# 70 HAYMAN CRESCENT HAYES LONDON UB4 8PP

## Residential Development

Energy & Sustainability Assessment

APRIL 25

| REVISION | DATE | BY |
|---|---|---|
| 24.04.25 | A | Rafi Zaidi |


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## 1. SUMMARY

It is our opinion that sufficient design works have been carried out at this early stage to demonstrate that the proposal is successfully addressing the requirements of London Plan Policy S12 and the local energy policies (LP22) of the London Borough of Hillingdon.

The energy hierarchy has been adopted to follow a Be Lean, Be Clean, Be Green methodology. The preferred energy strategy is to reduce energy demand and consequently the amount of conditioning and renewable energy contribution needed. This starts with a fabric first approach to improve thermal elements and controlled fittings. The feasibility of CHP systems and decentralised energy networks have been considered within the Be Clean case.

The final Be Green improvements have additionally explored the adoption and effect of adding renewable energy. The most appropriate renewable energy source has been identified as **PV Panels** which achieves minimum of 35% carbon dioxide emission reduction as required by London Borough of Hillingdon.

Be Green

| Reference | Be Green CO2 emission (DER) | Target CO2 emission (DER) | % Reductin over Part L 2021 |
|---|---|---|---|
| 70 Hayman Crescent, Hayes, Loondon, UB4 8PP | 4.44 | 9.63 | 53.89% |

*The carbon footprint of regulated emission has been determined using the following National Calculation methodology (NCM). FSAP 10.2 – Part L1 2021*

The building CO2 emissions for the development have been calculated to be improve 53.89% beyond Lean Calculations. This has been achieved through energy efficiency measures, using improved building fabric, increasing the efficiency of the building services and finally the installation of a renewable energy source.

The Clean total energy requirements and carbon dioxide emissions have been calculated taking full account of all regulated emissions (space & hot water heating, and electricity for pumps, fans, lights). The Lean calculations was determined by using the orientation and the use of building elements (walls, windows etc.) with U-values consistent with achieving compliance with Approved Document Part L1A.

## 2. INTRODUCTION

This Energy Assessment relates to a planning application to a semi-detached dwelling at 70 Hayman Crescent, Hayes, London, UB4 8PP.

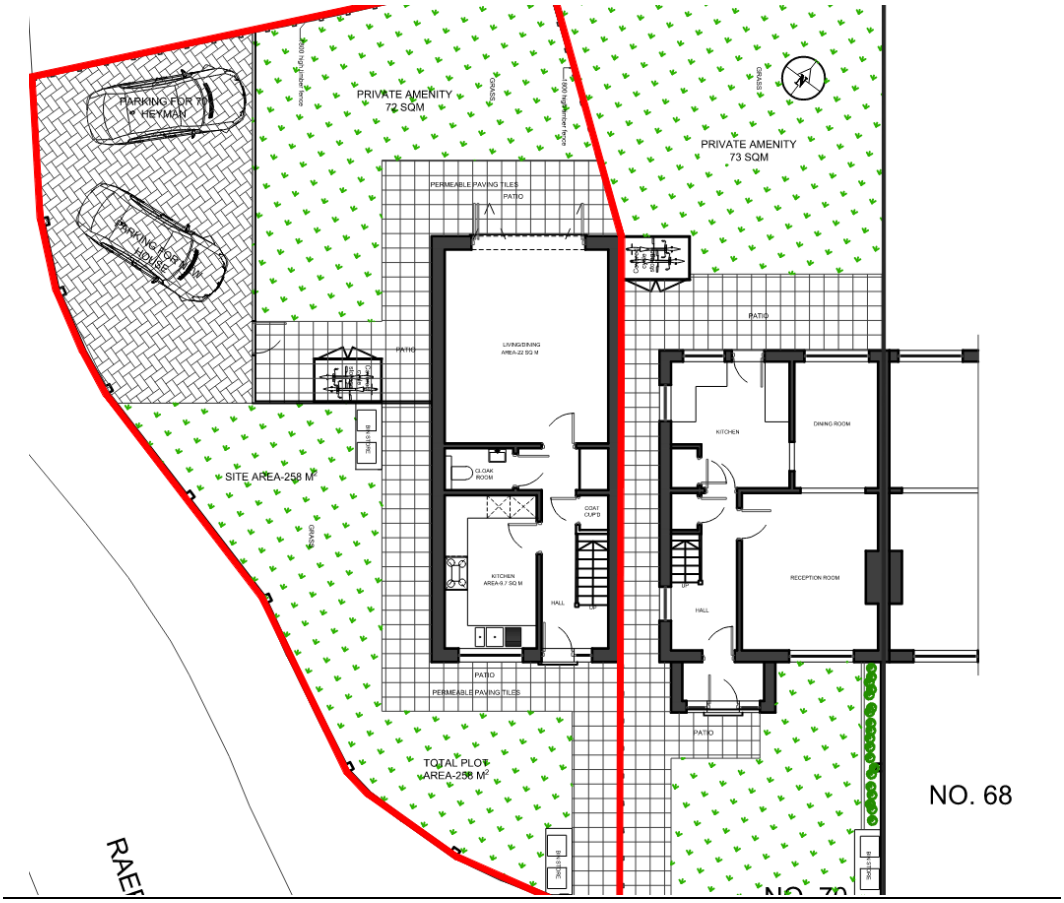
The requirement for new developments to obtain a proportion of their energy needs from on-site renewable energy sources is now a well-established feature of planning policy.

This Energy Assessment sets out the applicable policies on energy and CO2 emissions, and the methodology for and the results from an energy demand assessment.

It includes an overview of possible renewable energy technologies and identifies the technology most suitable for this development and reasons why other technologies have been excluded.

In presenting the information, this Energy Assessment demonstrates that the proposed development will fully satisfy, the current applicable planning policies relating to energy conservation, and renewable energy.

A Sustainability Statement has been prepared to demonstrate a commitment to enhance the environmental performance of the development. This includes the specification of materials, waste reduction, biodiversity, and internal water use limited by design to 105 L/p/d (litres per person per day).



## 3. STATUTORY REQUIREDMENTS

BUILDING REGULATIONS – PART L 2021

This section of the building regulations deals with the conservation of energy in new domestic and commercial buildings; specifically the energy used for space heating/cooling, water heating, cooking, lighting and appliances. The methodology for the assessment of such has been adopted from the Building Research Establishment's Domestic Energy Model energy assessment method for the domestic dwelling.

This method requires the calculation of a target emissions rate (TER), which assumes standard or typical building components and the calculation of the buildings actual emissions (DER for SAP). It is a requirement that the building's actual emissions will be lower than the target emission rate.

"On 6 April 2014 the 2013 changes to Part L of the Building Regulations came into effect. Part L 2013 delivers an overall reduction in CO2emissions for new residential and new nondomestic buildings, with the targets for individual buildings being differentiated according to building type. This reduction in CO2emissions affected the percentage reduction necessary above the Part L 2013 regulations to meet the Mayor's targets in the London Plan.

As outlined in the Sustainable, Design and Construction SPG, since 6 April 2014 the Mayor has applied a 35 per cent carbon reduction target beyond Part L 2013 of the Building Regulations - this is deemed to be broadly equivalent to the 40 per cent target beyond Part L 2010 of the Building Regulations, as specified in Policy 5.2 of the London Plan for 2013-2016.

Detailed energy statements should be submitted as part of applications. This should demonstrate the predicted energy and associated carbon dioxide emission savings achieved through the incorporated of energy efficiency measures, decentralised energy and low/zero carbon technologies. This should be demonstrated in line with policy 5.2 of the London Plan, which requires a 35% reduction in CO2 emissions above 2010 Building Regulations covering the period up to October 2013 and 40% thereafter."

The strategy outlined in this report has aimed to achieve a 35% reduction in CO2 emissions against a Part L1A. This target has been achieved following the energy hierarchy presented in the London Plan.

NATIONAL PLANNING POLICY FRAMEWORK

The National Planning Policy Framework (NPPF) was adopted in March 2012 and updated in July 2021. The framework sets out a structure for delivering sustainable developments with relevance for energy and carbon issues.

The NPPF sets out 12 core planning principles, of which the following are directly related to sustainability:

1) Proactively drive and support sustainable economic development to deliver the homes, business and industrial units, infrastructure and thriving local places that the country needs;
2) Support the transition to a low carbon future in a changing climate, taking full account of flood risk and coastal change, and encourage the reuse of existing resources, including conversion of existing buildings, and encourage the use of renewable resources (for example, by the development of renewable energy);

3) Contribute to conserving and enhancing the natural environment and reducing pollution. Allocations of land for development should prefer land of lesser environmental value, where consistent with other policies in this Framework (the NPPF)

PLANNING POLICY STATEMENT 22: RENEWABLE ENERGY (ODPM, 2004) Planning Policy Assessment covers the consideration of issues relating to renewable energy technologies and their application to new developments.

Technical advice and guidance on the various individual renewable technologies and examples of good practice within development plans and developments are also available. Requirements include:

a) Renewable energy developments should be capable of being accommodated throughout England in locations where the technology is viable and environmental, economic, and social impacts can be addressed satisfactorily.
b) The wider environmental and economic benefits of all proposals for renewable energy projects, whatever their scale, are material considerations that should be given significant weight in determining whether proposals should be granted planning permission.
c) Development proposals should demonstrate any environmental, economic and social benefits as well as how any environmental and social impacts have been minimized through careful consideration of location, scale, design and other measures.

THE LONDON PLAN AND LONDON BOROUGH OF HILLINGDON.

This report has been prepared in accompaniment to a planning application for New Dwelling and a proportion of the report seeks to address policy 5.2/S12 of London Plan as well as LBRUT Core Strategy policies CP1 & CP2, also DM HD1, DM SD1 and DM SD2 of the Development Management Plan. The extract below outlines the approach for producing energy assessments as per 'Energy Planning Greater London Authority guidance on preparing energy assessments April 2015'.

LBRUT Policy LP 22 - Sustainable Design and Construction

Developers are required to incorporate measures to improve energy conservation and efficiency as well as contributions to renewable and low carbon energy generation. Proposed developments are required to meet the following minimum reductions in carbon dioxide emissions:

- All new major residential developments (10 units or more) should achieve zero carbon standards in line with London Plan policy.
- All other new residential buildings should achieve a 35% reduction.
- All non-residential buildings over 100sqm should achieve a 35% reduction. From 2019 all major non-residential buildings should achieve zero carbon standards in line with London Plan policy.

Targets are expressed as a percentage improvement over the target emission rate (TER) based on Part L of the 2013 Building Regulations. This should be achieved by following the Energy Hierarchy: Be Lean (use less energy), Be Clean (supply energy efficiently) and Be Green (use renewable energy).

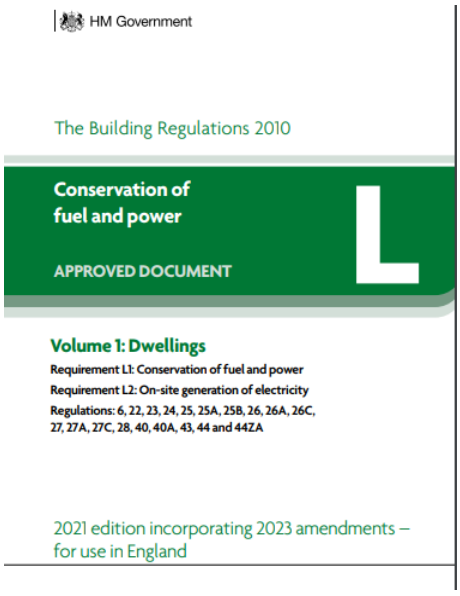
High standards of energy and water efficiency in existing developments will be supported wherever possible through retrofitting. Householder extensions and other development proposals that do not meet the thresholds set out in this policy are encouraged to complete and submit the Sustainable Construction Checklist SPD as far as possible, and opportunities for micro-generation of renewable energy will be supported in line with other policies in this Plan.

The London Plan Policy SI 2 - Minimising Greenhouse Gas Emissions

A. This means reducing greenhouse gas emissions in operation and minimising both annual and peak energy demand in accordance with the following energy hierarchy:

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

B. Residential development should achieve 10 per cent on-site reduction beyond Building Regulations, and non-residential development should achieve 15 per cent through energy efficiency measures.

## 4. CALCULATION METHODOLOGY

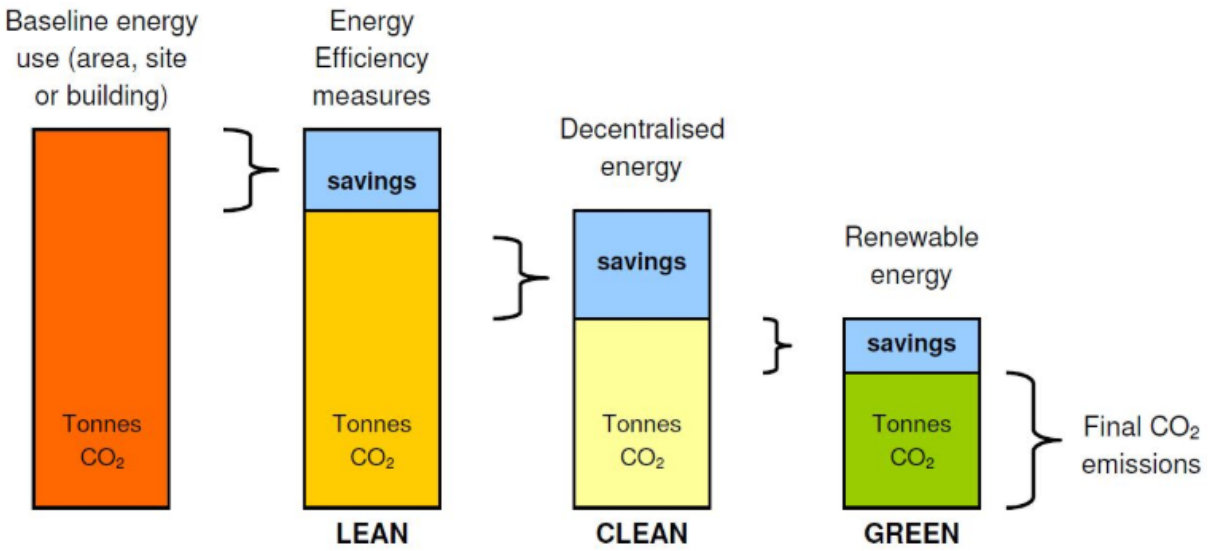
This Energy Assessment takes a standard hierarchical approach as follows:

1. Lean
A calculation of baseline energy demand demonstrates the projected annual heating, cooling and electricity demand of the development. The assessment shows the carbon dioxide emissions resulting from the predicted energy use (Dwelling Emissions Rate) and improvement of the services and fabric over the baseline calculations.

2. Clean
The feasibility of connecting to an existing or planned heat network was considered as part of this energy strategy. No existing or planned heat networks were identified within a reasonable distance of the site and the small scale of the site is not sufficient to support the inclusion of a CHP system.

3. Green
Details of renewable energy technologies to be incorporated in the development, demonstrating how much carbon dioxide emissions from expected energy use will be reduced through on-site renewable energy generation.

The starting point was to determine the performance of the "Lean" for the dwellings, using the orientation, level of insulation and the performance of building services equipment.




**The Energy Hierarchy:** In line with best practice, the Energy Hierarchy (as set out in the London Plan) has been adopted throughout the proposed design and the resulting CO2 savings are set out in this report.

## 5. BE LEAN & LE CLEAN - ENERGY DEMAND AND EFFICIENCY

The total CO2 emissions has been calculated taking into full account of energy demands for space heating, hot water, and electricity for pumps, fans, lights. The baseline was determined by using the orientation and the building elements (walls, windows etc.) with U-values and other reference values.

### Target Required: Domestic

· New main wall to achieve u-value of 0.18 W/m$^2$K
· New Roof to achieve 0.16 W/m$^2$K
· New Floor to achieve 0.12 W/m$^2$K
· Windows to achieve u-value of 1.40 W/m$^2$K
· Doors to achieve 1.20 W/m$^2$K
· Highly efficient gas fired boiler
· Controls: Time and temperature zone controls, heaters
· Air pressure test 5.00 or less
· Ventilation – intermittent extract fans
· Accredited construction thermal bridging to table K1 applied

**Be Clean -Improved Efficiency, building fabric and services**

The following improvements have been applied to the services over the baseline(lean) calculations reducing the CO2 emissions:

Be Lean

| Reference | Be Lean CO2 emission (DER) | Target CO2 emission (DER) | % Reduction over Lean (DER) |
|---|---|---|---|
| 70 Hayman Crescent, Hayes, Loondon, UB4 8PP | 8.12 | 9.63 | 15.68% |

### Applied Details: Domestic

· Main wall to achieve u-value of 0.15 W/m$^2$K
. Windows to achieve u-value of 1.20W/ m$^2$K
· Introduction of PV Panels 5.0 kWP

The tabulated calculations results are in table below. The results show the CO2 emissions from the baseline (lean) calculations.

