 92.4579 | 95.5398 | 92.4579 | (67) |

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 182.7879 | 184.6846 | 179.9048 | 169.7292 | 156.8844 | 144.8120 | 136.7469 | 134.8501 | 139.6299 | 149.8055 | 162.6504 | 174.7228 | (68) |

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 33.4542 | 33.4542 | 33.4542 | 33.4542 | 33.4542 | 33.4542 | 33.4542 | 33.4542 | 33.4542 | 33.4542 | 33.4542 | 33.4542 | (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.0000 | 3.0000 | 3.0000 | (70) |

Losses e.g. evaporation (negative values) (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | -83.6334 | -83.6334 | -83.6334 | -83.6334 | -83.6334 | -83.6334 | -83.6334 | -83.6334 | -83.6334 | -83.6334 | -83.6334 | -83.6334 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 135.6971 | 133.4889 | 129.2349 | 119.9108 | 114.1997 | 108.2300 | 104.5633 | 107.5925 | 111.1440 | 117.7680 | 126.7062 | 134.5049 | (72) |

Total internal gains

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 468.3053 | 477.9001 | 458.9601 | 442.5424 | 420.9044 | 402.9443 | 388.1306 | 389.2630 | 400.6763 | 417.3939 | 442.2589 | 459.0480 | (73) |

---

6. Solar gains

---

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Southeast | 4.8400 | 36.7938 | 0.6300 | 0.7000 | 0.7700 | 54.4242 | (77) |
| Southwest | 2.1300 | 36.7938 | 0.6300 | 0.7000 | 0.7700 | 23.9512 | (79) |
| Northwest | 6.4400 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 22.2065 | (81) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 100.5819 | 178.7042 | 264.1032 | 360.0762 | 433.2898 | 443.3413 | 421.9414 | 365.3051 | 297.0214 | 202.7888 | 121.8172 | 85.2079 | (83) |
| Total gains | 568.8872 | 656.6043 | 723.0633 | 802.6186 | 854.1943 | 846.2856 | 810.0720 | 754.5681 | 697.6977 | 620.1827 | 564.0760 | 544.2560 | (84) |

---

7. Mean internal temperature (heating season)

---

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| tau | 49.7279 | 49.8803 | 50.0306 | 50.7489 | 50.8856 | 51.5317 | 51.5317 | 51.6532 | 51.2809 | 50.8856 | 50.6098 | 50.3247 | |
| alpha | 4.3152 | 4.3254 | 4.3354 | 4.3833 | 4.3924 | 4.4354 | 4.4354 | 4.4435 | 4.4187 | 4.3924 | 4.3740 | 4.3550 | |
| util living area | 0.9867 | 0.9747 | 0.9504 | 0.8833 | 0.7555 | 0.5726 | 0.4243 | 0.4717 | 0.7070 | 0.9125 | 0.9747 | 0.9889 | (86) |
| MIT | 19.5874 | 19.8168 | 20.1336 | 20.5367 | 20.8236 | 20.9607 | 20.9916 | 20.9868 | 20.9018 | 20.5293 | 19.9989 | 19.5571 | (87) |
| Th 2 | 19.8540 | 19.8570 | 19.8601 | 19.8743 | 19.8770 | 19.8894 | 19.8894 | 19.8917 | 19.8846 | 19.8770 | 19.8716 | 19.8659 | (88) |
| util rest of house | 0.9828 | 0.9674 | 0.9360 | 0.8507 | 0.6942 | 0.4837 | 0.3202 | 0.3629 | 0.6199 | 0.8804 | 0.9662 | 0.9856 | (89) |
| MIT 2 | 18.2470 | 18.5378 | 18.9336 | 19.4247 | 19.7355 | 19.8678 | 19.8868 | 19.8872 | 19.8217 | 19.4309 | 18.7808 | 18.2170 | (90) |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.6077 | (91) |
| MIT | 19.0615 | 19.3150 | 19.6628 | 20.1004 | 20.3967 | 20.5320 | 20.5582 | 20.5554 | 20.4781 | 20.0983 | 19.5210 | 19.0313 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.0615 | 19.3150 | 19.6628 | 20.1004 | 20.3967 | 20.5320 | 20.5582 | 20.5554 | 20.4781 | 20.0983 | 19.5210 | 19.0313 | (93) |

---

8. Space heating requirement

---

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9793 | 0.9632 | 0.9330 | 0.8579 | 0.7240 | 0.5362 | 0.3834 | 0.4289 | 0.6683 | 0.8876 | 0.9628 | 0.9824 | (94) |
| Useful gains | 557.1117 | 632.4237 | 674.6539 | 688.5822 | 618.4434 | 453.7602 | 310.5941 | 323.6612 | 466.2975 | 550.4601 | 543.1197 | 534.6892 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | 1211.4143 | 1179.3639 | 1073.6760 | 900.6795 | 697.4622 | 469.7704 | 313.4600 | 328.3062 | 507.5683 | 761.7551 | 1001.5750 | 1202.7066 | (97) |
| Space heating kWh | 486.8011 | 367.5438 | 296.8724 | 152.7100 | 58.7900 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 157.2034 | 330.0878 | 497.0049 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 2347.0136 | |
| Solar heating kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | 486.8011 | 367.5438 | 296.8724 | 152.7100 | 58.7900 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 157.2034 | 330.0878 | 497.0049 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 2347.0136 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 36.7008 | (99) |

---

9a. Energy requirements - Individual heating systems, including micro-CHP

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| | | |
|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | 0.0000 | (201) |
| Fraction of space heat from main system(s) | 1.0000 | (202) |
| Efficiency of main space heating system 1 (in %) | 92.3000 | (206) |
| Efficiency of main space heating system 2 (in %) | 0.0000 | (207) |
| Efficiency of secondary/supplementary heating system, % | 0.0000 | (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement | 486.8011 | 367.5438 | 296.8724 | 152.7100 | 58.7900 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 157.2034 | 330.0878 | 497.0049 | (98) |
| Space heating efficiency (main heating system 1) | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.3000 | 92.3000 | 92.3000 | (210) |
| Space heating fuel (main heating system) | 527.4118 | 398.2056 | 321.6386 | 165.4497 | 63.6945 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 170.3179 | 357.6249 | 538.4669 | (211) |
| Space heating efficiency (main heating system 2) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (212) |
| Space heating fuel (main heating system 2) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (213) |