Be Green

| Reference | Be Green CO2 emission (DER) | Target CO2 emission (DER) | % Reductin over Part L 2021 |
|---|---|---|---|
| 70 Hayman Crescent, Hayes, Loondon, UB4 8PP | 4.44 | 9.63 | 53.89% |

## 6. OVERVIEW OF RENEWABLE ENERGY

Energy from renewable sources has been defined in Article 2 of EU Directive 2010/13/EU 'on the energy performance of buildings' and includes wind, solar, aerothermal, geothermal, hydrothermal and ocean energy, hydropower, biomass, landfill gas, sewage treatment plant gas and biogases. For the purposes of this energy Assessment and the use of renewable energy on a domestic scale these can be summarised as follows:

- Bio-fuels — combustion of solid or liquid bio-fuels to produce heat or electricity.
- Decentralised energy.
- Heat pumps — extraction of heat from the earth, atmosphere or water bodies.
- Hydroelectricity — use of water cycle driven flows to generate electricity.
- Photovoltaic — direct generation of electricity from sunlight.
- Solar thermal — direct heating of water for space heating or domestic hot water.
- Wind turbines — use of solar driven air movement to generate electricity.

The technologies and their potential application to this site are discussed in more detail in the following sections. However, one further pertinent point must be made. The reason for adopting renewable energy technologies is to reduce greenhouse gas emissions, mainly carbon dioxide, and none of the technologies are wholly "zero carbon". This is because, when the whole life cycle is taken into account some energy has to be put into every system to manufacture and maintain the equipment (which has a finite life) or to operate the equipment, and generally at present this energy is derived from non-renewable sources. Examples include the energy needed to refine and process the silicon used to manufacture photovoltaic panels, the diesel fuel used to transport wood pellets and to power the wood processing machinery for the production of wood fuel pellets.

Finally, due to the dynamic and innovative nature of the renewable energy technology industry even apparently similar products can differ in vital practical details which means that detailed design of installations must be undertaken by experts, often working closely with the product manufacturers, as virtually no two products are identical or interchangeable.

The following sections contain a summary of each possibly applicable technology, and a comparison of the advantages and disadvantages of technologies relevant to this development.

5.1 DECENTRALISED ENERGY
**Not considered suitable for this development.**

5.2 BIO-FUELS
**Not considered suitable for this development.**

5.3 AIR SOURCE HEAT PUMPS

A new technology which works very well in new build development. The ASHP can be used to provide both the hot water and heating for the dwelling.

**Not considered a suitable for this development due to noise.**

5.4 Ground source heat pumps
**Not considered suitable for this development.**

5.5 HYDROELECTRICITY
**Not considered suitable for this development.**

5.6 PHOTOVOLTAIC

Photovoltaic (PV) systems use areas of semiconductor material that produce electricity when exposed to light. They are connected to the building electricity supply via an inverter which converts the output to a form which is compatible with the mains electricity voltage and frequency. This also allows excess electricity to be exported at times when the actual demand from the dwellings is less than that being produced by the PV system. This ensures that all the electricity produced is used and achieves a reduction in carbon dioxide emissions. For all purposes relating to planning, the exported electricity is by convention treated as if it were used on site.

The output of photovoltaic systems is generally specified as kW peak, or kWp with each 1kWp of system expected to produce an average 800 kWh of electricity per year, although this may be reduced depending on location, orientation and over shading. The area required to produce an output of 1 kWp varies but for this exercise 6.7m2 has been used. (The developer will be required to submit a quotation and technical evaluation to ensure that the calculated quantity of panels will produce the required on site generation per annum)

Because the availability of sunlight, to produce electricity, will generally not align with demand, it is normal for the system to be connected to the electricity grid and excess production exported. The introduction of the feed-in-tariff has improved the economics of solar PV systems.

There are no direct environmental consequences from the installation of PV panels but the installation can have a visual impact that may require consideration.

**Considered a suitable for this development.**

5.7 SOLAR THERMAL PANELS

Solar thermal panels harness solar energy to heat domestic hot water. They are usually supplemented with the main heating system, as they can only provide a portion of the hot water demand, depending on the time of year. Overall, it is estimated that a suitably sized system can provide up to 60% of the hot water energy. Solar thermal systems require the installation of a thermal store and / or a domestic hot water cylinder. This is not currently planned for this development as it is proposed to use combination boilers to provide the heating and domestic hot water.

It is for this reason that solar thermal systems are not considered suitable for the development.

5.8 WIND TURBINES

**Not considered suitable for this development.**

## 7. CONCLUSION

This section looks at how the development can reduce overall energy usage and demand from renewable energy sources.

All possible renewable energy technologies were evaluated in relation to the site, starting with Combined Heat and Power (CHP). Most technologies were excluded because of the small scale of the development and location. One technology was identified as being most suitable for installation; the use of photovoltaic (PV) panels mounted on the roof of the development.

**Therefore, In order to achieve the enhanced reduction, we propose to have 5.0 kWP of PV panels for each dwelling.**

Be Green

| Reference | Be Green CO2 emission (DER) | Target CO2 emission (DER) | % Reductin over Part L 2021 |
|---|---|---|---|
| 70 Hayman Crescent, Hayes, Loondon, UB4 8PP | 4.44 | 9.63 | 53.89% |

The building CO2 emissions have been calculated to be reduced by average of 53.89% beyond Lean (DER). This has been achieved through energy efficiency measures, using improved building fabric, increasing the efficiency of the building services.

*The developer will be required to submit a quotation and technical evaluation to ensure that the calculated quantity of panels will produce the required on-site generation per annum and the amount of required panels can fit on the building.*

## 8. COOLING AND OVERHEATING

The building has been designed to be airtight and with a high performing fabric. However, other features incorporated within the design of the building mitigate against the effects of overheating.
The heat distribution system within the houses will be designed such that the heat pump internal unit is in close proximity to all hot water outlets, and the heating system will be configured with efficient pipe layouts and a short overall length. Additionally, the high thermal mass of the building will help to retain heat, and the rooms will be of slightly increased height – approximately 2.5m from floor to ceiling.

Openable windows will enable ventilation whilst the overall proportion of glazing to wall area will be kept considerably below 20%, helping to limit solar gain. This will help to reduce the need for artificial cooling in a potentially warmer future climate.

Policy 5.9 of the London Plan and Policy LP20 of the Local Plan seek to reduce the impact of the urban heat island effect in London and encourages the design of places and spaces to avoid overheating and excessive heat generation, and to reduce overheating due to the impacts of climate change.

In addition to this, unregulated energy will be reduced across the site by ensuring:

- All white goods will conform to EU energy labelling scheme.
- All lighting will be low energy, with external lighting controlled by daylight and/or PIR sensors to avoid wastage.

**Summer Overheating and Cooling**

With a continual drive for energy efficiency through both the Building Regulations and Local Planning Authority requirements, the risk of overheating to dwellings in the summer months is becoming more prevalent. Overheating can be a mild discomfort or a hazard to health if managed incorrectly, so it is vitally important that overheating risk be mitigated to ensure the dwelling will be both energy efficient and comfortable to live in.

Summer overheating is caused when there is excess build-up of heat within a dwelling. This can occur where there is excessive solar gain and limited means to absorb excess heat into the building fabric or purge this heat through ventilation. Summer overheating can be managed through a variety of measures and the chosen solution will vary from development to development. These measures can include:

**Limiting solar gain**

- Glazing g value: This is a measure of how much solar radiation penetrates the glazing. The lower the g value the less solar gain enters a dwelling. Glazing with low g values may have a darker tint to the glazing, so aesthetic considerations are also a factor. Lower g values (below 0.5) are often required in apartments with single facades. Specifying g values below 0.2 will increase cost substantially and also limit the number of available suppliers for glazing.

- Internal Shading: Blinds can be used to limit solar gain in a dwelling. They can either be automatic, triggered by the sun's presence on the window, or operated manual. Manual operation requires the occupant to be present however, so this option isn't a reliable option when trying to mitigate overheating risk.

**Purging excess heat build up**

- Thermal Mass: thermal mass is the measure of a dwellings ability to absorb energy. A dwelling with a high thermal mass (high proportion of concrete) has the ability to absorb heat during the day, which helps maintain a steady internal temperature. This heat can be released back into the dwelling at night time, when the temperature of the dwelling is lower, helping to maintain a consistent internal temperature.

- Ventilation: A dwelling can be ventilated to purge excess heat build-up. This can be done through openable windows, especially where cross ventilation is possible. Where ventilation through windows isn't possible, due to security, noise or pollution issues, Mechanical Ventilation can be used. The ventilation rates required to purge a dwelling can often be quite high, requiring oversized systems.

In this instance thermal mass and mechanical ventilation have been used to prevent excess heat build up.

The above measures, in conjunction with increased building fabric U Value performance, will ensure that the proposed development will comply with the requirements set in Policies 5.9 of the London Plan and LP20 of the Local Plan.

## 9. WATER SAVING MEASURES

Policy 5.15 B (Water Use and Supplies) of the London Plan and Local Plan Policy LP22 A (Sustainable Design and Construction) of the Local Plan state that the developer should aim to minimise the use of mains water by the following:-

A) Incorporating water saving measures and equipment;
B) Designing residential development so that mains water consumption would meet a target of 105 litres or less per head per day (excluding an allowance of 5 litres or less per head per day for external water consumption).

The scheme will include the following devices:

- Water efficient taps.
- Water efficient cisterns
- Low output showers.
- Flow restrictors to manage water pressures to achieve optimum levels.
- Water meters to all premises with guidance on water consumption and savings.

Advice will be provided to the residents through a comprehensive Home Owners Pack, detailing how to make optimum use of the devices installed around the home. Further, in marketing the scheme sustainable elements such as water reduction will be promoted.

The specification shown in Table 3 will be adopted on the development to ensure that the internal water use is reduced to a maximum of 105 litres per head per day in line with Policy Internal Water Use Assessment and is in line with Part G of Building Regulations.

The proposed flow rates criteria for the dwellings at this development shall be as follow:-

**Table 3**

| Appliance | Fittings Flowrates / capacity |
|---|---|
| Washing Machine | 17.6 litres per kg (dry load) |
| Dishwasher | 4.5 litres per place settings |
| Kitchen Tap | 10 litres per minute |
| Dual Flash WC | 6 litres per flush (full) & 4 litres (half) |
| Bath | 190 litre capacity to overflow |
| Basin Tap | 5 litres per minute |
| Shower | 6 litres per minute |

The calculations provided within Appendix 1 demonstrate that's by using the above figures the water consumption rate of 103.4 litres per person per day can be achieved which is below the target usage level of 105 (l/p/d).

# Building Regulations England Part L (BREL) Compliance Report

Approved Document L1 2021 Edition, England assessed by Array SAP 10 program, Array

**Date:** Mon 24 Mar 2025 20:23:02

| Project Information | | | |
|---|---|---|---|
| Assessed By | Chris Law | Building Type | House, Semi-detached |
| OCDEA Registration | EES/027443 | Assessment Date | 2025-03-24 |

| Dwelling Details | | | |
|---|---|---|---|
| Assessment Type | As designed | Total Floor Area | 142 $m^2$ |
| Site Reference | | Plot Reference | 00001 |
| Address | 70 Hayman Crescent, Hayes, UB4 8PP | | |

| Client Details | |
|---|---|
| Name | Syed Rafi |
| Company | ZAIDI Building Services Associates |
| Address | ZBSA, Swindon, SN1 2DJ |

**This report covers items included within the SAP calculations. It is not a complete report of regulations compliance.**

| 1a Target emission rate and dwelling emission rate | | |
|---|---|---|
| Fuel for main heating system | Electricity | |
| *Target carbon dioxide emission rate* | *9.63 kg$CO_2$/$m^2$* | |
| Dwelling carbon dioxide emission rate | 4.44 kg$CO_2$/$m^2$ | OK |
| **1b Target primary energy rate and dwelling primary energy** | | |
| *Target primary energy* | *50.19 kWh$_{PE}$/$m^2$* | |
| Dwelling primary energy | 38.11 kWh$_{PE}$/$m^2$ | OK |
| **1c Target fabric energy efficiency and dwelling fabric energy efficiency** | | |
| *Target fabric energy efficiency* | *38.7 kWh/$m^2$* | |
| Dwelling fabric energy efficiency | 34.4 kWh/$m^2$ | OK |

| 2a Fabric U-values | | | | |
|---|---|---|---|---|
| **Element** | ***Maximum permitted average U-Value [W/$m^2$K]*** | **Dwelling average U-Value [W/$m^2$K]** | **Element with highest individual U-Value** | |
| External walls | *0.26* | 0.18 | Walls (1) (0.18) | OK |
| Party walls | *0.2* | N/A | N/A | **N/A** |
| Curtain walls | *1.6* | N/A | N/A | **N/A** |
| Floors | *0.18* | 0.12 | Heatloss Floor 1 (0.12) | OK |
| Roofs | *0.16* | 0.15 | Roof (1) (0.15) | OK |
| Windows, doors, and roof windows | *1.6* | 1.2 | Front (1.2) | OK |
| Rooflights | *2.2* | 1.2 | Side, South (1.2) | OK |

| 2b Envelope elements (better than typically expected values are flagged with a subsequent (!)) | | |
|---|---|---|
| **Name** | **Net area [$m^2$]** | **U-Value [W/$m^2$K]** |
| Exposed wall: Walls (1) | 106.86 | 0.18 |
| Ground floor: Heatloss Floor 1, Heatloss Floor 1 | 57.8 | 0.12 |
| Exposed roof: Roof (1) | 104.21 | 0.15 |

| 2c Openings (better than typically expected values are flagged with a subsequent (!)) | | | | |
|---|---|---|---|---|
| **Name** | **Area [$m^2$]** | **Orientation** | **Frame factor** | **U-Value [W/$m^2$K]** |
| Front, Window | 6.9 | East | 1.0 | 1.2 |
| Rear, Window | 23 | West | 1.0 | 1.2 |
| Side, Window | 2.8 | South | 1.0 | 1.2 |
| Front, External Door | 2 | East | N/A | 1.2 |
| Side, Rooflight | 2.4 | South | 1.0 | 1.2 |

| 2d Thermal bridging (better than typically expected values are flagged with a subsequent (!)) | | | | |
|---|---|---|---|---|
| Building part **1**: Thermal bridging calculated from linear thermal transmittances for each junction | | | | |
| **Main element** | **Junction detail** | **Source** | **Psi value [W/mK]** | **Drawing / reference** |
| External wall | E2: Other lintels (including other steel lintels) | Not government-approved scheme | 0.031 **(!)** | |
| External wall | E3: Sill | Not government-approved scheme | 0.028 **(!)** | |
| | | | | |

| Main element | Junction detail | Source | Psi value [W/mK] | Drawing / reference |
|---|---|---|---|---|
| External wall | E4: Jamb | Not government-approved scheme | 0.023 **(!)** | |
| External wall | E5: Ground floor (normal) | Not government-approved scheme | 0.055 | |
| External wall | E6: Intermediate floor within a dwelling | Not government-approved scheme | 0.001 **(!)** | |
| External wall | E11: Eaves (insulation at rafter level) | Not government-approved scheme | 0.02 **(!)** | |
| External wall | E13: Gable (insulation at rafter level) | Not government-approved scheme | 0.042 | |
| External wall | E16: Corner (normal) | Not government-approved scheme | 0.039 **(!)** | |
| External wall | E18: Party wall between dwellings | Not government-approved scheme | 0.042 | |
| Party wall | P1: Ground floor | Not government-approved scheme | 0.043 | |
| Party wall | P2: Intermediate floor within a dwelling | SAP table default | 0 **(!)** | |
| Party wall | P5: Roof (insulation at rafter level) | Not government-approved scheme | 0.038 **(!)** | |

| 3 Air permeability (better than typically expected values are flagged with a subsequent (!)) | | |
|---|---|---|
| *Maximum permitted air permeability at 50Pa* | *8 $m^3/hm^2$* | |
| Dwelling air permeability at 50Pa | 5 $m^3/hm^2$, Design value | OK |
| Air permeability test certificate reference | | |

| 4 Space heating | |
|---|---|
| **Main heating system 1**: Boiler with radiators or underfloor heating - Electricity | |
| Efficiency | 100.0% |
| Emitter type | Radiators |
| Flow temperature | |
| System type | Direct acting electric boiler |
| Manufacturer | |
| Model | |
| Commissioning | |
| **Secondary heating system**: N/A | |
| Fuel | N/A |
| Efficiency | N/A |
| Commissioning | |

| 5 Hot water | |
|---|---|
| **Cylinder/store** - type: N/A | |
| Capacity | N/A |
| Declared heat loss | N/A |
| Primary pipework insulated | N/A |
| Manufacturer | |
| Model | |
| Commissioning | |
| **Waste water heat recovery system 1** - type: N/A | |
| Efficiency | |
| Manufacturer | |
| Model | |

| 6 Controls | |
|---|---|
| **Main heating 1** - type: Time and temperature zone control by arrangement of plumbing and electrical services | |
| Function | |
| Ecodesign class | |
| Manufacturer | |
| Model | |
| **Water heating** - type: N/A | |
| Manufacturer | |
| Model | |

| 7 Lighting | | |
|---|---|---|
| *Minimum permitted light source efficacy* | *75 lm/W* | |
| Lowest light source efficacy | 80 lm/W | **OK** |
| External lights control | N/A | |

| 8 Mechanical ventilation | | |
|---|---|---|
| **System type:** N/A | | |
| *Maximum permitted specific fan power* | *N/A* | |
| Specific fan power | N/A | **N/A** |
| *Minimum permitted heat recovery efficiency* | *N/A* | |
| Heat recovery efficiency | N/A | **N/A** |
| Manufacturer/Model | | |
| Commissioning | | |

| 9 Local generation | |
|---|---|
| Technology type: **Photovoltaic system (1)** | |
| Peak power | 5 kWp |
| Orientation | South |
| Pitch | 45° |
| Overshading | None or very little |
| Manufacturer | |
| MCS certificate | |

| 10 Heat networks |
|---|
| N/A |

| 11 Supporting documentary evidence |
|---|
| N/A |

| 12 Declarations | |
|---|---|
| **a. Assessor Declaration** | |
| This declaration by the assessor is confirmation that the contents of this BREL Compliance Report are a true and accurate reflection based upon the design information submitted for this dwelling for the purpose of carrying out the "As designed" assessment, and that the supporting documentary evidence (SAP Conventions, Appendix 1 (documentary evidence) schedules the minimum documentary evidence required) has been reviewed in the course of preparing this BREL Compliance Report. | |
| Signed:<br><br>Name: | Assessor ID:<br><br>Date: |
| **b. Client Declaration** | |
| N/A | |

# Summary for Input Data

elmhurst energy

| | | | |
|---|---|---|---|
| **Property Reference** | | **Issued on Date** | 24/03/2025 |
| **Assessment Reference** | 00001 | **Prop Type Ref** | |
| **Property** | 70 Hayman Crescent, Hayes, UB4 8PP | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 84 B | **DER** | 2.44 | **TER** | 9.63 |
| **Environmental** | 98 A | **% DER < TER** | | | 74.66 |
| **$CO_2$ Emissions (t/year)** | 0.16 | **DFEE** | 34.37 | **TFEE** | 38.65 |
| **Compliance Check** | | **TFEE** | | | 11.09 |
| **% DPER < TPER** | 24.07 | **DPER** | 38.11 | **TPER** | 50.19 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Chris Law | **Assessor ID** | AX42-0001 |
| **Client** | | | |

## SUMMARY FOR INPUT DATA FOR: New Build (As Designed)

| | | |
|---|---|---|
| **Orientation** | East | |
| **Property Tenture** | 1 | |
| **Transaction Type** | 6 | |
| **Terrain Type** | Suburban | |
| **1.0 Property Type** | House, Semi-Detached | |
| Which Floor | 0 | |
| **2.0 Number of Storeys** | 3 | |
| **3.0 Date Built** | 2025 | |
| **3.0 Property Age Band** | L | |
| **4.0 Sheltered Sides** | 2 | |
| **5.0 Sunlight/Shade** | Average or unknown | |
| **6.0 Thermal Mass Parameter** | Precise calculation | |
| Thermal Mass | 194.91 | kJ/m²K |
| **7.0 Electricity Tariff** | Standard | |
| Smart electricity meter fitted | No | |
| Smart gas meter fitted | No | |

**7.0 Measurements**

| | Heat Loss Perimeter | Internal Floor Area | Average Storey Height |
|---|---|---|---|
| **Ground floor:** | 21.53 m | 57.80 m² | 2.65 m |
| **1st Storey:** | 21.53 m | 57.80 m² | 2.65 m |
| **2nd Storey:** | 15.25 m | 26.00 m² | 1.80 m |

| | | |
|---|---|---|
| **8.0 Living Area** | 24.40 | m² |

**9.0 External Walls**

| Description | Type | Construction | U-Value (W/m²K) | Kappa (kJ/m²K) | Gross Area(m²) | Nett Area (m²) | Shelter Res | Shelter | Openings | Area Calculation Type |
|---|---|---|---|---|---|---|---|---|---|---|
| External Wall 1 | Cavity Wall | Cavity wall : dense plaster, dense block, filled cavity, any outside structure | 0.18 | 190.00 | 141.56 | 106.86 | 0.00 | None | 34.70 | Enter Gross Area |

**10.0 External Roofs**

| Description | Type | Construction | U-Value (W/m²K) | Kappa (kJ/m²K) | Gross Area(m²) | Nett Area (m²) | Shelter Code | Shelter Factor | Calculation Type | Openings |
|---|---|---|---|---|---|---|---|---|---|---|
| External Roof 1 | External Slope Roof | Plasterboard, insulated slope | 0.15 | 9.00 | 106.61 | 104.21 | None | 0.00 | Enter Gross Area | 2.40 |

**11.0 Heat Loss Floors**

| Description | Type | Storey Index | Construction | U-Value (W/m²K) | Shelter Code | Shelter Factor | Kappa (kJ/m²K) | Area (m²) |
|---|---|---|---|---|---|---|---|---|
| Heatloss Floor 1 | Ground Floor - Solid | Lowest occupied | Slab on ground, screed over insulation | 0.12 | None | 0.00 | 110.00 | 57.80 |

**12.0 Opening Types**

| Description | Data Source | Type | Glazing | Glazing Gap | Filling Type | G-value | Frame Type | Frame Factor | U Value (W/m²K) |
|---|---|---|---|---|---|---|---|---|---|
| Window | BFRC, BSI or CERTASS data | Window | Double glazed | | | 0.60 | | 1.00 | 1.20 |
| External Door | BFRC, BSI or CERTASS data | Half Glazed Door | Double glazed | | | 0.60 | | 1.00 | 1.20 |
| Rooflight | BFRC, BSI or CERTASS data | Roof Light | Double glazed | | | 0.60 | | 1.00 | 1.20 |

# Summary for Input Data

elmhurst energy

**13.0 Openings**

| Name | Opening Type | Location | Orientation | Area (m²) | Pitch |
|---|---|---|---|---|---|
| Front | Window | External Wall 1 | East | 6.90 | 0 |
| Rear | Window | External Wall 1 | West | 23.00 | 0 |
| Side | Window | External Wall 1 | South | 2.80 | 0 |
| Front | External Door | External Wall 1 | East | 2.00 | 0 |
| Side | Rooflight | External Roof 1 | South | 2.40 | 57 |

| | | |
|---|---|---|
| **14.0 Conservatory** | None | |
| **15.0 Draught Proofing** | 100 | % |
| **16.0 Draught Lobby** | No | |
| **17.0 Thermal Bridging** | Calculate Bridges | |

**17.1 List of Bridges**

| Bridge Type | Source Type | Length | Psi | Adjusted Reference: | Imported |
|---|---|---|---|---|---|
| E2 Other lintels (including other steel lintels) | Non Gov Approved Schemes | 16.68 | 0.03 | 0.03 | No |
| E3 Sill | Non Gov Approved Schemes | 21.69 | 0.03 | 0.03 | No |
| E4 Jamb | Non Gov Approved Schemes | 55.64 | 0.02 | 0.02 | No |
| E5 Ground floor (normal) | Non Gov Approved Schemes | 21.53 | 0.06 | 0.06 | No |
| E6 Intermediate floor within a dwelling | Non Gov Approved Schemes | 21.53 | 0.00 | 0.00 | No |
| E11 Eaves (insulation at rafter level) | Non Gov Approved Schemes | 11.39 | 0.02 | 0.02 | No |
| E13 Gable (insulation at rafter level) | Non Gov Approved Schemes | 9.97 | 0.04 | 0.04 | No |
| E16 Corner (normal) | Non Gov Approved Schemes | 15.90 | 0.04 | 0.04 | No |
| E18 Party wall between dwellings | Non Gov Approved Schemes | 15.90 | 0.04 | 0.04 | No |
| P1 Party wall - Ground floor | Non Gov Approved Schemes | 11.39 | 0.04 | 0.04 | No |
| P2 Party wall - Intermediate floor within a dwelling | Table K1 - Default | 11.39 | 0.00 | 0.00 | No |
| P5 Party wall - Roof (insulation at rafter level) | Non Gov Approved Schemes | 11.39 | 0.04 | 0.04 | No |

| | | |
|---|---|---|
| Y-value | 0.02 | W/m²K |
| **19.0 Mechanical Ventilation** | | |
| **Mechanical Ventilation** | | |
| Mechanical Ventilation System Present | No | |
| **20.0 Fans, Open Fireplaces, Flues** | | |
| Number of open chimneys | 0 | |
| Number of open flues | 0 | |
| Number of chimneys/flues attached to closed fire | 0 | |
| Number of flues attached to solid fuel boiler | 0 | |
| Number of flues attached to other heater | 0 | |
| Number of blocked chimneys | 0 | |
| Number of intermittent extract fans | 4 | |
| Number of passive vents | 0 | |
| Number of flueless gas fires | 0 | |
| **21.0 Fixed Cooling System** | No | |
| **22.0 Pressure Testing** | Yes | |
| Designed $AP_{50}$ | 5.00 | m³/(h.m²) @ 50 Pa |
| Property Tested? | Yes | |
| Test Method | Blower Door | |
| **22.0 Lighting** | | |
| No Fixed Lighting | No | |

| Name | Efficacy | Power | Capacity | Count |
|---|---|---|---|---|
| Lighting 1 | 80.00 | 25.00 | 2000.00 | 24 |

| | | |
|---|---|---|
| **24.0 Main Heating 1** | SAP table | |
| Percentage of Heat | 100.00 | % |
| Database Ref. No. | 0 | |
| Fuel Type | Electricity | |
| SAP Code | 191 | |
| In Winter | 100.00 | |
| In Summer | 100.00 | |

# Summary for Input Data

elmhurst energy

| | |
|---|---|
| Controls SAP Code | 2110 |
| Delayed Start Stat | No |
| Burner Control | Modulating |
| HETAS approved System | No |
| Is MHS Pumped | Pump in heated space |
| Heating Pump Age | 2013 or later |
| Heat Emitter | Radiators |
| Flow Temperature | Unknown |
| Boiler Interlock | Yes |

**25.0 Main Heating 2** — None

**26.0 Heat Networks** — None

**27.0 Secondary Heating** — None

**28.0 Water Heating**

| | |
|---|---|
| Water Heating | Independent |
| SAP Code | 909 |
| Fuel Type | Electricity |
| Flue Gas Heat Recovery System | No |
| Waste Water Heat Recovery Instantaneous System 1 | No |
| Waste Water Heat Recovery Instantaneous System 2 | No |
| Waste Water Heat Recovery Storage System | No |
| Solar Panel | No |
| Water use <= 125 litres/person/day | Yes |
| Summer Immersion | No |
| Cold Water Source | From mains |
| Bath Count | 1 |
| Supplementary Immersion | No |
| Immersion Only Heating Hot Water | No |

**28.3 Waste Water Heat Recovery System**

**29.0 Hot Water Cylinder** — None

| | |
|---|---|
| Cylinder Stat | No |
| Cylinder In Heated Space | No |
| Independent Time Control | No |
| In Airing Cupboard | No |

**31.0 Thermal Store** — None

**32.0 Photovoltaic Unit** — One Dwelling

| | |
|---|---|
| Export Capable Meter? | Yes |
| Connected To Dwelling | Yes |
| Diverter | No |
| Battery Capacity [kWh] | 0.00 |

| PV Cells kWp | Orientation | Elevation | Overshading | FGHRS | MCS Certificate | Overshading Factor | MCS Certificate Reference | Panel Manufacturer |
|---|---|---|---|---|---|---|---|---|
| 5.00 | South | 45° | None Or Little | No | No | 1.00 | | |

**34.0 Small-scale Hydro** — None

| | | |
|---|---|---|
| Electricity Generated | 0.00 | |
| Apportioned | 0.00 | kWh/Year |
| Connected to dwelling's electricity meter | Yes | |

# Summary for Input Data

| Electricity Generation | Annual |
|---|---|

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|

**Recommendations**

**Lower cost measures**

**None**

**Further measures to achieve even higher standards**

| | Typical Cost | Typical savings per year | Ratings after improvement | |
|---|---|---|---|---|
| | | | SAP rating | Environmental Impact |
| Solar water heating | £4,000 - £6,000 | £111 | B 86 | A 98 |
| | | | 0 | 0 |
| | | | 0 | 0 |

| | | | | |
|---|---|---|---|---|
| E11 Eaves (insulation at rafter level) | 11.3900 | 0.0200 | 0.2278 | |
| E13 Gable (insulation at rafter level) | 9.9700 | 0.0420 | 0.4187 | |
| E16 Corner (normal) | 15.9000 | 0.0390 | 0.6201 | |
| E18 Party wall between dwellings | 15.9000 | 0.0420 | 0.6678 | |
| P1 Party wall - Ground floor | 11.3900 | 0.0430 | 0.4898 | |
| P2 Party wall - Intermediate floor within a dwelling | 11.3900 | 0.0000 | 0.0000 | |
| P5 Party wall - Roof (insulation at rafter level) | 11.3900 | 0.0380 | 0.4328 | |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 6.4668 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 91.5081 (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 | 67.2993 | 66.9486 | 66.6049 | 64.9903 | 64.6882 | 63.2820 | 63.2820 | 63.0216 | 63.8236 | 64.6882 | 65.2993 | 65.9382 | (38) |
| Heat transfer coeff | 158.8074 | 158.4567 | 158.1130 | 156.4984 | 156.1963 | 154.7901 | 154.7901 | 154.5297 | 155.3317 | 156.1963 | 156.8074 | 157.4463 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 156.4970 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.1215 | 1.1190 | 1.1166 | 1.1052 | 1.1031 | 1.0932 | 1.0932 | 1.0913 | 1.0970 | 1.1031 | 1.1074 | 1.1119 | (40) |
| HLP (average) | | | | | | | | | | | | 1.1052 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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

Assumed occupancy 2.9201 (42)
Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 84.4179 | 83.1642 | 81.3987 | 78.1434 | 75.7059 | 73.0031 | 71.5432 | 73.2963 | 75.2052 | 78.0973 | 81.4196 | 84.1325 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 44.5344 | 42.9150 | 41.2956 | 39.6761 | 38.0567 | 36.4373 | 36.4373 | 38.0567 | 39.6761 | 41.2956 | 42.9150 | 44.5344 | (42c) |

Average daily hot water use (litres/day) 118.7546 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 128.9523 | 126.0792 | 122.6942 | 117.8195 | 113.7626 | 109.4403 | 107.9804 | 111.3530 | 114.8813 | 119.3928 | 124.3346 | 128.6670 | (44) |
| Energy conte | 204.2290 | 179.5351 | 188.5765 | 161.2891 | 153.1463 | 134.5697 | 130.5930 | 137.8783 | 141.6601 | 162.0150 | 177.1374 | 201.4614 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1972.0907 | |

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (46) |

Water storage loss:
Total storage 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 | (56) |

If cylinder contains dedicated solar storage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (57) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Primary 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 | (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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 173.5946 | 152.6048 | 160.2900 | 137.0957 | 130.1744 | 114.3842 | 111.0040 | 117.1965 | 120.4111 | 137.7127 | 150.5668 | 171.2422 | (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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 173.5946 | 152.6048 | 160.2900 | 137.0957 | 130.1744 | 114.3842 | 111.0040 | 117.1965 | 120.4111 | 137.7127 | 150.5668 | 171.2422 | (64) |

Total per year (kWh/year) = Sum(64)m = 1676.2771 (64)
12Total per year (kWh/year) 1676 (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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 43.3987 | 38.1512 | 40.0725 | 34.2739 | 32.5436 | 28.5961 | 27.7510 | 29.2991 | 30.1028 | 34.4282 | 37.6417 | 42.8105 | (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 | 146.0035 | 146.0035 | 146.0035 | 146.0035 | 146.0035 | 146.0035 | 146.0035 | 146.0035 | 146.0035 | 146.0035 | 146.0035 | 146.0035 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 156.9767 | 173.7957 | 156.9767 | 162.2093 | 156.9767 | 162.2093 | 156.9767 | 156.9767 | 162.2093 | 156.9767 | 162.2093 | 156.9767 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 311.2240 | 314.4535 | 306.3152 | 288.9897 | 267.1193 | 246.5643 | 232.8323 | 229.6027 | 237.7411 | 255.0666 | 276.9369 | 297.4919 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 37.6003 | 37.6003 | 37.6003 | 37.6003 | 37.6003 | 37.6003 | 37.6003 | 37.6003 | 37.6003 | 37.6003 | 37.6003 | 37.6003 | (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) | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | (71) |
| Water heating gains (Table 5) | 58.3315 | 56.7726 | 53.8609 | 47.6027 | 43.7414 | 39.7167 | 37.2997 | 39.3806 | 41.8094 | 46.2744 | 52.2801 | 57.5410 | (72) |
| Total internal gains | 596.3333 | 614.8228 | 586.9539 | 568.6027 | 537.6385 | 515.2914 | 493.9098 | 492.7611 | 508.5608 | 528.1188 | 561.2274 | 581.8108 | (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 | |
|---|---|---|---|---|---|---|---|
| East | 6.9000 | 19.6403 | 0.6000 | 0.0000 | 0.7700 | 62.6092 | (76) |
| South | 2.8000 | 46.7521 | 0.6000 | 0.0000 | 0.7700 | 60.4785 | (78) |
| West | 23.0000 | 19.6403 | 0.6000 | 0.0000 | 0.7700 | 208.6974 | (80) |
| South | 2.4000 | 49.1253 | 0.6000 | 0.0000 | 1.0000 | 70.7404 | (82) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 402.5256 | 753.0720 | 1174.1259 | 1637.9904 | 1960.1031 | 1989.9359 | 1901.0192 | 1661.3627 | 1338.7553 | 874.4751 | 495.2678 | 335.5150 | (83) |
| Total gains | 998.8588 | 1367.8948 | 1761.0798 | 2206.5931 | 2497.7416 | 2505.2273 | 2394.9290 | 2154.1238 | 1847.3161 | 1402.5939 | 1056.4952 | 917.3258 | (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 | 48.2753 | 48.3821 | 48.4873 | 48.9875 | 49.0823 | 49.5282 | 49.5282 | 49.6116 | 49.3555 | 49.0823 | 48.8910 | 48.6926 | |
| alpha | 4.2184 | 4.2255 | 4.2325 | 4.2658 | 4.2722 | 4.3019 | 4.3019 | 4.3074 | 4.2904 | 4.2722 | 4.2594 | 4.2462 | |
| util living area | 0.9898 | 0.9654 | 0.8986 | 0.7436 | 0.5561 | 0.3910 | 0.2835 | 0.3281 | 0.5552 | 0.8647 | 0.9759 | 0.9927 | (86) |
| MIT | 19.4654 | 19.8641 | 20.3441 | 20.7659 | 20.9410 | 20.9896 | 20.9980 | 20.9963 | 20.9572 | 20.6187 | 19.9370 | 19.3965 | (87) |
| Th 2 | 19.9833 | 19.9853 | 19.9873 | 19.9966 | 19.9983 | 20.0064 | 20.0064 | 20.0079 | 20.0033 | 19.9983 | 19.9948 | 19.9911 | (88) |
| util rest of house | 0.9872 | 0.9572 | 0.8775 | 0.7028 | 0.5033 | 0.3321 | 0.2199 | 0.2583 | 0.4837 | 0.8283 | 0.9689 | 0.9908 | (89) |
| MIT 2 | 18.2022 | 18.7050 | 19.2915 | 19.7759 | 19.9519 | 20.0005 | 20.0057 | 20.0065 | 19.9754 | 19.6344 | 18.8092 | 18.1199 | (90) |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.1723 | (91) |
| MIT | 18.4199 | 18.9047 | 19.4729 | 19.9465 | 20.1223 | 20.1709 | 20.1767 | 20.1770 | 20.1446 | 19.8040 | 19.0036 | 18.3398 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 18.4199 | 18.9047 | 19.4729 | 19.9465 | 20.1223 | 20.1709 | 20.1767 | 20.1770 | 20.1446 | 19.8040 | 19.0036 | 18.3398 | (93) |