Space heating fuel (secondary)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (215) |
| Water heating | | | | | | | | | | | | |
| Water heating requirement | | | | | | | | | | | | |
| | 211.0233 | 186.6488 | 198.5661 | 175.4762 | 170.6527 | 154.3908 | 152.9233 | 158.7165 | 160.1268 | 177.7903 | 188.0720 | 208.8575 (64) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 (216) |
| (217)m | 85.8713 | 85.5504 | 84.9597 | 83.7497 | 81.9276 | 79.8000 | 79.8000 | 79.8000 | 79.8000 | 83.7849 | 85.3079 | 85.9323 (217) |
| Fuel for water heating, kWh/month | | | | | | | | | | | | |
| | 245.7436 | 218.1740 | 233.7180 | 209.5247 | 208.2970 | 193.4722 | 191.6332 | 198.8929 | 200.6601 | 212.1984 | 220.4626 | 243.0487 (219) |
| Space cooling fuel requirement | | | | | | | | | | | | |
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (221) |
| Pumps and Fa | 7.3041 | 6.5973 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 (231) |
| Lighting | 19.2109 | 15.4117 | 13.8765 | 10.1665 | 7.8529 | 6.4159 | 7.1637 | 9.3117 | 12.0949 | 15.8692 | 17.9242 | 19.7448 (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (233a)m | -14.2190 | -21.3504 | -32.6640 | -39.1713 | -44.4192 | -42.2717 | -41.7635 | -38.3385 | -32.6927 | -25.4681 | -16.0903 | -12.1463 (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | |
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (233b)m | -4.5080 | -9.7427 | -19.8568 | -30.5602 | -41.1375 | -41.5966 | -41.1014 | -34.4594 | -24.8186 | -14.1640 | -6.0921 | -3.5455 (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | |
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235d) |

| | |
|---|---|
| Annual totals kWh/year | |
| Space heating fuel - main system 1 | 2542.8099 (211) |
| Space heating fuel - main system 2 | 0.0000 (213) |
| Space heating fuel - secondary | 0.0000 (215) |
| Efficiency of water heater | 79.8000 |
| Water heating fuel used | 2575.8255 (219) |
| Space cooling fuel | 0.0000 (221) |
| | |
| Electricity for pumps and fans: | |
| Total electricity for the above, kWh/year | 86.0000 (231) |
| Electricity for lighting (calculated in Appendix L) | 155.0431 (232) |
| | |
| Energy saving/generation technologies (Appendices M ,N and Q) | |
| PV generation | -632.1778 (233) |
| Wind generation | 0.0000 (234) |
| Hydro-electric generation (Appendix N) | 0.0000 (235a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 (235) |
| Appendix Q - special features | |
| Energy saved or generated | -0.0000 (236) |
| Energy used | 0.0000 (237) |
| Total delivered energy for all uses | 4727.5007 (238) |

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12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

---

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 2542.8099 | 0.2100 | 533.9901 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2575.8255 | 0.2100 | 540.9234 | (264) |
| Space and water heating | | | 1074.9134 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 155.0431 | 0.1443 | 22.3775 | (268) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -360.5950 | 0.1333 | -48.0601 | |
| PV Unit electricity exported | -271.5828 | 0.1252 | -34.0001 | |
| Total | | | -82.0602 | (269) |
| Total CO2, kg/year | | | 1027.1600 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 16.0600 | (273) |

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13a. Primary energy - Individual heating systems including micro-CHP

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| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 2542.8099 | 1.1300 | 2873.3752 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2575.8255 | 1.1300 | 2910.6828 | (278) |
| Space and water heating | | | 5784.0580 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 155.0431 | 1.5338 | 237.8103 | (282) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -360.5950 | 1.4925 | -538.1900 | |
| PV Unit electricity exported | -271.5828 | 0.4595 | -124.7945 | |
| Total | | | -662.9845 | (283) |
| Total Primary energy kWh/year | | | 5488.9846 | (286) |
| Target Primary Energy Rate (TPER) | | | 85.8300 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Property Reference** | Unit 50 | **Issued on Date** | 17/05/2025 |
| **Assessment Reference** | 00001 | **Prop Type Ref** | Unit 50 |
| **Property** | | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 73 C | **DER** | 8.37 | **TER** | 20.14 |
| **Environmental** | 94 A | **% DER < TER** | | | 58.44 |
| **$CO_2$ Emissions (t/year)** | 0.39 | **DFEE** | 56.10 | **TFEE** | 58.73 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 4.48 |
| **% DPER < TPER** | 18.54 | **DPER** | 87.96 | **TPER** | 107.98 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Robert Arnold | **Assessor ID** | BA04-0001 |
| **Client** | | | |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

## 1. Overall dwelling characteristics

| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 52.6300 | (1b) | x 3.0000 | (2b) = | 157.8900 | (1b) - (3b) (4) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 52.6300 | | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | 157.8900 | (5) |

## 2. Ventilation rate

| | m3 per hour | |
|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 (6a) |
| Number of open flues | 0 * 20 = | 0.0000 (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 (6f) |
| Number of intermittent extract fans | 0 * 10 = | 0.0000 (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 (7c) |
| | **Air changes per hour** | |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 0.0000 / (5) = | 0.0000 (8) |
| Pressure test | | Yes |
| Pressure Test Method | | Blower Door |
| Measured/design AP50 | | 3.0000 (17) |
| Infiltration rate | | 0.1500 (18) |
| Number of sides sheltered | | 0 (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.1500 (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.1912 | 0.1875 | 0.1837 | 0.1650 | 0.1612 | 0.1425 | 0.1425 | 0.1388 | 0.1500 | 0.1612 | 0.1687 | 0.1762 | (22b) |
| Balanced mechanical ventilation with heat recovery | | | | | | | | | | | | | |
| If mechanical ventilation | | | | | | | | | | | | 0.5000 | (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | | | | | | | | | | | | 0.5000 | (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | | | | | | | | | | | | 81.0000 | (23c) |
| Effective ac | 0.2862 | 0.2825 | 0.2787 | 0.2600 | 0.2562 | 0.2375 | 0.2375 | 0.2337 | 0.2450 | 0.2562 | 0.2637 | 0.2712 | (25) |