8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9814 | 0.9460 | 0.8651 | 0.7006 | 0.5100 | 0.3419 | 0.2308 | 0.2702 | 0.4942 | 0.8202 | 0.9595 | 0.9862 | (94) |
| Useful gains | 980.3066 | 1294.0824 | 1523.4589 | 1546.0308 | 1273.8772 | 856.5509 | 552.8541 | 582.1269 | 912.8747 | 1150.3837 | 1013.7532 | 904.7066 | (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 | 2242.3460 | 2219.1402 | 2051.1796 | 1728.7533 | 1315.5387 | 862.3242 | 553.6356 | 583.6635 | 938.9143 | 1437.6268 | 1866.5698 | 2226.2669 | (97) |
| Space heating kWh | 938.9573 | 621.6388 | 392.6241 | 131.5602 | 30.9962 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 213.7089 | 614.0280 | 983.2409 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 3926.7544 | |
| 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 | 938.9573 | 621.6388 | 392.6241 | 131.5602 | 30.9962 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 213.7089 | 614.0280 | 983.2409 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 3926.7544 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 27.7313 | (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 %) | 100.0000 | (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 | 938.9573 | 621.6388 | 392.6241 | 131.5602 | 30.9962 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 213.7089 | 614.0280 | 983.2409 | (98) |
| Space heating efficiency (main heating system 1) | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 100.0000 | 100.0000 | 100.0000 | (210) |
| Space heating fuel (main heating system) | 938.9573 | 621.6388 | 392.6241 | 131.5602 | 30.9962 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 213.7089 | 614.0280 | 983.2409 | (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 | 173.5946 | 152.6048 | 160.2900 | 137.0957 | 130.1744 | 114.3842 | 111.0040 | 117.1965 | 120.4111 | 137.7127 | 150.5668 | 171.2422 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 100.0000 | (216) |
| (217)m | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 | (217) |
| Fuel for water heating, kWh/month | 173.5946 | 152.6048 | 160.2900 | 137.0957 | 130.1744 | 114.3842 | 111.0040 | 117.1965 | 120.4111 | 137.7127 | 150.5668 | 171.2422 | (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 | 3.4822 | 3.1452 | 3.4822 | 3.3699 | 3.4822 | 3.3699 | 3.4822 | 3.4822 | 3.3699 | 3.4822 | 3.3699 | 3.4822 | (231) |
| Lighting | 32.9252 | 26.4138 | 23.7827 | 17.4242 | 13.4590 | 10.9961 | 12.2777 | 15.9591 | 20.7292 | 27.1979 | 30.7199 | 33.8403 | (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233a)m | -103.2063 | -143.8566 | -193.7416 | -191.4866 | -186.8362 | -166.1596 | -163.7186 | -157.8217 | -145.2887 | -147.0844 | -111.6806 | -89.6423 | (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 | -36.7024 | -81.6630 | -171.4880 | -274.3253 | -370.8036 | -375.4516 | -373.4905 | -322.9132 | -247.8422 | -135.8682 | -52.6496 | -28.5612 | (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 | 3926.7544 | (211) |
| Space heating fuel - main system 2 | 0.0000 | (213) |
| Space heating fuel - secondary | 0.0000 | (215) |
| Efficiency of water heater | 100.0000 | |
| Water heating fuel used | 1676.2771 | (219) |
| Space cooling fuel | 0.0000 | (221) |
| Electricity for pumps and fans: | | |
| central heating pump | 41.0000 | (230c) |
| Total electricity for the above, kWh/year | 41.0000 | (231) |
| Electricity for lighting (calculated in Appendix L) | 265.7250 | (232) |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -4272.2819 | (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 | 1637.4746 | (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 | 3926.7544 | 0.1573 | 617.5392 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 1676.2771 | 0.1415 | 237.2655 | (264) |
| Space and water heating | | | 854.8047 | (265) |
| Pumps, fans and electric keep-hot | 41.0000 | 0.1387 | 5.6872 | (267) |
| Energy for lighting | 265.7250 | 0.1443 | 38.3523 | (268) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -1800.5231 | 0.1369 | -246.5192 | |
| PV Unit electricity exported | -2471.7588 | 0.1243 | -307.2522 | |
| Total | | | -553.7714 | (269) |
| Total CO2, kg/year | | | 345.0729 | (272) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 2.4400 | (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 | 3926.7544 | 1.5821 | 6212.6854 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 1676.2771 | 1.5234 | 2553.6517 | (278) |
| Space and water heating | | | 8766.3371 | (279) |
| Pumps, fans and electric keep-hot | 41.0000 | 1.5128 | 62.0248 | (281) |
| Energy for lighting | 265.7250 | 1.5338 | 407.5779 | (282) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -1800.5231 | 1.5062 | -2711.8908 | |
| PV Unit electricity exported | -2471.7588 | 0.4563 | -1127.7431 | |
| Total | | | -3839.6340 | (283) |
| Total Primary energy kWh/year | | | 5396.3059 | (286) |
| Dwelling Primary energy Rate (DPER) | | | 38.1100 | (287) |

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

1. Overall dwelling characteristics

| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 57.8000 (1b) | x | 2.6500 (2b) | = | 153.1700 | (1b) - (3b) |
| First floor | 57.8000 (1c) | x | 2.6500 (2c) | = | 153.1700 | (1c) - (3c) |
| Second floor | 26.0000 (1d) | x | 1.8000 (2d) | = | 46.8000 | (1d) - (3d) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 141.6000 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = | 353.1400 | (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) = | 0.1133 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3633 | (18) |
| Number of sides sheltered | | 2 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.8500 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.3088 | (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 | 0.3937 | 0.3860 | 0.3783 | 0.3397 | 0.3319 | 0.2933 | 0.2933 | 0.2856 | 0.3088 | 0.3319 | 0.3474 | 0.3628 | (22b) |
| Effective ac | 0.5775 | 0.5745 | 0.5715 | 0.5577 | 0.5551 | 0.5430 | 0.5430 | 0.5408 | 0.5477 | 0.5551 | 0.5603 | 0.5658 | (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 Semi-glazed door | | | 2.0000 | 1.0000 | 2.0000 | | | (26a) |
| TER Opening Type | | | 31.1200 | 1.1450 | 35.6336 | | | (27) |
| TER Roof Light | | | 2.2800 | 1.5918 | 4.2222 | | | (27a) |
| Heatloss Floor 1 | | | 57.8000 | 0.1300 | 7.5140 | | | (28a) |
| External Wall 1 | 141.5600 | 33.1200 | 108.4400 | 0.1800 | 19.5192 | | | (29a) |
| External Roof 1 | 106.6100 | 2.2800 | 104.3300 | 0.1100 | 11.4763 | | | (30) |
| Total net area of external elements Aum(A, m2) | | | 305.9700 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | | (26)...(30) + (32) = | 80.3653 | | | (33) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 194.9102 (35)

List of Thermal Bridges

| K1 Element | Length | Psi-value | Total |
|---|---|---|---|
| E2 Other lintels (including other steel lintels) | 16.6800 | 0.0500 | 0.8340 |
| E3 Sill | 21.6900 | 0.0500 | 1.0845 |
| E4 Jamb | 55.6400 | 0.0500 | 2.7820 |
| E5 Ground floor (normal) | 21.5300 | 0.1600 | 3.4448 |
| E6 Intermediate floor within a dwelling | 21.5300 | 0.0000 | 0.0000 |
| E11 Eaves (insulation at rafter level) | 11.3900 | 0.0400 | 0.4556 |
| E13 Gable (insulation at rafter level) | 9.9700 | 0.0800 | 0.7976 |
| E16 Corner (normal) | 15.9000 | 0.0900 | 1.4310 |
| E18 Party wall between dwellings | 15.9000 | 0.0600 | 0.9540 |
| P1 Party wall - Ground floor | 11.3900 | 0.0800 | 0.9112 |
| P2 Party wall - Intermediate floor within a dwelling | 11.3900 | 0.0000 | 0.0000 |
| P5 Party wall - Roof (insulation at rafter level) | 11.3900 | 0.0800 | 0.9112 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 13.6059 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 93.9712 (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 | 67.2993 | 66.9486 | 66.6049 | 64.9903 | 64.6882 | 63.2820 | 63.2820 | 63.0216 | 63.8236 | 64.6882 | 65.2993 | 65.9382 | (38) |
| Heat transfer coeff | 161.2705 | 160.9198 | 160.5761 | 158.9615 | 158.6594 | 157.2532 | 157.2532 | 156.9928 | 157.7949 | 158.6594 | 159.2705 | 159.9094 | (39) |

Average = Sum(39)m / 12 = 158.9601

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.1389 | 1.1364 | 1.1340 | 1.1226 | 1.1205 | 1.1105 | 1.1105 | 1.1087 | 1.1144 | 1.1205 | 1.1248 | 1.1293 | (40) |
| HLP (average) | | | | | | | | | | | | 1.1226 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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

Assumed occupancy 2.9201 (42)

Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 84.4179 | 83.1642 | 81.3987 | 78.1434 | 75.7059 | 73.0031 | 71.5432 | 73.2963 | 75.2052 | 78.0973 | 81.4196 | 84.1325 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 44.5344 | 42.9150 | 41.2956 | 39.6761 | 38.0567 | 36.4373 | 36.4373 | 38.0567 | 39.6761 | 41.2956 | 42.9150 | 44.5344 | (42c) |

Average daily hot water use (litres/day) 118.7546 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 128.9523 | 126.0792 | 122.6942 | 117.8195 | 113.7626 | 109.4403 | 107.9804 | 111.3530 | 114.8813 | 119.3928 | 124.3346 | 128.6670 | (44) |
| Energy conte | 204.2290 | 179.5351 | 188.5765 | 161.2891 | 153.1463 | 134.5697 | 130.5930 | 137.8783 | 141.6601 | 162.0150 | 177.1374 | 201.4614 | (45) |

Energy content (annual) Total = Sum(45)m = 1972.0907

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 30.6343 | 26.9303 | 28.2865 | 24.1934 | 22.9719 | 20.1854 | 19.5889 | 20.6817 | 21.2490 | 24.3022 | 26.5706 | 30.2192 | (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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 250.8239 | 221.6208 | 235.1714 | 206.3809 | 199.7412 | 179.6615 | 177.1879 | 184.4732 | 186.7520 | 208.6099 | 222.2293 | 248.0563 | (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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 250.8239 | 221.6208 | 235.1714 | 206.3809 | 199.7412 | 179.6615 | 177.1879 | 184.4732 | 186.7520 | 208.6099 | 222.2293 | 248.0563 | (64) |

Total per year (kWh/year) = Sum(64)m = 2520.7081 (64)

12Total per year (kWh/year) 2521 (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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 105.1821 | 93.3640 | 99.9776 | 89.7021 | 88.1971 | 80.8179 | 80.6981 | 83.1205 | 83.1755 | 91.1459 | 94.9717 | 104.2618 | (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 | 146.0035 | 146.0035 | 146.0035 | 146.0035 | 146.0035 | 146.0035 | 146.0035 | 146.0035 | 146.0035 | 146.0035 | 146.0035 | 146.0035 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 156.9767 | 173.7957 | 156.9767 | 162.2093 | 156.9767 | 162.2093 | 156.9767 | 156.9767 | 162.2093 | 156.9767 | 162.2093 | 156.9767 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 311.2240 | 314.4535 | 306.3152 | 288.9897 | 267.1193 | 246.5643 | 232.8323 | 229.6027 | 237.7411 | 255.0666 | 276.9369 | 297.4919 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 37.6003 | 37.6003 | 37.6003 | 37.6003 | 37.6003 | 37.6003 | 37.6003 | 37.6003 | 37.6003 | 37.6003 | 37.6003 | 37.6003 | (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) | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 141.3737 | 138.9345 | 134.3785 | 124.5862 | 118.5444 | 112.2471 | 108.4652 | 111.7210 | 115.5215 | 122.5079 | 131.9051 | 140.1369 (72) |

Total internal gains

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 679.3755 | 696.9847 | 667.4715 | 645.5862 | 612.4416 | 587.8217 | 565.0752 | 565.1016 | 582.2729 | 604.3523 | 640.8523 | 664.4066 (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 | |
|---|---|---|---|---|---|---|---|
| East | 6.5700 | 19.6403 | 0.6300 | 0.7000 | 0.7700 | 39.4352 | (76) |
| South | 2.6600 | 46.7521 | 0.6300 | 0.7000 | 0.7700 | 38.0062 | (78) |
| West | 21.8900 | 19.6403 | 0.6300 | 0.7000 | 0.7700 | 131.3908 | (80) |
| South | 2.2800 | 49.1253 | 0.6300 | 0.7000 | 1.0000 | 44.4550 | (82) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 253.2873 | 473.8950 | 738.9136 | 1030.9052 | 1233.6787 | 1252.4714 | 1196.5006 | 1045.6332 | 842.5442 | 550.3083 | 311.6503 | 211.1175 | (83) |
| Total gains | 932.6627 | 1170.8798 | 1406.3851 | 1676.4915 | 1846.1203 | 1840.2931 | 1761.5758 | 1610.7348 | 1424.8171 | 1154.6606 | 952.5026 | 875.5241 | (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, ni1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| tau | 47.5379 | 47.6415 | 47.7435 | 48.2285 | 48.3203 | 48.7524 | 48.7524 | 48.8333 | 48.5850 | 48.3203 | 48.1349 | 47.9426 | |
| alpha | 4.1692 | 4.1761 | 4.1829 | 4.2152 | 4.2214 | 4.2502 | 4.2502 | 4.2556 | 4.2390 | 4.2214 | 4.2090 | 4.1962 | |
| util living area | 0.9921 | 0.9798 | 0.9481 | 0.8594 | 0.7089 | 0.5270 | 0.3883 | 0.4401 | 0.6879 | 0.9213 | 0.9834 | 0.9939 | (86) |
| MIT | 19.3753 | 19.6726 | 20.0847 | 20.5548 | 20.8461 | 20.9661 | 20.9926 | 20.9877 | 20.8996 | 20.4590 | 19.8226 | 19.3273 | (87) |
| Th 2 | 19.9692 | 19.9712 | 19.9732 | 19.9824 | 19.9841 | 19.9922 | 19.9922 | 19.9937 | 19.9891 | 19.9841 | 19.9806 | 19.9770 | (88) |
| util rest of house | 0.9901 | 0.9747 | 0.9353 | 0.8277 | 0.6531 | 0.4514 | 0.3015 | 0.3476 | 0.6107 | 0.8955 | 0.9784 | 0.9923 | (89) |
| MIT 2 | 18.0782 | 18.4562 | 18.9720 | 19.5398 | 19.8555 | 19.9717 | 19.9895 | 19.9887 | 19.9190 | 19.4456 | 18.6563 | 18.0222 | (90) |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.1723 | (91) |
| MIT | 18.3017 | 18.6658 | 19.1637 | 19.7147 | 20.0262 | 20.1431 | 20.1623 | 20.1608 | 20.0880 | 19.6202 | 18.8572 | 18.2471 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 18.3017 | 18.6658 | 19.1637 | 19.7147 | 20.0262 | 20.1431 | 20.1623 | 20.1608 | 20.0880 | 19.6202 | 18.8572 | 18.2471 | (93) |

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8. Space heating requirement