## 3. Heat losses and heat loss parameter

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| Windows | | | 10.1600 | 1.0536 | 10.7050 | | | (27) |
| Glass Door | | | 4.6900 | 1.3258 | 6.2178 | | | (27) |
| Front Door | | | 1.8900 | 1.4000 | 2.6460 | | | (26) |
| External Walls | 49.2600 | 14.8500 | 34.4100 | 0.1500 | 5.1615 | 150.0000 | 5161.5000 | (29a) |
| Wall to Communal Corridor | 21.1400 | 1.8900 | 19.2500 | 0.1400 | 2.6950 | 150.0000 | 2887.5000 | (29a) |
| External Roof | 52.6300 | | 52.6300 | 0.1000 | 5.2630 | 9.0000 | 473.6700 | (30) |
| Total net area of external elements Aum(A, m2) | | | 123.0300 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 32.6883 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 49 | | | 26.5900 | 0.0000 | 0.0000 | 110.0000 | 2924.9000 | (32) |
| Party Floor | | | 52.6300 | | | 80.0000 | 4210.4000 | (32d) |
| Internal Walls | | | 100.6700 | | | 9.0000 | 906.0300 | (32c) |
| Heat capacity Cm = Sum(A x k) | | | | | (28)...(30) + (32) + (32a)...(32e) = | | 16564.0000 | (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | | | | | | | 314.7254 | (35) |

List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E1 Steel lintel with perforated steel base plate | 7.4900 | 0.0500 | 0.3745 |
| E4 Jamb | 31.2000 | 0.0500 | 1.5600 |
| E15 Flat roof with parapet | 16.4200 | 0.5600 | 9.1952 |
| E16 Corner (normal) | 3.0000 | 0.0900 | 0.2700 |
| E18 Party wall between dwellings | 6.0000 | 0.0300 | 0.1800 |
| E7 Party floor between dwellings (in blocks of flats) | 7.0460 | 0.0350 | 0.2466 |
| E24 Eaves (insulation at ceiling level - inverted) | 16.4200 | 0.1200 | 1.9704 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 13.7967 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 46.4850 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 14.9147 | 14.7193 | 14.5239 | 13.5470 | 13.3516 | 12.3746 | 12.3746 | 12.1792 | 12.7654 | 13.3516 | 13.7424 | 14.1331 | (38) |
| Heat transfer coeff | 61.3997 | 61.2043 | 61.0089 | 60.0320 | 59.8366 | 58.8596 | 58.8596 | 58.6642 | 59.2504 | 59.8366 | 60.2273 | 60.6181 | (39) |

Average = Sum(39)m / 12 = 59.9831

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.1666 | 1.1629 | 1.1592 | 1.1406 | 1.1369 | 1.1184 | 1.1184 | 1.1147 | 1.1258 | 1.1369 | 1.1444 | 1.1518 | (40) |
| HLP (average) | | | | | | | | | | | | 1.1397 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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## 4. Water heating energy requirements (kWh/year)

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Assumed occupancy 1.7677 (42)

Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 52.4965 | 51.6928 | 50.5084 | 48.6863 | 47.0537 | 44.7698 | 42.9633 | 45.0752 | 46.1373 | 48.3995 | 50.7553 | 52.4492 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 22.7646 | 22.4209 | 21.9320 | 21.1999 | 20.5401 | 19.6318 | 18.9427 | 19.7854 | 20.2276 | 21.1276 | 22.0633 | 22.7465 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.7325 | 31.5423 | 30.3520 | 29.1617 | 27.9714 | 26.7812 | 26.7812 | 27.9714 | 29.1617 | 30.3520 | 31.5423 | 32.7325 | (42c) |

Average daily hot water use (litres/day) 99.2627 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 107.9936 | 105.6560 | 102.7924 | 99.0479 | 95.5653 | 91.1828 | 88.6872 | 92.8320 | 95.5267 | 99.8790 | 104.3608 | 107.9282 | (44) |
| Energy conte | 158.9853 | 139.8043 | 146.8882 | 129.3813 | 123.1455 | 105.4498 | 98.0020 | 109.2649 | 110.8061 | 128.7043 | 141.0472 | 158.5005 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1549.9795 | |
| Distribution loss (46)m = 0.15 x (45)m | 23.8478 | 20.9706 | 22.0332 | 19.4072 | 18.4718 | 15.8175 | 14.7003 | 16.3897 | 16.6209 | 19.3056 | 21.1571 | 23.7751 | (46) |

Water storage loss:

Store volume 110.0000 (47)

b) If manufacturer declared loss factor is not known :

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.0152 (51)
Volume factor from Table 2a 1.0294 (52)
Temperature factor from Table 2b 0.6000 (53)

Enter (49) or (54) in (55) 1.0327 (55)

Total storage loss

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (56) |

If cylinder contains dedicated solar storage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.0144 | 28.9162 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | 32.0144 | 30.9817 | 32.0144 | 30.9817 | 32.0144 | (57) |
| Primary loss 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |

Total heat required for water heating calculated for each month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 214.2621 | 189.7317 | 202.1650 | 182.8750 | 178.4223 | 158.9435 | 153.2788 | 164.5417 | 164.2998 | 183.9811 | 194.5408 | 213.7774 | (62) |
| WWHRS 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63a) |
| PV diverter -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |

Output from w/h

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 214.2621 | 189.7317 | 202.1650 | 182.8750 | 178.4223 | 158.9435 | 153.2788 | 164.5417 | 164.2998 | 183.9811 | 194.5408 | 213.7774 | (64) |

Total per year (kWh/year) = Sum(64)m = 2200.8192 (64)

12Total per year (kWh/year) 2201 (64)

Electric shower(s)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)