---

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9851 | 0.9659 | 0.9226 | 0.8183 | 0.6556 | 0.4630 | 0.3163 | 0.3633 | 0.6188 | 0.8842 | 0.9706 | 0.9882 | (94) |
| Useful gains | 918.8004 | 1130.8956 | 1297.5225 | 1371.8109 | 1210.2489 | 852.1260 | 557.2476 | 585.1734 | 881.7363 | 1020.9307 | 924.4722 | 865.1970 | (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 | 2258.0604 | 2215.1958 | 2033.4928 | 1719.1217 | 1321.0273 | 871.6678 | 560.1882 | 590.4249 | 944.8773 | 1431.1435 | 1872.5830 | 2246.2645 | (97) |
| Space heating kWh | 996.4094 | 728.6497 | 547.5619 | 250.0638 | 82.4191 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 305.1983 | 682.6398 | 1027.5142 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 4620.4563 | |
| 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 | 996.4094 | 728.6497 | 547.5619 | 250.0638 | 82.4191 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 305.1983 | 682.6398 | 1027.5142 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 4620.4563 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 32.6303 | (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 | 996.4094 | 728.6497 | 547.5619 | 250.0638 | 82.4191 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 305.1983 | 682.6398 | 1027.5142 | (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) | 1079.5335 | 789.4363 | 593.2415 | 270.9250 | 89.2948 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 330.6591 | 739.5881 | 1113.2332 | (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 | 250.8239 | 221.6208 | 235.1714 | 206.3809 | 199.7412 | 179.6615 | 177.1879 | 184.4732 | 186.7520 | 208.6099 | 222.2293 | 248.0563 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 | (216) |
| (217)m | 86.8306 | 86.5242 | 85.8896 | 84.4914 | 82.2345 | 79.8000 | 79.8000 | 79.8000 | 79.8000 | 84.9119 | 86.4067 | 86.8942 | (217) |
| Fuel for water heating, kWh/month | 288.8658 | 256.1375 | 273.8066 | 244.2625 | 242.8921 | 225.1397 | 222.0399 | 231.1694 | 234.0250 | 245.6781 | 257.1899 | 285.4693 | (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 | 32.6167 | 26.1663 | 23.5599 | 17.2610 | 13.3329 | 10.8931 | 12.1627 | 15.8095 | 20.5350 | 26.9430 | 30.4321 | 33.5232 | (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233a)m | -53.3185 | -74.7876 | -106.9362 | -119.5334 | -128.2258 | -119.3413 | -117.7476 | -111.4114 | -100.2433 | -85.0601 | -58.4339 | -46.1318 | (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 | -31.3121 | -65.7268 | -130.4132 | -195.5939 | -258.4183 | -259.6725 | -256.7322 | -217.5735 | -159.6593 | -94.0434 | -41.8119 | -24.7818 | (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 | 5005.9115 | (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 | 3006.6759 | (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) | 263.2352 | (232) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -2856.9098 | (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 | 5504.9128 | (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 | 5005.9115 | 0.2100 | 1051.2414 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 3006.6759 | 0.2100 | 631.4019 | (264) |
| Space and water heating | | | 1682.6434 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 263.2352 | 0.1443 | 37.9930 | (268) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -1121.1710 | 0.1347 | -151.0471 | |
| PV Unit electricity exported | -1735.7388 | 0.1259 | -218.5771 | |
| Total | | | -369.6243 | (269) |
| Total CO2, kg/year | | | 1362.9413 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 9.6300 | (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 | 5005.9115 | 1.1300 | 5656.6800 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 3006.6759 | 1.1300 | 3397.5438 | (278) |
| Space and water heating | | | 9054.2238 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 263.2352 | 1.5338 | 403.7589 | (282) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -1121.1710 | 1.4979 | -1679.4244 | |
| PV Unit electricity exported | -1735.7388 | 0.4622 | -802.3292 | |
| Total | | | -2481.7537 | (283) |
| Total Primary energy kWh/year | | | 7106.3298 | (286) |
| Target Primary Energy Rate (TPER) | | | 50.1900 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Property Reference** | | **Issued on Date** | 24/03/2025 |
| **Assessment Reference** | 00001 | **Prop Type Ref** | |
| **Property** | 70 Hayman Crescent, Hayes, UB4 8PP | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 84 B | **DER** | 2.44 | **TER** | 9.63 |
| **Environmental** | 98 A | **% DER < TER** | | | 74.66 |
| **$CO_2$ Emissions (t/year)** | 0.16 | **DFEE** | 34.37 | **TFEE** | 38.65 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 11.09 |
| **% DPER < TPER** | 24.07 | **DPER** | 38.11 | **TPER** | 50.19 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Chris Law | **Assessor ID** | AX42-0001 |
| **Client** | | | |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF FABRIC ENERGY EFFICIENCY

---

## 1. Overall dwelling characteristics

| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 57.8000 (1b) | x | 2.6500 (2b) | = | 153.1700 | (1b) - (3b) |
| First floor | 57.8000 (1c) | x | 2.6500 (2c) | = | 153.1700 | (1c) - (3c) |
| Second floor | 26.0000 (1d) | x | 1.8000 (2d) | = | 46.8000 | (1d) - (3d) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 141.6000 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = | 353.1400 | (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) = | 0.1133 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3633 | (18) |
| Number of sides sheltered | | 2 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.8500 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.3088 | (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 | 0.3937 | 0.3860 | 0.3783 | 0.3397 | 0.3319 | 0.2933 | 0.2933 | 0.2856 | 0.3088 | 0.3319 | 0.3474 | 0.3628 | (22b) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | | | | | | | | | | | | 0.0000 | (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | | | | | | | | | | | | 0.0000 | (23c) |
| Effective ac | 0.5775 | 0.5745 | 0.5715 | 0.5577 | 0.5551 | 0.5430 | 0.5430 | 0.5408 | 0.5477 | 0.5551 | 0.5603 | 0.5658 | (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 | | | 32.7000 | 1.1450 | 37.4427 | | | (27) |
| External Door | | | 2.0000 | 1.2000 | 2.4000 | | | (26a) |
| Rooflight | | | 2.4000 | 1.1450 | 3.3962 | | | (27a) |
| Heatloss Floor 1 | | | 57.8000 | 0.1200 | 6.9360 | 110.0000 | 6358.0000 | (28a) |
| External Wall 1 | 141.5600 | 34.7000 | 106.8600 | 0.1800 | 19.2348 | 190.0000 | 20303.4000 | (29a) |
| External Roof 1 | 106.6100 | 2.4000 | 104.2100 | 0.1500 | 15.6315 | 9.0000 | 937.8900 | (30) |
| Total net area of external elements Aum(A, m2) | | | 305.9700 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 85.0413 | | | (33) |
| Heat capacity Cm = Sum(A x k) | | | | | (28)...(30) + (32) + (32a)...(32e) = | | 27599.2900 | (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | | | | | | | 194.9102 | (35) |

List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E2 Other lintels (including other steel lintels) | 16.6800 | 0.0310 | 0.5171 |
| E3 Sill | 21.6900 | 0.0280 | 0.6073 |
| E4 Jamb | 55.6400 | 0.0230 | 1.2797 |

| | | | | |
|---|---|---|---|---|
| E5 Ground floor (normal) | 21.5300 | 0.0550 | 1.1842 | |
| E6 Intermediate floor within a dwelling | 21.5300 | 0.0010 | 0.0215 | |
| E11 Eaves (insulation at rafter level) | 11.3900 | 0.0200 | 0.2278 | |
| E13 Gable (insulation at rafter level) | 9.9700 | 0.0420 | 0.4187 | |
| E16 Corner (normal) | 15.9000 | 0.0390 | 0.6201 | |
| E18 Party wall between dwellings | 15.9000 | 0.0420 | 0.6678 | |
| P1 Party wall - Ground floor | 11.3900 | 0.0430 | 0.4898 | |
| P2 Party wall - Intermediate floor within a dwelling | 11.3900 | 0.0000 | 0.0000 | |
| P5 Party wall - Roof (insulation at rafter level) | 11.3900 | 0.0380 | 0.4328 | |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 6.4668 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 91.5081 (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 | 67.2993 | 66.9486 | 66.6049 | 64.9903 | 64.6882 | 63.2820 | 63.2820 | 63.0216 | 63.8236 | 64.6882 | 65.2993 | 65.9382 | (38) |
| Heat transfer coeff | 158.8074 | 158.4567 | 158.1130 | 156.4984 | 156.1963 | 154.7901 | 154.7901 | 154.5297 | 155.3317 | 156.1963 | 156.8074 | 157.4463 | (39) |

Average = Sum(39)m / 12 = 156.4970

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.1215 | 1.1190 | 1.1166 | 1.1052 | 1.1031 | 1.0932 | 1.0932 | 1.0913 | 1.0970 | 1.1031 | 1.1074 | 1.1119 | (40) |
| HLP (average) | | | | | | | | | | | | 1.1052 | |
| 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 2.9201 (42)

Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 31.5929 | 31.1237 | 30.4630 | 29.2447 | 28.3325 | 27.3210 | 26.7746 | 27.4307 | 28.1451 | 29.2275 | 30.4708 | 31.4861 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 44.5344 | 42.9150 | 41.2956 | 39.6761 | 38.0567 | 36.4373 | 36.4373 | 38.0567 | 39.6761 | 41.2956 | 42.9150 | 44.5344 | (42c) |

Average daily hot water use (litres/day) 69.7775 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 76.1274 | 74.0387 | 71.7586 | 68.9209 | 66.3892 | 63.7583 | 63.2119 | 65.4874 | 67.8212 | 70.5230 | 73.3858 | 76.0206 | (44) |
| Energy conte | 120.5671 | 105.4302 | 110.2902 | 94.3492 | 89.3726 | 78.3982 | 76.4493 | 81.0871 | 83.6304 | 95.6991 | 104.5516 | 119.0298 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1158.8548 | |

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (46) |

Water storage loss:

Total storage 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 | (56) |

If cylinder contains dedicated solar storage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (57) |
| Primary 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 | (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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 102.4821 | 89.6156 | 93.7467 | 80.1968 | 75.9667 | 66.6385 | 64.9819 | 68.9240 | 71.0858 | 81.3442 | 88.8688 | 101.1753 | (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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 102.4821 | 89.6156 | 93.7467 | 80.1968 | 75.9667 | 66.6385 | 64.9819 | 68.9240 | 71.0858 | 81.3442 | 88.8688 | 101.1753 | (64) |
| | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | | 985.0266 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | 985 | (64) |

Electric shower(s)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 58.6048 | 52.2174 | 57.0194 | 54.4129 | 55.4339 | 52.8786 | 54.6412 | 55.4339 | 54.4129 | 57.0194 | 55.9472 | 58.6048 | (64a) |
| | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | | | 666.6265 | (64a) |

Heat gains from water heating, kWh/month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 40.2717 | 35.4583 | 37.6915 | 33.6524 | 32.8502 | 29.8793 | 29.9058 | 31.0895 | 31.3747 | 34.5909 | 36.2040 | 39.9450 | (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 | 146.0035 | 146.0035 | 146.0035 | 146.0035 | 146.0035 | 146.0035 | 146.0035 | 146.0035 | 146.0035 | 146.0035 | 146.0035 | 146.0035 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 156.9767 | 173.7957 | 156.9767 | 162.2093 | 156.9767 | 162.2093 | 156.9767 | 156.9767 | 162.2093 | 156.9767 | 162.2093 | 156.9767 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 311.2240 | 314.4535 | 306.3152 | 288.9897 | 267.1193 | 246.5643 | 232.8323 | 229.6027 | 237.7411 | 255.0666 | 276.9369 | 297.4919 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 37.6003 | 37.6003 | 37.6003 | 37.6003 | 37.6003 | 37.6003 | 37.6003 | 37.6003 | 37.6003 | 37.6003 | 37.6003 | 37.6003 | (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) | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | (71) |
| Water heating gains (Table 5) | 54.1287 | 52.7653 | 50.6606 | 46.7395 | 44.1534 | 41.4990 | 40.1959 | 41.7870 | 43.5759 | 46.4931 | 50.2833 | 53.6896 | (72) |
| Total internal gains | 589.1304 | 607.8155 | 580.7536 | 564.7395 | 535.0506 | 517.0736 | 496.8060 | 495.1675 | 510.3273 | 525.3375 | 556.2306 | 574.9593 | (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 | |
|---|---|---|---|---|---|---|---|
| East | 6.9000 | 19.6403 | 0.6000 | 0.0000 | 0.7700 | 62.6092 | (76) |
| South | 2.8000 | 46.7521 | 0.6000 | 0.0000 | 0.7700 | 60.4785 | (78) |
| West | 23.0000 | 19.6403 | 0.6000 | 0.0000 | 0.7700 | 208.6974 | (80) |
| South | 2.4000 | 49.1253 | 0.6000 | 0.0000 | 1.0000 | 70.7404 | (82) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 402.5256 | 753.0720 | 1174.1259 | 1637.9904 | 1960.1031 | 1989.9359 | 1901.0192 | 1661.3627 | 1338.7553 | 874.4751 | 495.2678 | 335.5150 | (83) |
| Total gains | 991.6560 | 1360.8874 | 1754.8796 | 2202.7299 | 2495.1536 | 2507.0095 | 2397.8252 | 2156.5302 | 1849.0826 | 1399.8126 | 1051.4984 | 910.4743 | (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 | 48.2753 | 48.3821 | 48.4873 | 48.9875 | 49.0823 | 49.5282 | 49.5282 | 49.6116 | 49.3555 | 49.0823 | 48.8910 | 48.6926 | |
| alpha | 4.2184 | 4.2255 | 4.2325 | 4.2658 | 4.2722 | 4.3019 | 4.3019 | 4.3074 | 4.2904 | 4.2722 | 4.2594 | 4.2462 | |
| util living area | 0.9901 | 0.9659 | 0.8995 | 0.7444 | 0.5566 | 0.3907 | 0.2831 | 0.3278 | 0.5548 | 0.8653 | 0.9763 | 0.9929 | (86) |
| MIT | 19.4591 | 19.8585 | 20.3405 | 20.7649 | 20.9408 | 20.9897 | 20.9980 | 20.9963 | 20.9574 | 20.6173 | 19.9329 | 19.3903 | (87) |
| Th 2 | 19.9833 | 19.9853 | 19.9873 | 19.9966 | 19.9983 | 20.0064 | 20.0064 | 20.0079 | 20.0033 | 19.9983 | 19.9948 | 19.9911 | (88) |
| util rest of house | 0.9875 | 0.9579 | 0.8786 | 0.7037 | 0.5038 | 0.3318 | 0.2196 | 0.2580 | 0.4833 | 0.8291 | 0.9694 | 0.9911 | (89) |
| MIT 2 | 18.5890 | 18.9822 | 19.4418 | 19.8238 | 19.9620 | 20.0018 | 20.0059 | 20.0068 | 19.9816 | 19.7135 | 19.0669 | 18.5268 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.1723 | (91) |
| MIT | 18.7390 | 19.1332 | 19.5966 | 19.9859 | 20.1307 | 20.1720 | 20.1768 | 20.1773 | 20.1498 | 19.8693 | 19.2161 | 18.6756 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 18.7390 | 19.1332 | 19.5966 | 19.9859 | 20.1307 | 20.1720 | 20.1768 | 20.1773 | 20.1498 | 19.8693 | 19.2161 | 18.6756 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9833 | 0.9495 | 0.8693 | 0.7032 | 0.5109 | 0.3417 | 0.2306 | 0.2700 | 0.4941 | 0.8237 | 0.9624 | 0.9877 | (94) |
| Useful gains | 975.0531 | 1292.1334 | 1525.5657 | 1548.9466 | 1274.8552 | 856.7317 | 552.8789 | 582.1753 | 913.6660 | 1153.0695 | 1011.9494 | 899.2740 | (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 | 2293.0150 | 2255.3498 | 2070.7505 | 1734.9315 | 1316.8415 | 862.4950 | 553.6568 | 583.7057 | 939.7190 | 1447.8257 | 1899.8959 | 2279.1266 | (97) |
| Space heating kWh | 980.5637 | 647.2815 | 405.6175 | 133.9092 | 31.2378 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 219.2986 | 639.3215 | 1026.6103 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 4083.8401 | |
| 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 | 980.5637 | 647.2815 | 405.6175 | 133.9092 | 31.2378 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 219.2986 | 639.3215 | 1026.6103 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 4083.8401 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 28.8407 | (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 | 1455.0268 | 1145.4466 | 1174.4255 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (100) |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.9711 | 0.9854 | 0.9767 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (101) |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 1412.9467 | 1128.7352 | 1147.0934 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (102) |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 2821.1616 | 2698.0496 | 2422.6850 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 1013.9148 | 1167.5699 | 949.0401 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (104) |
| Cooled fraction | | | | | | | | | | fC = cooled area / (4) = | | 1.0000 | (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 | 253.4787 | 291.8925 | 237.2600 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) |
| Space cooling requirement | | | | | | | | | | | | 782.6312 | (107) |
| Energy for space heating | | | | | | | | | | | | 28.8407 | (99) |
| Energy for space cooling | | | | | | | | | | | | 5.5271 | (108) |
| Total | | | | | | | | | | | | 34.3677 | (109) |
| Fabric Energy Efficiency (DFEE) | | | | | | | | | | | | 34.4 | (109) |

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

## 1. Overall dwelling characteristics

| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 57.8000 | (1b) | x 2.6500 | (2b) = | 153.1700 | (1b) - (3b) |
| First floor | 57.8000 | (1c) | x 2.6500 | (2c) = | 153.1700 | (1c) - (3c) |
| Second floor | 26.0000 | (1d) | x 1.8000 | (2d) = | 46.8000 | (1d) - (3d) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 141.6000 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | | 353.1400 | (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) = 0.1133 (8)
Pressure test Yes
Pressure Test Method Blower Door
Measured/design AP50 5.0000 (17)
Infiltration rate 0.3633 (18)
Number of sides sheltered 2 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 0.8500 (20)
Infiltration rate adjusted to include shelter factor (21) = (18) x (20) = 0.3088 (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 | 0.3937 | 0.3860 | 0.3783 | 0.3397 | 0.3319 | 0.2933 | 0.2933 | 0.2856 | 0.3088 | 0.3319 | 0.3474 | 0.3628 | (22b) |

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) 0.0000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0.0000 (23c)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective ac | 0.5775 | 0.5745 | 0.5715 | 0.5577 | 0.5551 | 0.5430 | 0.5430 | 0.5408 | 0.5477 | 0.5551 | 0.5603 | 0.5658 | (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 Semi-glazed door | | | 2.0000 | 1.0000 | 2.0000 | | | (26a) |
| TER Opening Type | | | 31.1200 | 1.1450 | 35.6336 | | | (27) |
| TER Roof Light | | | 2.2800 | 1.5918 | 4.2222 | | | (27a) |
| Heatloss Floor 1 | | | 57.8000 | 0.1300 | 7.5140 | | | (28a) |
| External Wall 1 | 141.5600 | 33.1200 | 108.4400 | 0.1800 | 19.5192 | | | (29a) |
| External Roof 1 | 106.6100 | 2.2800 | 104.3300 | 0.1100 | 11.4763 | | | (30) |
| Total net area of external elements Aum(A, m2) | | | 305.9700 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | | (26)...(30) + (32) = | 80.3653 | | | (33) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 194.9102 (35)

List of Thermal Bridges

| K1 Element | Length | Psi-value | Total |
|---|---|---|---|
| E2 Other lintels (including other steel lintels) | 16.6800 | 0.0500 | 0.8340 |
| E3 Sill | 21.6900 | 0.0500 | 1.0845 |
| E4 Jamb | 55.6400 | 0.0500 | 2.7820 |
| E5 Ground floor (normal) | 21.5300 | 0.1600 | 3.4448 |
| E6 Intermediate floor within a dwelling | 21.5300 | 0.0000 | 0.0000 |
| E11 Eaves (insulation at rafter level) | 11.3900 | 0.0400 | 0.4556 |
| E13 Gable (insulation at rafter level) | 9.9700 | 0.0800 | 0.7976 |
| E16 Corner (normal) | 15.9000 | 0.0900 | 1.4310 |
| E18 Party wall between dwellings | 15.9000 | 0.0600 | 0.9540 |
| P1 Party wall - Ground floor | 11.3900 | 0.0800 | 0.9112 |
| P2 Party wall - Intermediate floor within a dwelling | 11.3900 | 0.0000 | 0.0000 |
| P5 Party wall - Roof (insulation at rafter level) | 11.3900 | 0.0800 | 0.9112 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 13.6059 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 93.9712 (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 | 67.2993 | 66.9486 | 66.6049 | 64.9903 | 64.6882 | 63.2820 | 63.2820 | 63.0216 | 63.8236 | 64.6882 | 65.2993 | 65.9382 | (38) |
| Heat transfer coeff | 161.2705 | 160.9198 | 160.5761 | 158.9615 | 158.6594 | 157.2532 | 157.2532 | 156.9928 | 157.7949 | 158.6594 | 159.2705 | 159.9094 | (39) |

Average = Sum(39)m / 12 = 158.9601

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.1389 | 1.1364 | 1.1340 | 1.1226 | 1.1205 | 1.1105 | 1.1105 | 1.1087 | 1.1144 | 1.1205 | 1.1248 | 1.1293 | (40) |
| HLP (average) | | | | | | | | | | | | 1.1226 | |
| 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 2.9201 (42)

Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 31.5929 | 31.1237 | 30.4630 | 29.2447 | 28.3325 | 27.3210 | 26.7746 | 27.4307 | 28.1451 | 29.2275 | 30.4708 | 31.4861 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 44.5344 | 42.9150 | 41.2956 | 39.6761 | 38.0567 | 36.4373 | 36.4373 | 38.0567 | 39.6761 | 41.2956 | 42.9150 | 44.5344 | (42c) |

Average daily hot water use (litres/day) 69.7775 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 76.1274 | 74.0387 | 71.7586 | 68.9209 | 66.3892 | 63.7583 | 63.2119 | 65.4874 | 67.8212 | 70.5230 | 73.3858 | 76.0206 | (44) |
| Energy conte | 120.5671 | 105.4302 | 110.2902 | 94.3492 | 89.3726 | 78.3982 | 76.4493 | 81.0871 | 83.6304 | 95.6991 | 104.5516 | 119.0298 | (45) |

Energy content (annual) Total = Sum(45)m = 1158.8548

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (46) |

Water storage loss:
Total storage 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 | (56) |

If cylinder contains dedicated solar storage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (57) |
| Primary 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 | (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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 102.4821 | 89.6156 | 93.7467 | 80.1968 | 75.9667 | 66.6385 | 64.9819 | 68.9240 | 71.0858 | 81.3442 | 88.8688 | 101.1753 | (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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 102.4821 | 89.6156 | 93.7467 | 80.1968 | 75.9667 | 66.6385 | 64.9819 | 68.9240 | 71.0858 | 81.3442 | 88.8688 | 101.1753 | (64) |

Total per year (kWh/year) = Sum(64)m = 985.0266 (64)

12Total per year (kWh/year) 985 (64)

Electric shower(s)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 58.6048 | 52.2174 | 57.0194 | 54.4129 | 55.4339 | 52.8786 | 54.6412 | 55.4339 | 54.4129 | 57.0194 | 55.9472 | 58.6048 | (64a) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | | | | | | | | | | | 666.6265 | (64a) |
| Heat gains from water heating, kWh/month | | | | | | | | | | | | | |
| | 40.2717 | 35.4583 | 37.6915 | 33.6524 | 32.8502 | 29.8793 | 29.9058 | 31.0895 | 31.3747 | 34.5909 | 36.2040 | 39.9450 | (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 | 146.0035 | 146.0035 | 146.0035 | 146.0035 | 146.0035 | 146.0035 | 146.0035 | 146.0035 | 146.0035 | 146.0035 | 146.0035 | 146.0035 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 156.9767 | 173.7957 | 156.9767 | 162.2093 | 156.9767 | 162.2093 | 156.9767 | 156.9767 | 162.2093 | 156.9767 | 162.2093 | 156.9767 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 311.2240 | 314.4535 | 306.3152 | 288.9897 | 267.1193 | 246.5643 | 232.8323 | 229.6027 | 237.7411 | 255.0666 | 276.9369 | 297.4919 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 37.6003 | 37.6003 | 37.6003 | 37.6003 | 37.6003 | 37.6003 | 37.6003 | 37.6003 | 37.6003 | 37.6003 | 37.6003 | 37.6003 | (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) | | | | | | | | | | | | | |
| | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 54.1287 | 52.7653 | 50.6606 | 46.7395 | 44.1534 | 41.4990 | 40.1959 | 41.7870 | 43.5759 | 46.4931 | 50.2833 | 53.6896 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 589.1304 | 607.8155 | 580.7536 | 564.7395 | 535.0506 | 517.0736 | 496.8060 | 495.1675 | 510.3273 | 525.3375 | 556.2306 | 574.9593 | (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 | |
|---|---|---|---|---|---|---|---|
| East | 6.5700 | 19.6403 | 0.6300 | 0.7000 | 0.7700 | 39.4352 | (76) |
| South | 2.6600 | 46.7521 | 0.6300 | 0.7000 | 0.7700 | 38.0062 | (78) |
| West | 21.8900 | 19.6403 | 0.6300 | 0.7000 | 0.7700 | 131.3908 | (80) |
| South | 2.2800 | 49.1253 | 0.6300 | 0.7000 | 1.0000 | 44.4550 | (82) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 253.2873 | 473.8950 | 738.9136 | 1030.9052 | 1233.6787 | 1252.4714 | 1196.5006 | 1045.6332 | 842.5442 | 550.3083 | 311.6503 | 211.1175 | (83) |
| Total gains | 842.4177 | 1081.7105 | 1319.6673 | 1595.6447 | 1768.7293 | 1769.5450 | 1693.3066 | 1540.8007 | 1352.8716 | 1075.6458 | 867.8809 | 786.0768 | (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 | 47.5379 | 47.6415 | 47.7435 | 48.2285 | 48.3203 | 48.7524 | 48.7524 | 48.8333 | 48.5850 | 48.3203 | 48.1349 | 47.9426 | |
| alpha | 4.1692 | 4.1761 | 4.1829 | 4.2152 | 4.2214 | 4.2502 | 4.2502 | 4.2556 | 4.2390 | 4.2214 | 4.2090 | 4.1962 | |
| util living area | | | | | | | | | | | | | |
| | 0.9946 | 0.9847 | 0.9575 | 0.8755 | 0.7291 | 0.5452 | 0.4032 | 0.4586 | 0.7127 | 0.9360 | 0.9881 | 0.9959 | (86) |
| MIT | 19.2949 | 19.5971 | 20.0204 | 20.5144 | 20.8284 | 20.9615 | 20.9915 | 20.9856 | 20.8849 | 20.4064 | 19.7497 | 19.2469 | (87) |
| Th 2 | 19.9692 | 19.9712 | 19.9732 | 19.9824 | 19.9841 | 19.9922 | 19.9922 | 19.9937 | 19.9891 | 19.9841 | 19.9806 | 19.9770 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9931 | 0.9807 | 0.9466 | 0.8460 | 0.6739 | 0.4680 | 0.3134 | 0.3629 | 0.6360 | 0.9139 | 0.9844 | 0.9948 | (89) |
| MIT 2 | 18.4158 | 18.7166 | 19.1320 | 19.6027 | 19.8712 | 19.9739 | 19.9897 | 19.9891 | 19.9255 | 19.5173 | 18.8770 | 18.3737 | (90) |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.1723 | (91) |
| MIT | 18.5673 | 18.8683 | 19.2851 | 19.7598 | 20.0362 | 20.1441 | 20.1624 | 20.1608 | 20.0908 | 19.6705 | 19.0274 | 18.5242 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 18.5673 | 18.8683 | 19.2851 | 19.7598 | 20.0362 | 20.1441 | 20.1624 | 20.1608 | 20.0908 | 19.6705 | 19.0274 | 18.5242 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9903 | 0.9750 | 0.9374 | 0.8387 | 0.6769 | 0.4800 | 0.3288 | 0.3792 | 0.6444 | 0.9054 | 0.9796 | 0.9926 | (94) |
| Useful gains | 834.2773 | 1054.6373 | 1237.0753 | 1338.1901 | 1197.3409 | 849.4540 | 556.7760 | 584.2368 | 871.7597 | 973.8958 | 850.1475 | 780.2483 | (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 | | | | | | | | | | | | | |
| | 2300.8911 | 2247.7820 | 2052.9760 | 1726.2848 | 1322.6091 | 871.8296 | 560.1911 | 590.4217 | 945.3219 | 1439.1266 | 1899.6798 | 2290.5721 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 1091.1606 | 801.7932 | 607.0301 | 279.4282 | 93.1995 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 346.1317 | 755.6632 | 1123.6809 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 5098.0875 | |
| 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 | | | | | | | | | | | | | |
| | 1091.1606 | 801.7932 | 607.0301 | 279.4282 | 93.1995 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 346.1317 | 755.6632 | 1123.6809 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 5098.0875 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 36.0034 | (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 | 1478.1800 | 1163.6736 | 1193.1451 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (100) |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.9060 | 0.9469 | 0.9239 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (101) |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 1339.2750 | 1101.8661 | 1102.3522 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (102) |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 1974.7293 | 1889.5647 | 1716.6669 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103) |
| Space cooling kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 457.5271 | 586.0477 | 457.0502 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (104) |
| Cooled fraction | | | | | | | | | | fC = cooled area / (4) = | | 1.0000 | (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 | 114.3818 | 146.5119 | 114.2625 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) |
| Space cooling requirement | | | | | | | | | | | | 375.1563 | (107) |

| | |
|---|---|
| Energy for space heating | 36.0034 (99) |
| Energy for space cooling | 2.6494 (108) |
| Total | 38.6529 (109) |
| Fabric Energy Efficiency (TFEE) | 38.7 (109) |

| | | | | |
|---|---|---|---|---|
| E11 Eaves (insulation at rafter level) | 11.3900 | 0.0200 | 0.2278 | |
| E13 Gable (insulation at rafter level) | 9.9700 | 0.0420 | 0.4187 | |
| E16 Corner (normal) | 15.9000 | 0.0390 | 0.6201 | |
| E18 Party wall between dwellings | 15.9000 | 0.0420 | 0.6678 | |
| P1 Party wall - Ground floor | 11.3900 | 0.0430 | 0.4898 | |
| P2 Party wall - Intermediate floor within a dwelling | 11.3900 | 0.0000 | 0.0000 | |
| P5 Party wall - Roof (insulation at rafter level) | 11.3900 | 0.0380 | 0.4328 | |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 6.4668 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 91.5081 (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 | 67.2993 | 66.9486 | 66.6049 | 64.9903 | 64.6882 | 63.2820 | 63.2820 | 63.0216 | 63.8236 | 64.6882 | 65.2993 | 65.9382 | (38) |
| Heat transfer coeff | 158.8074 | 158.4567 | 158.1130 | 156.4984 | 156.1963 | 154.7901 | 154.7901 | 154.5297 | 155.3317 | 156.1963 | 156.8074 | 157.4463 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 156.4970 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.1215 | 1.1190 | 1.1166 | 1.1052 | 1.1031 | 1.0932 | 1.0932 | 1.0913 | 1.0970 | 1.1031 | 1.1074 | 1.1119 | (40) |
| HLP (average) | | | | | | | | | | | | 1.1052 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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

Assumed occupancy 2.9201 (42)
Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 84.4179 | 83.1642 | 81.3987 | 78.1434 | 75.7059 | 73.0031 | 71.5432 | 73.2963 | 75.2052 | 78.0973 | 81.4196 | 84.1325 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 44.5344 | 42.9150 | 41.2956 | 39.6761 | 38.0567 | 36.4373 | 36.4373 | 38.0567 | 39.6761 | 41.2956 | 42.9150 | 44.5344 | (42c) |

Average daily hot water use (litres/day) 118.7546 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 128.9523 | 126.0792 | 122.6942 | 117.8195 | 113.7626 | 109.4403 | 107.9804 | 111.3530 | 114.8813 | 119.3928 | 124.3346 | 128.6670 | (44) |
| Energy conte | 204.2290 | 179.5351 | 188.5765 | 161.2891 | 153.1463 | 134.5697 | 130.5930 | 137.8783 | 141.6601 | 162.0150 | 177.1374 | 201.4614 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1972.0907 | |

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (46) |

Water storage loss:
Total storage 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 | (56) |

If cylinder contains dedicated solar storage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (57) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Primary 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 | (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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 173.5946 | 152.6048 | 160.2900 | 137.0957 | 130.1744 | 114.3842 | 111.0040 | 117.1965 | 120.4111 | 137.7127 | 150.5668 | 171.2422 | (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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 173.5946 | 152.6048 | 160.2900 | 137.0957 | 130.1744 | 114.3842 | 111.0040 | 117.1965 | 120.4111 | 137.7127 | 150.5668 | 171.2422 | (64) |

Total per year (kWh/year) = Sum(64)m = 1676.2771 (64)
12Total per year (kWh/year) 1676 (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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 43.3987 | 38.1512 | 40.0725 | 34.2739 | 32.5436 | 28.5961 | 27.7510 | 29.2991 | 30.1028 | 34.4282 | 37.6417 | 42.8105 | (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 | 146.0035 | 146.0035 | 146.0035 | 146.0035 | 146.0035 | 146.0035 | 146.0035 | 146.0035 | 146.0035 | 146.0035 | 146.0035 | 146.0035 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 156.9767 | 173.7957 | 156.9767 | 162.2093 | 156.9767 | 162.2093 | 156.9767 | 156.9767 | 162.2093 | 156.9767 | 162.2093 | 156.9767 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 311.2240 | 314.4535 | 306.3152 | 288.9897 | 267.1193 | 246.5643 | 232.8323 | 229.6027 | 237.7411 | 255.0666 | 276.9369 | 297.4919 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 37.6003 | 37.6003 | 37.6003 | 37.6003 | 37.6003 | 37.6003 | 37.6003 | 37.6003 | 37.6003 | 37.6003 | 37.6003 | 37.6003 | (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) | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | (71) |
| Water heating gains (Table 5) | 58.3315 | 56.7726 | 53.8609 | 47.6027 | 43.7414 | 39.7167 | 37.2997 | 39.3806 | 41.8094 | 46.2744 | 52.2801 | 57.5410 | (72) |
| Total internal gains | 596.3333 | 614.8228 | 586.9539 | 568.6027 | 537.6385 | 515.2914 | 493.9098 | 492.7611 | 508.5608 | 528.1188 | 561.2274 | 581.8108 | (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 | |
|---|---|---|---|---|---|---|---|
| East | 6.9000 | 19.6403 | 0.6000 | 0.0000 | 0.7700 | 62.6092 | (76) |
| South | 2.8000 | 46.7521 | 0.6000 | 0.0000 | 0.7700 | 60.4785 | (78) |
| West | 23.0000 | 19.6403 | 0.6000 | 0.0000 | 0.7700 | 208.6974 | (80) |
| South | 2.4000 | 49.1253 | 0.6000 | 0.0000 | 1.0000 | 70.7404 | (82) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 402.5256 | 753.0720 | 1174.1259 | 1637.9904 | 1960.1031 | 1989.9359 | 1901.0192 | 1661.3627 | 1338.7553 | 874.4751 | 495.2678 | 335.5150 | (83) |
| Total gains | 998.8588 | 1367.8948 | 1761.0798 | 2206.5931 | 2497.7416 | 2505.2273 | 2394.9290 | 2154.1238 | 1847.3161 | 1402.5939 | 1056.4952 | 917.3258 | (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 | 48.2753 | 48.3821 | 48.4873 | 48.9875 | 49.0823 | 49.5282 | 49.5282 | 49.6116 | 49.3555 | 49.0823 | 48.8910 | 48.6926 | |
| alpha | 4.2184 | 4.2255 | 4.2325 | 4.2658 | 4.2722 | 4.3019 | 4.3019 | 4.3074 | 4.2904 | 4.2722 | 4.2594 | 4.2462 | |
| util living area | 0.9898 | 0.9654 | 0.8986 | 0.7436 | 0.5561 | 0.3910 | 0.2835 | 0.3281 | 0.5552 | 0.8647 | 0.9759 | 0.9927 | (86) |
| MIT | 19.4654 | 19.8641 | 20.3441 | 20.7659 | 20.9410 | 20.9896 | 20.9980 | 20.9963 | 20.9572 | 20.6187 | 19.9370 | 19.3965 | (87) |
| Th 2 | 19.9833 | 19.9853 | 19.9873 | 19.9966 | 19.9983 | 20.0064 | 20.0064 | 20.0079 | 20.0033 | 19.9983 | 19.9948 | 19.9911 | (88) |
| util rest of house | 0.9872 | 0.9572 | 0.8775 | 0.7028 | 0.5033 | 0.3321 | 0.2199 | 0.2583 | 0.4837 | 0.8283 | 0.9689 | 0.9908 | (89) |
| MIT 2 | 18.2022 | 18.7050 | 19.2915 | 19.7759 | 19.9519 | 20.0005 | 20.0057 | 20.0065 | 19.9754 | 19.6344 | 18.8092 | 18.1199 | (90) |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.1723 | (91) |
| MIT | 18.4199 | 18.9047 | 19.4729 | 19.9465 | 20.1223 | 20.1709 | 20.1767 | 20.1770 | 20.1446 | 19.8040 | 19.0036 | 18.3398 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 18.4199 | 18.9047 | 19.4729 | 19.9465 | 20.1223 | 20.1709 | 20.1767 | 20.1770 | 20.1446 | 19.8040 | 19.0036 | 18.3398 | (93) |