Heat gains from water heating, kWh/month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 97.0841 | 86.4269 | 93.0618 | 85.8142 | 85.1673 | 77.8570 | 76.8071 | 80.5520 | 79.6380 | 87.0156 | 89.6931 | 96.9229 | (65) |

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## 5. Internal gains (see Table 5 and 5a)

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Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 88.3827 | 88.3827 | 88.3827 | 88.3827 | 88.3827 | 88.3827 | 88.3827 | 88.3827 | 88.3827 | 88.3827 | 88.3827 | 88.3827 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 77.7052 | 86.0308 | 77.7052 | 80.2954 | 77.7052 | 80.2954 | 77.7052 | 77.7052 | 80.2954 | 77.7052 | 80.2954 | 77.7052 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 154.0593 | 155.6579 | 151.6294 | 143.0531 | 132.2270 | 122.0520 | 115.2545 | 113.6559 | 117.6844 | 126.2608 | 137.0868 | 147.2618 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 31.8383 | 31.8383 | 31.8383 | 31.8383 | 31.8383 | 31.8383 | 31.8383 | 31.8383 | 31.8383 | 31.8383 | 31.8383 | 31.8383 | (69) |
| Pumps, fans 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | -70.7061 | -70.7061 | -70.7061 | -70.7061 | -70.7061 | -70.7061 | -70.7061 | -70.7061 | -70.7061 | -70.7061 | -70.7061 | -70.7061 | (71) |
| Water heating gains (Table 5) | 130.4893 | 128.6114 | 125.0830 | 119.1864 | 114.4722 | 108.1347 | 103.2354 | 108.2689 | 110.6083 | 116.9565 | 124.5738 | 130.2727 | (72) |
| Total internal gains | 411.7686 | 419.8149 | 403.9324 | 392.0497 | 373.9192 | 359.9970 | 345.7099 | 349.1448 | 358.1029 | 370.4372 | 391.4708 | 404.7545 | (73) |

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## 6. Solar gains

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| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Northeast | 1.5500 | 11.2829 | 0.4500 | 0.7000 | 0.7700 | 3.8177 | (75) |
| Southeast | 1.7000 | 36.7938 | 0.4500 | 0.7000 | 0.7700 | 13.6542 | (77) |
| Northwest | 6.9100 | 11.2829 | 0.4500 | 0.7000 | 0.7700 | 17.0194 | (81) |
| Southeast | 2.4000 | 36.7938 | 0.4500 | 0.7000 | 0.7700 | 19.2766 | (77) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northwest | | | 2.2900 | | 11.2829 | | 0.4500 | | 0.7000 | | 0.7700 | | 5.6403 (81) |
| Solar gains | 59.4082 | 109.9888 | 173.8518 | 254.5663 | 320.8748 | 334.2749 | 315.7345 | 263.8620 | 201.4242 | 127.8596 | 72.7589 | 49.8047 (83) | |
| Total gains | 471.1768 | 529.8037 | 577.7843 | 646.6160 | 694.7940 | 694.2718 | 661.4444 | 613.0068 | 559.5271 | 498.2968 | 464.2297 | 454.5591 (84) | |

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| tau | 74.9371 | 75.1763 | 75.4170 | 76.6444 | 76.8946 | 78.1709 | 78.1709 | 78.4313 | 77.6554 | 76.8946 | 76.3957 | 75.9032 | |
| alpha | 5.9958 | 6.0118 | 6.0278 | 6.1096 | 6.1263 | 6.2114 | 6.2114 | 6.2288 | 6.1770 | 6.1263 | 6.0930 | 6.0602 | |
| util living area | 0.9949 | 0.9888 | 0.9720 | 0.9041 | 0.7494 | 0.5370 | 0.3908 | 0.4387 | 0.6990 | 0.9357 | 0.9875 | 0.9958 | (86) |
| MIT | 20.0613 | 20.2212 | 20.4546 | 20.7600 | 20.9394 | 20.9934 | 20.9992 | 20.9984 | 20.9699 | 20.7357 | 20.3591 | 20.0438 | (87) |
| Th 2 | 19.9468 | 19.9498 | 19.9528 | 19.9678 | 19.9708 | 19.9859 | 19.9859 | 19.9889 | 19.9798 | 19.9708 | 19.9648 | 19.9588 | (88) |
| util rest of house | 0.9928 | 0.9844 | 0.9610 | 0.8707 | 0.6841 | 0.4547 | 0.3012 | 0.3432 | 0.6096 | 0.9050 | 0.9818 | 0.9942 | (89) |
| MIT 2 | 18.8801 | 19.0846 | 19.3776 | 19.7475 | 19.9283 | 19.9830 | 19.9857 | 19.9885 | 19.9640 | 19.7322 | 19.2721 | 18.8670 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.6521 | (91) |
| MIT | 19.6503 | 19.8258 | 20.0799 | 20.4077 | 20.5876 | 20.6418 | 20.6466 | 20.6471 | 20.6200 | 20.3866 | 19.9810 | 19.6344 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.6503 | 19.8258 | 20.0799 | 20.4077 | 20.5876 | 20.6418 | 20.6466 | 20.6471 | 20.6200 | 20.3866 | 19.9810 | 19.6344 | (93) |

8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9921 | 0.9838 | 0.9626 | 0.8861 | 0.7244 | 0.5083 | 0.3597 | 0.4056 | 0.6671 | 0.9189 | 0.9819 | 0.9935 | (94) |
| Useful gains | 467.4589 | 521.2010 | 556.1524 | 572.9727 | 503.3111 | 352.8787 | 237.9136 | 248.6086 | 373.2651 | 457.8719 | 455.8496 | 451.5979 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | 942.5054 | 913.5200 | 828.4951 | 690.8314 | 531.8037 | 355.6205 | 238.1815 | 249.1520 | 386.3103 | 585.5949 | 775.7855 | 935.6015 | (97) |
| Space heating kWh | 353.4346 | 263.6384 | 202.6230 | 84.8583 | 21.1985 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 95.0259 | 230.3539 | 360.0986 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 1611.2311 | |
| Solar heating kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | 353.4346 | 263.6384 | 202.6230 | 84.8583 | 21.1985 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 95.0259 | 230.3539 | 360.0986 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 1611.2311 | |
| Space heating per m2 | | | | | | | | | | (98c) / (4) = | | 30.6143 | (99) |

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ext. temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | |
| Heat loss rate W | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 553.2805 | 435.5612 | 445.8482 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (100) |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.9601 | 0.9837 | 0.9735 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (101) |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 531.2212 | 428.4444 | 434.0109 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (102) |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 769.6629 | 733.4244 | 677.3608 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 171.6780 | 226.9052 | 181.0523 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (104) |
| Cooled fraction | | | | | | | | | | fC = cooled area / (4) = | | 0.9880 | (105) |
| Intermittency factor (Table 10b) | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | (106) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 42.4057 | 56.0473 | 44.7213 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) |
| Space cooling requirement | | | | | | | | | | | | 143.1743 | (107) |

9b. Energy requirements

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | 0.0000 | (301) |
| Fraction of space heat from community system | | | | | | | | | | | | 1.0000 | (302) |
| Fraction of heat from community Heat pump-Space and Water | | | | | | | | | | | | 1.0000 | (303a) |
| Factor for control and charging method (Table 4c(3)) for space heating | | | | | | | | | | | | 1.0000 | (305) |
| Factor for charging method (Table 4c(3)) for water heating | | | | | | | | | | | | 1.0000 | (305a) |
| Distribution loss factor (Table 12c) for community heating system | | | | | | | | | | | | 2.0000 | (306) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 | (208) |
| Space heating: | | | | | | | | | | | | | |
| Space heating requirement | 353.4346 | 263.6384 | 202.6230 | 84.8583 | 21.1985 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 95.0259 | 230.3539 | 360.0986 | (98) |
| Space heat from Heat pump = (98) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 307a | 706.8692 | 527.2767 | 405.2460 | 169.7165 | 42.3970 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 190.0518 | 460.7078 | 720.1972 | |
| Space heating requirement | 706.8692 | 527.2767 | 405.2460 | 169.7165 | 42.3970 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 190.0518 | 460.7078 | 720.1972 | (307) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | | | | | | | | | | | | 0.0000 | (308) |
| Space heating fuel for secondary/supplementary system | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (309) |
| Water heating | | | | | | | | | | | | | |
| Annual water heating requirement | 214.2621 | 189.7317 | 202.1650 | 182.8750 | 178.4223 | 158.9435 | 153.2788 | 164.5417 | 164.2998 | 183.9811 | 194.5408 | 213.7774 | (64) |
| Water heat from Heat pump = (64) x 1.00 x 1.00 x 2.00 | | | | | | | | | | | | | |
| 310a | 428.5242 | 379.4634 | 404.3301 | 365.7500 | 356.8446 | 317.8870 | 306.5576 | 329.0835 | 328.5996 | 367.9621 | 389.0817 | 427.5547 | |
| Water heating fuel | 428.5242 | 379.4634 | 404.3301 | 365.7500 | 356.8446 | 317.8870 | 306.5576 | 329.0835 | 328.5996 | 367.9621 | 389.0817 | 427.5547 | (310) |
| Cooling System Energy Efficiency Ratio | | | | | | | | | | | | 2.6000 | (314) |
| Space coolin | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 16.3099 | 21.5566 | 17.2005 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (315) |
| Pumps and Fa | 14.4295 | 13.0331 | 14.4295 | 13.9641 | 14.4295 | 13.9641 | 14.4295 | 14.4295 | 13.9641 | 14.4295 | 13.9641 | 14.4295 | (331) |
| Lighting | 15.0236 | 12.0525 | 10.8519 | 7.9506 | 6.1413 | 5.0175 | 5.6023 | 7.2820 | 9.4586 | 12.4102 | 14.0173 | 15.4411 | (332) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333a)m | -4.7077 | -7.5933 | -12.5618 | -16.2039 | -19.3062 | -18.7203 | -18.4575 | -16.4399 | -13.2441 | -9.4563 | -5.4809 | -3.9547 | (333a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334a) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335a) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (333b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (333b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (334b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (334b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (335b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (335b) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - community heating | 3222.4622 | (307) |
| Space heating fuel - secondary | 0.0000 | (309) |
| Water heating fuel - community heating | 4401.6385 | (310) |
| Efficiency of water heater | 0.0000 | (311) |
| Electricity used for heat distribution | 32.2246 | (313) |
| Space cooling fuel | 55.0670 | (321) |
| | | |
| Electricity for pumps and fans: | | |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.8820) | | |
| mechanical ventilation fans (SFP = 0.8820) | 169.8960 | (330a) |
| Total electricity for the above, kWh/year | 169.8960 | (331) |
| Electricity for lighting (calculated in Appendix L) | 121.2489 | (332) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -146.1266 | (333) |
| Wind generation | 0.0000 | (334) |
| Hydro-electric generation (Appendix N) | 0.0000 | (335a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (335) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (336) |
| Energy used | 0.0000 | (337) |
| Total delivered energy for all uses | 7824.1860 | (338) |

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12b. Carbon dioxide emissions - Community heating scheme

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (367) |
| Space and Water heating from Heat pump | 2722.8931 | 0.1565 | 180.0923 | (367) |
| Electrical energy for heat distribution (space & water) | 32.2246 | 0.0000 | 11.2370 | (372) |
| Overall CO2 factor for heat network | | | 0.0541 | (386) |
| Total CO2 associated with community systems | | | 412.5572 | (373) |
| Space and water heating | | | 412.5572 | (376) |
| Space cooling | 55.0670 | 0.1140 | 6.2764 | (377) |
| Pumps, fans and electric keep-hot | 169.8960 | 0.1387 | 23.5667 | (378) |
| Energy for lighting | 121.2489 | 0.1443 | 17.5000 | (379) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -146.1266 | 0.1319 | -19.2804 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -19.2804 | (380) |
| Total CO2, kg/year | | | 440.6199 | (383) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 8.3700 | (384) |

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13b. Primary energy - Community heating scheme