8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9814 | 0.9460 | 0.8651 | 0.7006 | 0.5100 | 0.3419 | 0.2308 | 0.2702 | 0.4942 | 0.8202 | 0.9595 | 0.9862 | (94) |
| Useful gains | 980.3066 | 1294.0824 | 1523.4589 | 1546.0308 | 1273.8772 | 856.5509 | 552.8541 | 582.1269 | 912.8747 | 1150.3837 | 1013.7532 | 904.7066 | (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 | 2242.3460 | 2219.1402 | 2051.1796 | 1728.7533 | 1315.5387 | 862.3242 | 553.6356 | 583.6635 | 938.9143 | 1437.6268 | 1866.5698 | 2226.2669 | (97) |
| Space heating kWh | 938.9573 | 621.6388 | 392.6241 | 131.5602 | 30.9962 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 213.7089 | 614.0280 | 983.2409 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 3926.7544 | |
| 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 | 938.9573 | 621.6388 | 392.6241 | 131.5602 | 30.9962 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 213.7089 | 614.0280 | 983.2409 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 3926.7544 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 27.7313 | (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 %) | 100.0000 | (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 | 938.9573 | 621.6388 | 392.6241 | 131.5602 | 30.9962 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 213.7089 | 614.0280 | 983.2409 | (98) |
| Space heating efficiency (main heating system 1) | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 100.0000 | 100.0000 | 100.0000 | (210) |
| Space heating fuel (main heating system) | 938.9573 | 621.6388 | 392.6241 | 131.5602 | 30.9962 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 213.7089 | 614.0280 | 983.2409 | (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 | 173.5946 | 152.6048 | 160.2900 | 137.0957 | 130.1744 | 114.3842 | 111.0040 | 117.1965 | 120.4111 | 137.7127 | 150.5668 | 171.2422 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 100.0000 | (216) |
| (217)m | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 | (217) |
| Fuel for water heating, kWh/month | 173.5946 | 152.6048 | 160.2900 | 137.0957 | 130.1744 | 114.3842 | 111.0040 | 117.1965 | 120.4111 | 137.7127 | 150.5668 | 171.2422 | (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 | 3.4822 | 3.1452 | 3.4822 | 3.3699 | 3.4822 | 3.3699 | 3.4822 | 3.4822 | 3.3699 | 3.4822 | 3.3699 | 3.4822 | (231) |
| Lighting | 32.9252 | 26.4138 | 23.7827 | 17.4242 | 13.4590 | 10.9961 | 12.2777 | 15.9591 | 20.7292 | 27.1979 | 30.7199 | 33.8403 | (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233a)m | -103.2063 | -143.8566 | -193.7416 | -191.4866 | -186.8362 | -166.1596 | -163.7186 | -157.8217 | -145.2887 | -147.0844 | -111.6806 | -89.6423 | (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 | -36.7024 | -81.6630 | -171.4880 | -274.3253 | -370.8036 | -375.4516 | -373.4905 | -322.9132 | -247.8422 | -135.8682 | -52.6496 | -28.5612 | (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 | 3926.7544 | (211) |
| Space heating fuel - main system 2 | 0.0000 | (213) |
| Space heating fuel - secondary | 0.0000 | (215) |
| Efficiency of water heater | 100.0000 | |
| Water heating fuel used | 1676.2771 | (219) |
| Space cooling fuel | 0.0000 | (221) |
| Electricity for pumps and fans: | | |
| central heating pump | 41.0000 | (230c) |
| Total electricity for the above, kWh/year | 41.0000 | (231) |
| Electricity for lighting (calculated in Appendix L) | 265.7250 | (232) |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -4272.2819 | (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 | 1637.4746 | (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 | 3926.7544 | 0.1573 | 617.5392 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 1676.2771 | 0.1415 | 237.2655 | (264) |
| Space and water heating | | | 854.8047 | (265) |
| Pumps, fans and electric keep-hot | 41.0000 | 0.1387 | 5.6872 | (267) |
| Energy for lighting | 265.7250 | 0.1443 | 38.3523 | (268) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -1800.5231 | 0.1369 | -246.5192 | |
| PV Unit electricity exported | -2471.7588 | 0.1243 | -307.2522 | |
| Total | | | -553.7714 | (269) |
| Total CO2, kg/year | | | 345.0729 | (272) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 2.4400 | (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 | 3926.7544 | 1.5821 | 6212.6854 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 1676.2771 | 1.5234 | 2553.6517 | (278) |
| Space and water heating | | | 8766.3371 | (279) |
| Pumps, fans and electric keep-hot | 41.0000 | 1.5128 | 62.0248 | (281) |
| Energy for lighting | 265.7250 | 1.5338 | 407.5779 | (282) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -1800.5231 | 1.5062 | -2711.8908 | |
| PV Unit electricity exported | -2471.7588 | 0.4563 | -1127.7431 | |
| Total | | | -3839.6340 | (283) |
| Total Primary energy kWh/year | | | 5396.3059 | (286) |
| Dwelling Primary energy Rate (DPER) | | | 38.1100 | (287) |

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

1. Overall dwelling characteristics

| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 57.8000 (1b) | x | 2.6500 (2b) | = | 153.1700 | (1b) - (3b) |
| First floor | 57.8000 (1c) | x | 2.6500 (2c) | = | 153.1700 | (1c) - (3c) |
| Second floor | 26.0000 (1d) | x | 1.8000 (2d) | = | 46.8000 | (1d) - (3d) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 141.6000 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = | 353.1400 | (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) = | 0.1133 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3633 | (18) |
| Number of sides sheltered | | 2 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.8500 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.3088 | (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 | 0.3937 | 0.3860 | 0.3783 | 0.3397 | 0.3319 | 0.2933 | 0.2933 | 0.2856 | 0.3088 | 0.3319 | 0.3474 | 0.3628 | (22b) |
| Effective ac | 0.5775 | 0.5745 | 0.5715 | 0.5577 | 0.5551 | 0.5430 | 0.5430 | 0.5408 | 0.5477 | 0.5551 | 0.5603 | 0.5658 | (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 Semi-glazed door | | | 2.0000 | 1.0000 | 2.0000 | | | (26a) |
| TER Opening Type | | | 31.1200 | 1.1450 | 35.6336 | | | (27) |
| TER Roof Light | | | 2.2800 | 1.5918 | 4.2222 | | | (27a) |
| Heatloss Floor 1 | | | 57.8000 | 0.1300 | 7.5140 | | | (28a) |
| External Wall 1 | 141.5600 | 33.1200 | 108.4400 | 0.1800 | 19.5192 | | | (29a) |
| External Roof 1 | 106.6100 | 2.2800 | 104.3300 | 0.1100 | 11.4763 | | | (30) |
| Total net area of external elements Aum(A, m2) | | | 305.9700 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | | (26)...(30) + (32) = | 80.3653 | | | (33) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 194.9102 (35)

List of Thermal Bridges

| K1 Element | Length | Psi-value | Total |
|---|---|---|---|
| E2 Other lintels (including other steel lintels) | 16.6800 | 0.0500 | 0.8340 |
| E3 Sill | 21.6900 | 0.0500 | 1.0845 |
| E4 Jamb | 55.6400 | 0.0500 | 2.7820 |
| E5 Ground floor (normal) | 21.5300 | 0.1600 | 3.4448 |
| E6 Intermediate floor within a dwelling | 21.5300 | 0.0000 | 0.0000 |
| E11 Eaves (insulation at rafter level) | 11.3900 | 0.0400 | 0.4556 |
| E13 Gable (insulation at rafter level) | 9.9700 | 0.0800 | 0.7976 |
| E16 Corner (normal) | 15.9000 | 0.0900 | 1.4310 |
| E18 Party wall between dwellings | 15.9000 | 0.0600 | 0.9540 |
| P1 Party wall - Ground floor | 11.3900 | 0.0800 | 0.9112 |
| P2 Party wall - Intermediate floor within a dwelling | 11.3900 | 0.0000 | 0.0000 |
| P5 Party wall - Roof (insulation at rafter level) | 11.3900 | 0.0800 | 0.9112 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 13.6059 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 93.9712 (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 | 67.2993 | 66.9486 | 66.6049 | 64.9903 | 64.6882 | 63.2820 | 63.2820 | 63.0216 | 63.8236 | 64.6882 | 65.2993 | 65.9382 | (38) |
| Heat transfer coeff | 161.2705 | 160.9198 | 160.5761 | 158.9615 | 158.6594 | 157.2532 | 157.2532 | 156.9928 | 157.7949 | 158.6594 | 159.2705 | 159.9094 | (39) |

Average = Sum(39)m / 12 = 158.9601

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.1389 | 1.1364 | 1.1340 | 1.1226 | 1.1205 | 1.1105 | 1.1105 | 1.1087 | 1.1144 | 1.1205 | 1.1248 | 1.1293 | (40) |
| HLP (average) | | | | | | | | | | | | 1.1226 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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

Assumed occupancy 2.9201 (42)

Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 84.4179 | 83.1642 | 81.3987 | 78.1434 | 75.7059 | 73.0031 | 71.5432 | 73.2963 | 75.2052 | 78.0973 | 81.4196 | 84.1325 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 44.5344 | 42.9150 | 41.2956 | 39.6761 | 38.0567 | 36.4373 | 36.4373 | 38.0567 | 39.6761 | 41.2956 | 42.9150 | 44.5344 | (42c) |

Average daily hot water use (litres/day) 118.7546 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 128.9523 | 126.0792 | 122.6942 | 117.8195 | 113.7626 | 109.4403 | 107.9804 | 111.3530 | 114.8813 | 119.3928 | 124.3346 | 128.6670 | (44) |
| Energy conte | 204.2290 | 179.5351 | 188.5765 | 161.2891 | 153.1463 | 134.5697 | 130.5930 | 137.8783 | 141.6601 | 162.0150 | 177.1374 | 201.4614 | (45) |

Energy content (annual) Total = Sum(45)m = 1972.0907

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 30.6343 | 26.9303 | 28.2865 | 24.1934 | 22.9719 | 20.1854 | 19.5889 | 20.6817 | 21.2490 | 24.3022 | 26.5706 | 30.2192 | (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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 250.8239 | 221.6208 | 235.1714 | 206.3809 | 199.7412 | 179.6615 | 177.1879 | 184.4732 | 186.7520 | 208.6099 | 222.2293 | 248.0563 | (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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 250.8239 | 221.6208 | 235.1714 | 206.3809 | 199.7412 | 179.6615 | 177.1879 | 184.4732 | 186.7520 | 208.6099 | 222.2293 | 248.0563 | (64) |

Total per year (kWh/year) = Sum(64)m = 2520.7081 (64)

12Total per year (kWh/year) 2521 (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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 105.1821 | 93.3640 | 99.9776 | 89.7021 | 88.1971 | 80.8179 | 80.6981 | 83.1205 | 83.1755 | 91.1459 | 94.9717 | 104.2618 | (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 | 146.0035 | 146.0035 | 146.0035 | 146.0035 | 146.0035 | 146.0035 | 146.0035 | 146.0035 | 146.0035 | 146.0035 | 146.0035 | 146.0035 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 156.9767 | 173.7957 | 156.9767 | 162.2093 | 156.9767 | 162.2093 | 156.9767 | 156.9767 | 162.2093 | 156.9767 | 162.2093 | 156.9767 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 311.2240 | 314.4535 | 306.3152 | 288.9897 | 267.1193 | 246.5643 | 232.8323 | 229.6027 | 237.7411 | 255.0666 | 276.9369 | 297.4919 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 37.6003 | 37.6003 | 37.6003 | 37.6003 | 37.6003 | 37.6003 | 37.6003 | 37.6003 | 37.6003 | 37.6003 | 37.6003 | 37.6003 | (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) | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 141.3737 | 138.9345 | 134.3785 | 124.5862 | 118.5444 | 112.2471 | 108.4652 | 111.7210 | 115.5215 | 122.5079 | 131.9051 | 140.1369 (72) |

Total internal gains

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 679.3755 | 696.9847 | 667.4715 | 645.5862 | 612.4416 | 587.8217 | 565.0752 | 565.1016 | 582.2729 | 604.3523 | 640.8523 | 664.4066 (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 | |
|---|---|---|---|---|---|---|---|
| East | 6.5700 | 19.6403 | 0.6300 | 0.7000 | 0.7700 | 39.4352 | (76) |
| South | 2.6600 | 46.7521 | 0.6300 | 0.7000 | 0.7700 | 38.0062 | (78) |
| West | 21.8900 | 19.6403 | 0.6300 | 0.7000 | 0.7700 | 131.3908 | (80) |
| South | 2.2800 | 49.1253 | 0.6300 | 0.7000 | 1.0000 | 44.4550 | (82) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 253.2873 | 473.8950 | 738.9136 | 1030.9052 | 1233.6787 | 1252.4714 | 1196.5006 | 1045.6332 | 842.5442 | 550.3083 | 311.6503 | 211.1175 | (83) |
| Total gains | 932.6627 | 1170.8798 | 1406.3851 | 1676.4915 | 1846.1203 | 1840.2931 | 1761.5758 | 1610.7348 | 1424.8171 | 1154.6606 | 952.5026 | 875.5241 | (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 | 47.5379 | 47.6415 | 47.7435 | 48.2285 | 48.3203 | 48.7524 | 48.7524 | 48.8333 | 48.5850 | 48.3203 | 48.1349 | 47.9426 | |
| alpha | 4.1692 | 4.1761 | 4.1829 | 4.2152 | 4.2214 | 4.2502 | 4.2502 | 4.2556 | 4.2390 | 4.2214 | 4.2090 | 4.1962 | |
| util living area | 0.9921 | 0.9798 | 0.9481 | 0.8594 | 0.7089 | 0.5270 | 0.3883 | 0.4401 | 0.6879 | 0.9213 | 0.9834 | 0.9939 | (86) |
| MIT | 19.3753 | 19.6726 | 20.0847 | 20.5548 | 20.8461 | 20.9661 | 20.9926 | 20.9877 | 20.8996 | 20.4590 | 19.8226 | 19.3273 | (87) |
| Th 2 | 19.9692 | 19.9712 | 19.9732 | 19.9824 | 19.9841 | 19.9922 | 19.9922 | 19.9937 | 19.9891 | 19.9841 | 19.9806 | 19.9770 | (88) |
| util rest of house | 0.9901 | 0.9747 | 0.9353 | 0.8277 | 0.6531 | 0.4514 | 0.3015 | 0.3476 | 0.6107 | 0.8955 | 0.9784 | 0.9923 | (89) |
| MIT 2 | 18.0782 | 18.4562 | 18.9720 | 19.5398 | 19.8555 | 19.9717 | 19.9895 | 19.9887 | 19.9190 | 19.4456 | 18.6563 | 18.0222 | (90) |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.1723 | (91) |
| MIT | 18.3017 | 18.6658 | 19.1637 | 19.7147 | 20.0262 | 20.1431 | 20.1623 | 20.1608 | 20.0880 | 19.6202 | 18.8572 | 18.2471 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 18.3017 | 18.6658 | 19.1637 | 19.7147 | 20.0262 | 20.1431 | 20.1623 | 20.1608 | 20.0880 | 19.6202 | 18.8572 | 18.2471 | (93) |