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| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Efficiency of heat source Heat pump | | | 280.0000 | (467a) |
| Space and Water heating from Heat pump | 2722.8931 | 1.5793 | 1817.6106 | (467) |
| Electrical energy for heat distribution (space & water) | 32.2246 | 0.0000 | 117.8136 | (472) |
| Overall CO2 factor for heat network | | | 0.5673 | (486) |
| Total CO2 associated with community systems | | | 4325.4439 | (473) |
| Space and water heating | | | 4325.4439 | (476) |
| Space cooling | 55.0670 | 1.4201 | 78.2017 | (477) |
| Pumps, fans and electric keep-hot | 169.8960 | 1.5128 | 257.0186 | (478) |
| Energy for lighting | 121.2489 | 1.5338 | 185.9756 | (479) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -146.1266 | 1.4875 | -217.3613 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -217.3613 | (480) |
| Total Primary energy kWh/year | | | 4629.2786 | (483) |
| Dwelling Primary energy Rate (DPER) | | | 87.9600 | (484) |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

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| | | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | |
| Ground floor | | 52.6300 | (1b) | x 3.0000 | (2b) = | 157.8900 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 52.6300 | | | | | | (4) |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | | 157.8900 | (5) |

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2. Ventilation rate

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| | m3 per hour | |
|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 (6a) |

| | | |
|---|---|---|
| Number of open flues | 0 * 20 = | 0.0000 (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 (6f) |
| Number of intermittent extract fans | 2 * 10 = | 20.0000 (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 (7c) |

| | | Air changes per hour | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 20.0000 / (5) = | 0.1267 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3767 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.3767 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.4803 | 0.4708 | 0.4614 | 0.4143 | 0.4049 | 0.3578 | 0.3578 | 0.3484 | 0.3767 | 0.4049 | 0.4238 | 0.4426 | (22b) |
| Effective ac | 0.6153 | 0.6108 | 0.6065 | 0.5858 | 0.5820 | 0.5640 | 0.5640 | 0.5607 | 0.5709 | 0.5820 | 0.5898 | 0.5979 | (25) |

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## 3. Heat losses and heat loss parameter

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| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| TER Opaque door | | | 1.8900 | 1.0000 | 1.8900 | | | (26) |
| TER Opening Type | | | 11.2700 | 1.1450 | 12.9046 | | | (27) |
| External Walls | 49.2600 | 11.2700 | 37.9900 | 0.1800 | 6.8382 | | | (29a) |
| Wall to Communal Corridor | 21.1400 | 1.8900 | 19.2500 | 0.1800 | 3.4650 | | | (29a) |
| External Roof | 52.6300 | | 52.6300 | 0.1100 | 5.7893 | | | (30) |
| Total net area of external elements Aum(A, m2) | | | 123.0300 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 30.8871 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall to Unit 49 | | | 26.5900 | 0.0000 | 0.0000 | | | (32) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 314.7254 (35)

List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | 7.4900 | 0.0500 | 0.3745 |
| E1 Steel lintel with perforated steel base plate | 31.2000 | 0.0500 | 1.5600 |
| E4 Jamb | 16.4200 | 0.5600 | 9.1952 |
| E15 Flat roof with parapet | 3.0000 | 0.0900 | 0.2700 |
| E16 Corner (normal) | 6.0000 | 0.0600 | 0.3600 |
| E18 Party wall between dwellings | 7.0460 | 0.0700 | 0.4932 |
| E7 Party floor between dwellings (in blocks of flats) | 16.4200 | 0.2400 | 3.9408 |
| E24 Eaves (insulation at ceiling level - inverted) | | | |

| | | |
|---|---|---|
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | 16.1937 (36) |
| Point Thermal bridges | (36a) = | 0.0000 |
| Total fabric heat loss | (33) + (36) + (36a) = | 47.0808 (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 32.0606 | 31.8272 | 31.5985 | 30.5243 | 30.3233 | 29.3877 | 29.3877 | 29.2145 | 29.7481 | 30.3233 | 30.7299 | 31.1550 | (38) |
| Heat transfer coeff | 79.1414 | 78.9080 | 78.6793 | 77.6051 | 77.4041 | 76.4685 | 76.4685 | 76.2953 | 76.8289 | 77.4041 | 77.8107 | 78.2358 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 77.6042 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.5037 | 1.4993 | 1.4950 | 1.4745 | 1.4707 | 1.4529 | 1.4529 | 1.4497 | 1.4598 | 1.4707 | 1.4784 | 1.4865 | (40) |
| HLP (average) | | | | | | | | | | | | 1.4745 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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## 4. Water heating energy requirements (kWh/year)

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| | | |
|---|---|---|
| Assumed occupancy | | 1.7677 (42) |

Hot water usage for mixer showers

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 53.8572 | 53.0479 | 51.8685 | 49.6119 | 47.9466 | 46.0894 | 45.0338 | 46.2043 | 47.4874 | 49.4814 | 51.7864 | 53.6509 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.2836 | 22.9378 | 22.4509 | 21.5530 | 20.8807 | 20.1352 | 19.7326 | 20.2161 | 20.7426 | 21.5403 | 22.4566 | 23.2049 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.7325 | 31.5423 | 30.3520 | 29.1617 | 27.9714 | 26.7812 | 26.7812 | 27.9714 | 29.1617 | 30.3520 | 31.5423 | 32.7325 | (42c) |

| | |
|---|---|
| Average daily hot water use (litres/day) | 100.9990 (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 109.8734 | 107.5280 | 104.6713 | 100.3266 | 96.7987 | 93.0058 | 91.5476 | 94.3919 | 97.3917 | 101.3737 | 105.7853 | 109.5883 | (44) |
| Energy conte | 174.0126 | 153.1184 | 160.8759 | 137.3421 | 130.3097 | 114.3615 | 110.7189 | 116.8769 | 120.0937 | 137.5631 | 150.7106 | 171.5888 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1677.5722 | |

Distribution loss (46)m = 0.15 x (45)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 26.1019 | 22.9678 | 24.1314 | 20.6013 | 19.5465 | 17.1542 | 16.6078 | 17.5315 | 18.0141 | 20.6345 | 22.6066 | 25.7383 | (46) |

| | |
|---|---|
| Water storage loss: | |
| Store volume | 150.0000 (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | 1.3938 (48) |
| Temperature factor from Table 2b | 0.5400 (49) |
| Enter (49) or (54) in (55) | 0.7527 (55) |

Total storage loss

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (56) |

If cylinder contains dedicated solar storage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (57) |
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |

Total heat required for water heating calculated for each month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 220.6075 | 195.2041 | 207.4708 | 182.4339 | 176.9046 | 159.4534 | 157.3138 | 163.4718 | 165.1856 | 184.1580 | 195.8025 | 218.1837 | (62) |
| WWHRS | -24.6213 | -21.7753 | -22.8018 | -18.8808 | -17.5962 | -15.0572 | -14.1137 | -15.0085 | -15.5788 | -18.3657 | -20.8061 | -24.1653 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |

Output from w/h

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 195.9862 | 173.4288 | 184.6690 | 163.5532 | 159.3084 | 144.3962 | 143.2000 | 148.4632 | 149.6068 | 165.7924 | 174.9964 | 194.0184 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 1997.4190 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 1997 | (64) |
| Electric shower(s) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | | | | | | | | | | | | | |
| | 95.1351 | 84.5804 | 90.7672 | 81.7397 | 80.6039 | 74.0987 | 74.0899 | 76.1375 | 76.0046 | 83.0157 | 86.1848 | 94.3292 | (65) |

## 5. Internal gains (see Table 5 and 5a)

| Metabolic gains (Table 5), Watts | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 88.3827 | 88.3827 | 88.3827 | 88.3827 | 88.3827 | 88.3827 | 88.3827 | 88.3827 | 88.3827 | 88.3827 | 88.3827 | 88.3827 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 77.8233 | 86.1615 | 77.8233 | 80.4174 | 77.8233 | 80.4174 | 77.8233 | 77.8233 | 80.4174 | 77.8233 | 80.4174 | 77.8233 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 154.0593 | 155.6579 | 151.6294 | 143.0531 | 132.2270 | 122.0520 | 115.2545 | 113.6559 | 117.6844 | 126.2608 | 137.0868 | 147.2618 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 31.8383 | 31.8383 | 31.8383 | 31.8383 | 31.8383 | 31.8383 | 31.8383 | 31.8383 | 31.8383 | 31.8383 | 31.8383 | 31.8383 | (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.0000 | 3.0000 | 3.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | | | | | | | | | | | | | |
| | -70.7061 | -70.7061 | -70.7061 | -70.7061 | -70.7061 | -70.7061 | -70.7061 | -70.7061 | -70.7061 | -70.7061 | -70.7061 | -70.7061 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 127.8698 | 125.8637 | 121.9989 | 113.5274 | 108.3386 | 102.9148 | 99.5833 | 102.3353 | 105.5620 | 111.5802 | 119.7010 | 126.7866 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 412.2672 | 420.1980 | 403.9664 | 389.5127 | 370.9037 | 354.8991 | 342.1759 | 343.3293 | 353.1787 | 368.1791 | 389.7201 | 404.3865 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Northeast | 1.1800 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 4.0689 | (75) |
| Southeast | 3.1100 | 36.7938 | 0.6300 | 0.7000 | 0.7700 | 34.9709 | (77) |
| Northwest | 6.9800 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 24.0685 | (81) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 63.1084 | 116.8430 | 184.6946 | 270.4560 | 340.9133 | 355.1542 | 335.4542 | 280.3358 | 213.9910 | 135.8298 | 77.2913 | 52.9063 | (83) |
| Total gains | 475.3755 | 537.0410 | 588.6610 | 659.9687 | 711.8170 | 710.0533 | 677.6301 | 623.6651 | 567.1697 | 504.0089 | 467.0114 | 457.2927 | (84) |

## 7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, ni1,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 58.1379 | 58.3098 | 58.4793 | 59.2888 | 59.4427 | 60.1700 | 60.1700 | 60.3066 | 59.8878 | 59.4427 | 59.1321 | 58.8108 | |
| alpha | 4.8759 | 4.8873 | 4.8986 | 4.9526 | 4.9628 | 5.0113 | 5.0113 | 5.0204 | 4.9925 | 4.9628 | 4.9421 | 4.9207 | |
| util living area | | | | | | | | | | | | | |
| | 0.9956 | 0.9914 | 0.9807 | 0.9409 | 0.8369 | 0.6521 | 0.4889 | 0.5486 | 0.8038 | 0.9610 | 0.9910 | 0.9964 | (86) |
| MIT | 19.6384 | 19.8148 | 20.0944 | 20.4874 | 20.7999 | 20.9574 | 20.9917 | 20.9857 | 20.8801 | 20.4829 | 20.0033 | 19.6184 | (87) |
| Th 2 | 19.6847 | 19.6880 | 19.6913 | 19.7066 | 19.7095 | 19.7230 | 19.7230 | 19.7255 | 19.7178 | 19.7095 | 19.7037 | 19.6976 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9938 | 0.9877 | 0.9721 | 0.9144 | 0.7701 | 0.5388 | 0.3512 | 0.4042 | 0.7032 | 0.9377 | 0.9864 | 0.9948 | (89) |
| MIT 2 | 18.1501 | 18.3765 | 18.7311 | 19.2203 | 19.5609 | 19.7039 | 19.7212 | 19.7220 | 19.6499 | 19.2284 | 18.6289 | 18.1337 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.6521 | (91) |
| MIT | 19.1206 | 19.3144 | 19.6201 | 20.0466 | 20.3688 | 20.5213 | 20.5497 | 20.5461 | 20.4521 | 20.0465 | 19.5251 | 19.1019 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.1206 | 19.3144 | 19.6201 | 20.0466 | 20.3688 | 20.5213 | 20.5497 | 20.5461 | 20.4521 | 20.0465 | 19.5251 | 19.1019 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9927 | 0.9864 | 0.9715 | 0.9224 | 0.8068 | 0.6117 | 0.4414 | 0.4988 | 0.7650 | 0.9450 | 0.9856 | 0.9939 | (94) |
| Useful gains | 471.9000 | 529.7136 | 571.9020 | 608.7784 | 574.2961 | 434.3478 | 299.0865 | 311.0774 | 433.8592 | 476.2878 | 460.3003 | 454.5028 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | | | | | | | | | | | | | |
| | 1172.9263 | 1137.4117 | 1032.2816 | 865.0330 | 671.0040 | 452.7930 | 302.0272 | 316.3260 | 488.0256 | 731.1975 | 966.8091 | 1165.8597 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 521.5636 | 408.3731 | 342.5224 | 184.5033 | 71.9507 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 189.6529 | 364.6863 | 529.2495 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 2612.5019 | |
| Solar heating kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | | | | | | | | | | | | | |
| | 521.5636 | 408.3731 | 342.5224 | 184.5033 | 71.9507 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 189.6529 | 364.6863 | 529.2495 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 2612.5019 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 49.6390 | (99) |

## 9a. Energy requirements - Individual heating systems, including micro-CHP

| | | |
|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | 0.0000 | (201) |
| Fraction of space heat from main system(s) | 1.0000 | (202) |
| Efficiency of main space heating system 1 (in %) | 92.3000 | (206) |
| Efficiency of main space heating system 2 (in %) | 0.0000 | (207) |
| Efficiency of secondary/supplementary heating system, % | 0.0000 | (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement | | | | | | | | | | | | | |
| | 521.5636 | 408.3731 | 342.5224 | 184.5033 | 71.9507 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 189.6529 | 364.6863 | 529.2495 | (98) |
| Space heating efficiency (main heating system 1) | | | | | | | | | | | | | |
| | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.3000 | 92.3000 | 92.3000 | (210) |
| Space heating fuel (main heating system) | | | | | | | | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 565.0743 | 442.4411 | 371.0969 | 199.8952 | 77.9530 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 205.4744 | 395.1098 | 573.4014 (211) |
| Space heating efficiency (main heating system 2) | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (212) |
| Space heating fuel (main heating system 2) | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (213) |
| Space heating fuel (secondary) | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (215) |
| Water heating | | | | | | | | | | | | |
| Water heating requirement | | | | | | | | | | | | |
| | 195.9862 | 173.4288 | 184.6690 | 163.5532 | 159.3084 | 144.3962 | 143.2000 | 148.4632 | 149.6068 | 165.7924 | 174.9964 | 194.0184 (64) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 (216) |
| (217)m | 86.1463 | 85.9117 | 85.4252 | 84.3307 | 82.3983 | 79.8000 | 79.8000 | 79.8000 | 79.8000 | 84.3621 | 85.6671 | 86.1923 (217) |
| Fuel for water heating, kWh/month | | | | | | | | | | | | |
| | 227.5039 | 201.8686 | 216.1763 | 193.9425 | 193.3395 | 180.9476 | 179.4487 | 186.0441 | 187.4772 | 196.5247 | 204.2749 | 225.0994 (219) |
| Space cooling fuel requirement | | | | | | | | | | | | |
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (221) |
| Pumps and Fa | 7.3041 | 6.5973 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 (231) |
| Lighting | 16.1701 | 12.9723 | 11.6801 | 8.5574 | 6.6099 | 5.4004 | 6.0298 | 7.8378 | 10.1805 | 13.3574 | 15.0871 | 16.6196 (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (233a)m | -11.7644 | -17.6989 | -27.1327 | -32.6122 | -37.0557 | -35.3015 | -34.8872 | -31.9953 | -27.2316 | -21.1523 | -13.3274 | -10.0464 (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | |
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (233b)m | -3.6478 | -7.8903 | -16.0911 | -24.7759 | -33.3564 | -33.7210 | -33.3096 | -27.9164 | -20.0994 | -11.4644 | -4.9284 | -2.8678 (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | |
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235d) |

| | |
|---|---|
| Annual totals kWh/year | |
| Space heating fuel - main system 1 | 2830.4463 (211) |
| Space heating fuel - main system 2 | 0.0000 (213) |
| Space heating fuel - secondary | 0.0000 (215) |
| Efficiency of water heater | 79.8000 |
| Water heating fuel used | 2392.6474 (219) |
| Space cooling fuel | 0.0000 (221) |
| Electricity for pumps and fans: | |
| Total electricity for the above, kWh/year | 86.0000 (231) |
| Electricity for lighting (calculated in Appendix L) | 130.5024 (232) |
| Energy saving/generation technologies (Appendices M ,N and Q) | |
| PV generation | -520.2739 (233) |
| Wind generation | 0.0000 (234) |
| Hydro-electric generation (Appendix N) | 0.0000 (235a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 (235) |
| Appendix Q - special features | |
| Energy saved or generated | -0.0000 (236) |
| Energy used | 0.0000 (237) |
| Total delivered energy for all uses | 4919.3221 (238) |

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 2830.4463 | 0.2100 | 594.3937 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2392.6474 | 0.2100 | 502.4559 | (264) |
| Space and water heating | | | 1096.8497 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 130.5024 | 0.1443 | 18.8355 | (268) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -300.2056 | 0.1332 | -39.9967 | |
| PV Unit electricity exported | -220.0683 | 0.1252 | -27.5497 | |
| Total | | | -67.5465 | (269) |
| Total CO2, kg/year | | | 1060.0680 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 20.1400 | (273) |

13a. Primary energy - Individual heating systems including micro-CHP

| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 2830.4463 | 1.1300 | 3198.4043 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2392.6474 | 1.1300 | 2703.6915 | (278) |
| Space and water heating | | | 5902.0958 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 130.5024 | 1.5338 | 200.1689 | (282) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -300.2056 | 1.4923 | -448.0034 | |
| PV Unit electricity exported | -220.0683 | 0.4595 | -101.1192 | |
| Total | | | -549.1226 | (283) |
| Total Primary energy kWh/year | | | 5683.2429 | (286) |
| Target Primary Energy Rate (TPER) | | | 107.9800 | (287) |