---

8. Space heating requirement

---

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9851 | 0.9659 | 0.9226 | 0.8183 | 0.6556 | 0.4630 | 0.3163 | 0.3633 | 0.6188 | 0.8842 | 0.9706 | 0.9882 | (94) |
| Useful gains | 918.8004 | 1130.8956 | 1297.5225 | 1371.8109 | 1210.2489 | 852.1260 | 557.2476 | 585.1734 | 881.7363 | 1020.9307 | 924.4722 | 865.1970 | (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 | 2258.0604 | 2215.1958 | 2033.4928 | 1719.1217 | 1321.0273 | 871.6678 | 560.1882 | 590.4249 | 944.8773 | 1431.1435 | 1872.5830 | 2246.2645 | (97) |
| Space heating kWh | 996.4094 | 728.6497 | 547.5619 | 250.0638 | 82.4191 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 305.1983 | 682.6398 | 1027.5142 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 4620.4563 | |
| 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 | 996.4094 | 728.6497 | 547.5619 | 250.0638 | 82.4191 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 305.1983 | 682.6398 | 1027.5142 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 4620.4563 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 32.6303 | (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 | 996.4094 | 728.6497 | 547.5619 | 250.0638 | 82.4191 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 305.1983 | 682.6398 | 1027.5142 | (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) | 1079.5335 | 789.4363 | 593.2415 | 270.9250 | 89.2948 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 330.6591 | 739.5881 | 1113.2332 | (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 | 250.8239 | 221.6208 | 235.1714 | 206.3809 | 199.7412 | 179.6615 | 177.1879 | 184.4732 | 186.7520 | 208.6099 | 222.2293 | 248.0563 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 | (216) |
| (217)m | 86.8306 | 86.5242 | 85.8896 | 84.4914 | 82.2345 | 79.8000 | 79.8000 | 79.8000 | 79.8000 | 84.9119 | 86.4067 | 86.8942 | (217) |
| Fuel for water heating, kWh/month | 288.8658 | 256.1375 | 273.8066 | 244.2625 | 242.8921 | 225.1397 | 222.0399 | 231.1694 | 234.0250 | 245.6781 | 257.1899 | 285.4693 | (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 | 32.6167 | 26.1663 | 23.5599 | 17.2610 | 13.3329 | 10.8931 | 12.1627 | 15.8095 | 20.5350 | 26.9430 | 30.4321 | 33.5232 | (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233a)m | -53.3185 | -74.7876 | -106.9362 | -119.5334 | -128.2258 | -119.3413 | -117.7476 | -111.4114 | -100.2433 | -85.0601 | -58.4339 | -46.1318 | (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 | -31.3121 | -65.7268 | -130.4132 | -195.5939 | -258.4183 | -259.6725 | -256.7322 | -217.5735 | -159.6593 | -94.0434 | -41.8119 | -24.7818 | (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 | 5005.9115 | (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 | 3006.6759 | (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) | 263.2352 | (232) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -2856.9098 | (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 | 5504.9128 | (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 | 5005.9115 | 0.2100 | 1051.2414 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 3006.6759 | 0.2100 | 631.4019 | (264) |
| Space and water heating | | | 1682.6434 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 263.2352 | 0.1443 | 37.9930 | (268) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -1121.1710 | 0.1347 | -151.0471 | |
| PV Unit electricity exported | -1735.7388 | 0.1259 | -218.5771 | |
| Total | | | -369.6243 | (269) |
| Total CO2, kg/year | | | 1362.9413 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 9.6300 | (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 | 5005.9115 | 1.1300 | 5656.6800 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 3006.6759 | 1.1300 | 3397.5438 | (278) |
| Space and water heating | | | 9054.2238 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 263.2352 | 1.5338 | 403.7589 | (282) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -1121.1710 | 1.4979 | -1679.4244 | |
| PV Unit electricity exported | -1735.7388 | 0.4622 | -802.3292 | |
| Total | | | -2481.7537 | (283) |
| Total Primary energy kWh/year | | | 7106.3298 | (286) |
| Target Primary Energy Rate (TPER) | | | 50.1900 | (287) |

| | | | | |
|---|---|---|---|---|
| E11 Eaves (insulation at rafter level) | 11.3900 | 0.0200 | 0.2278 | |
| E13 Gable (insulation at rafter level) | 9.9700 | 0.0420 | 0.4187 | |
| E16 Corner (normal) | 15.9000 | 0.0390 | 0.6201 | |
| E18 Party wall between dwellings | 15.9000 | 0.0420 | 0.6678 | |
| P1 Party wall - Ground floor | 11.3900 | 0.0430 | 0.4898 | |
| P2 Party wall - Intermediate floor within a dwelling | 11.3900 | 0.0000 | 0.0000 | |
| P5 Party wall - Roof (insulation at rafter level) | 11.3900 | 0.0380 | 0.4328 | |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 6.4668 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 91.5081 (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 | 67.2993 | 66.9486 | 66.6049 | 64.9903 | 64.6882 | 63.2820 | 63.2820 | 63.0216 | 63.8236 | 64.6882 | 65.2993 | 65.9382 | (38) |

Heat transfer coeff

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 158.8074 | 158.4567 | 158.1130 | 156.4984 | 156.1963 | 154.7901 | 154.7901 | 154.5297 | 155.3317 | 156.1963 | 156.8074 | 157.4463 | (39) |

Average = Sum(39)m / 12 = 156.4970

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.1215 | 1.1190 | 1.1166 | 1.1052 | 1.1031 | 1.0932 | 1.0932 | 1.0913 | 1.0970 | 1.1031 | 1.1074 | 1.1119 | (40) |
| HLP (average) | | | | | | | | | | | | 1.1052 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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

Assumed occupancy 2.9201 (42)

Hot water usage for mixer showers

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 84.4179 | 83.1642 | 81.3987 | 78.1434 | 75.7059 | 73.0031 | 71.5432 | 73.2963 | 75.2052 | 78.0973 | 81.4196 | 84.1325 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 44.5344 | 42.9150 | 41.2956 | 39.6761 | 38.0567 | 36.4373 | 36.4373 | 38.0567 | 39.6761 | 41.2956 | 42.9150 | 44.5344 | (42c) |

Average daily hot water use (litres/day) 118.7546 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | | | | | | | | | | | | | |
| | 128.9523 | 126.0792 | 122.6942 | 117.8195 | 113.7626 | 109.4403 | 107.9804 | 111.3530 | 114.8813 | 119.3928 | 124.3346 | 128.6670 | (44) |
| Energy conte | 204.2290 | 179.5351 | 188.5765 | 161.2891 | 153.1463 | 134.5697 | 130.5930 | 137.8783 | 141.6601 | 162.0150 | 177.1374 | 201.4614 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1972.0907 | |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (46) |
| Water storage loss: | | | | | | | | | | | | | |
| Total storage 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 | (56) |
| If cylinder contains dedicated solar storage | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (57) |
| Primary 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 | (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 | | | | | | | | | | | | | |
| | 173.5946 | 152.6048 | 160.2900 | 137.0957 | 130.1744 | 114.3842 | 111.0040 | 117.1965 | 120.4111 | 137.7127 | 150.5668 | 171.2422 | (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 | | | | | | | | | | | | | |
| | 173.5946 | 152.6048 | 160.2900 | 137.0957 | 130.1744 | 114.3842 | 111.0040 | 117.1965 | 120.4111 | 137.7127 | 150.5668 | 171.2422 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 1676.2771 | (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 | | | | | | | | | | | | | |
| | 43.3987 | 38.1512 | 40.0725 | 34.2739 | 32.5436 | 28.5961 | 27.7510 | 29.2991 | 30.1028 | 34.4282 | 37.6417 | 42.8105 | (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 | 175.2042 | 175.2042 | 175.2042 | 175.2042 | 175.2042 | 175.2042 | 175.2042 | 175.2042 | 175.2042 | 175.2042 | 175.2042 | 175.2042 | (66) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 37.6161 | 33.4103 | 27.1711 | 20.5703 | 15.3765 | 12.9815 | 14.0270 | 18.2328 | 24.4720 | 31.0728 | 36.2666 | 38.6616 | (67) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 464.5134 | 469.3336 | 457.1868 | 431.3279 | 398.6856 | 368.0064 | 347.5109 | 342.6907 | 354.8374 | 380.6964 | 413.3387 | 444.0178 | (68) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 55.4405 | 55.4405 | 55.4405 | 55.4405 | 55.4405 | 55.4405 | 55.4405 | 55.4405 | 55.4405 | 55.4405 | 55.4405 | 55.4405 | (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)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 58.3315 | 56.7726 | 53.8609 | 47.6027 | 43.7414 | 39.7167 | 37.2997 | 39.3806 | 41.8094 | 46.2744 | 52.2801 | 57.5410 | (72) |

Total internal gains

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 677.3029 | 676.3584 | 655.0607 | 616.3427 | 574.6453 | 534.5465 | 512.6794 | 514.1459 | 534.9607 | 574.8855 | 618.7273 | 657.0623 | (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 | |
|---|---|---|---|---|---|---|---|
| East | 6.9000 | 19.6403 | 0.6000 | 0.0000 | 0.7700 | 62.6092 | (76) |
| South | 2.8000 | 46.7521 | 0.6000 | 0.0000 | 0.7700 | 60.4785 | (78) |
| West | 23.0000 | 19.6403 | 0.6000 | 0.0000 | 0.7700 | 208.6974 | (80) |
| South | 2.4000 | 49.1253 | 0.6000 | 0.0000 | 1.0000 | 70.7404 | (82) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 402.5256 | 753.0720 | 1174.1259 | 1637.9904 | 1960.1031 | 1989.9359 | 1901.0192 | 1661.3627 | 1338.7553 | 874.4751 | 495.2678 | 335.5150 | (83) |
| Total gains | 1079.8285 | 1429.4303 | 1829.1866 | 2254.3331 | 2534.7484 | 2524.4824 | 2413.6986 | 2175.5085 | 1873.7160 | 1449.3606 | 1113.9951 | 992.5773 | (84) |

## 7. Mean internal temperature (heating season)

| | 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, nil,m (see Table 9a) | | | | | | | | | | | | | |
| tau | 48.2753 | 48.3821 | 48.4873 | 48.9875 | 49.0823 | 49.5282 | 49.5282 | 49.6116 | 49.3555 | 49.0823 | 48.8910 | 48.6926 | |
| alpha | 4.2184 | 4.2255 | 4.2325 | 4.2658 | 4.2722 | 4.3019 | 4.3019 | 4.3074 | 4.2904 | 4.2722 | 4.2594 | 4.2462 | |
| util living area | 0.9865 | 0.9600 | 0.8879 | 0.7337 | 0.5491 | 0.3881 | 0.2813 | 0.3250 | 0.5485 | 0.8535 | 0.9711 | 0.9902 | (86) |
| MIT | 19.5361 | 19.9119 | 20.3826 | 20.7780 | 20.9438 | 20.9899 | 20.9980 | 20.9964 | 20.9591 | 20.6411 | 19.9841 | 19.4632 | (87) |
| Th 2 | 19.9833 | 19.9853 | 19.9873 | 19.9966 | 19.9983 | 20.0064 | 20.0064 | 20.0079 | 20.0033 | 19.9983 | 19.9948 | 19.9911 | (88) |
| util rest of house | 0.9831 | 0.9509 | 0.8654 | 0.6925 | 0.4967 | 0.3296 | 0.2182 | 0.2557 | 0.4775 | 0.8155 | 0.9629 | 0.9877 | (89) |
| MIT 2 | 18.2916 | 18.7640 | 19.3360 | 19.7881 | 19.9541 | 20.0006 | 20.0057 | 20.0065 | 19.9767 | 19.6583 | 18.8675 | 18.2047 | (90) |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.1723 | (91) |
| MIT | 18.5061 | 18.9618 | 19.5163 | 19.9587 | 20.1247 | 20.1711 | 20.1767 | 20.1771 | 20.1460 | 19.8276 | 19.0599 | 18.4216 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 18.5061 | 18.9618 | 19.5163 | 19.9587 | 20.1247 | 20.1711 | 20.1767 | 20.1771 | 20.1460 | 19.8276 | 19.0599 | 18.4216 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9762 | 0.9391 | 0.8533 | 0.6909 | 0.5035 | 0.3394 | 0.2291 | 0.2676 | 0.4880 | 0.8081 | 0.9528 | 0.9822 | (94) |
| Useful gains | 1054.1215 | 1342.3446 | 1560.9063 | 1557.4384 | 1276.1989 | 856.7451 | 552.8826 | 582.1963 | 914.3040 | 1171.1752 | 1061.4071 | 974.8646 | (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 | 2256.0291 | 2228.1825 | 2058.0536 | 1730.6718 | 1315.9025 | 862.3539 | 553.6401 | 583.6743 | 939.1370 | 1441.3201 | 1875.4034 | 2239.1336 | (97) |
| Space heating kWh | 894.2193 | 595.2830 | 369.8776 | 124.7280 | 29.5395 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 200.9878 | 586.0774 | 940.6161 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 3741.3287 | |
| 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 | 894.2193 | 595.2830 | 369.8776 | 124.7280 | 29.5395 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 200.9878 | 586.0774 | 940.6161 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 3741.3287 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 26.4218 | (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 %) | 100.0000 | (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 | 894.2193 | 595.2830 | 369.8776 | 124.7280 | 29.5395 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 200.9878 | 586.0774 | 940.6161 | (98) |
| Space heating efficiency (main heating system 1) | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 100.0000 | 100.0000 | 100.0000 | (210) |
| Space heating fuel (main heating system) | 894.2193 | 595.2830 | 369.8776 | 124.7280 | 29.5395 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 200.9878 | 586.0774 | 940.6161 | (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 | 173.5946 | 152.6048 | 160.2900 | 137.0957 | 130.1744 | 114.3842 | 111.0040 | 117.1965 | 120.4111 | 137.7127 | 150.5668 | 171.2422 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 100.0000 | (216) |
| (217)m | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 | (217) |
| Fuel for water heating, kWh/month | 173.5946 | 152.6048 | 160.2900 | 137.0957 | 130.1744 | 114.3842 | 111.0040 | 117.1965 | 120.4111 | 137.7127 | 150.5668 | 171.2422 | (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 | 3.4822 | 3.1452 | 3.4822 | 3.3699 | 3.4822 | 3.3699 | 3.4822 | 3.4822 | 3.3699 | 3.4822 | 3.3699 | 3.4822 | (231) |
| Lighting | 32.9252 | 26.4138 | 23.7827 | 17.4242 | 13.4590 | 10.9961 | 12.2777 | 15.9591 | 20.7292 | 27.1979 | 30.7199 | 33.8403 | (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233a)m | -102.7221 | -143.0782 | -192.1989 | -190.5194 | -186.5276 | -166.1596 | -163.7186 | -157.8217 | -145.2887 | -146.1597 | -111.1184 | -89.2850 | (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 | -37.1865 | -82.4413 | -173.0307 | -275.2925 | -371.1122 | -375.4516 | -373.4905 | -322.9132 | -247.8422 | -136.7929 | -53.2118 | -28.9185 | (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 | 3741.3287 | (211) |
| Space heating fuel - main system 2 | 0.0000 | (213) |
| Space heating fuel - secondary | 0.0000 | (215) |
| Efficiency of water heater | 100.0000 | |
| Water heating fuel used | 1676.2771 | (219) |
| Space cooling fuel | 0.0000 | (221) |
| Electricity for pumps and fans: | | |
| central heating pump | 41.0000 | (230c) |
| Total electricity for the above, kWh/year | 41.0000 | (231) |
| Electricity for lighting (calculated in Appendix L) | 265.7250 | (232) |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -4272.2819 | (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 | 1452.0489 | (238) |

10a. Fuel costs - using Table 12 prices

| | Fuel kWh/year | Fuel price p/kWh | Fuel cost £/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 3741.3287 | 16.4900 | 616.9451 | (240) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 1676.2771 | 16.4900 | 276.4181 | (247) |
| Energy for instantaneous electric shower(s) | 0.0000 | 16.4900 | 0.0000 | (247a) |
| Pumps, fans and electric keep-hot | 41.0000 | 16.4900 | 6.7609 | (249) |
| Energy for lighting | 265.7250 | 16.4900 | 43.8181 | (250) |
| Additional standing charges | | | 0.0000 | (251) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -1794.5980 | 16.4900 | -295.9292 | |
| PV Unit electricity exported | -2477.6840 | 5.5900 | -138.5025 | |
| Total | | | -434.4317 | (252) |
| Total energy cost | | | 509.5104 | (255) |

11a. SAP rating - Individual heating systems

| | | |
|---|---|---|
| Energy cost deflator (Table 12): | 0.3600 | (256) |
| Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] = | 0.9830 | (257) |
| SAP value | 84.0659 | |
| SAP rating (Section 12) | 84 | (258) |
| SAP band | B | |

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 | 3741.3287 | 0.1573 | 588.4821 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 1676.2771 | 0.1415 | 237.2655 | (264) |
| Space and water heating | | | 825.7476 | (265) |
| Pumps, fans and electric keep-hot | 41.0000 | 0.1387 | 5.6872 | (267) |
| Energy for lighting | 265.7250 | 0.1443 | 38.3523 | (268) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -1794.5980 | 0.1369 | -245.6318 | |
| PV Unit electricity exported | -2477.6840 | 0.1244 | -308.2457 | |
| Total | | | -553.8775 | (269) |
| Total CO2, kg/year | | | 315.9096 | (272) |
| CO2 emissions per m2 | | | 2.2300 | (273) |
| EI value | | | 97.7314 | |
| EI rating | | | 98 | (274) |
| EI band | | | A | |

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY

1. Overall dwelling characteristics

| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 57.8000 (1b) | x | 2.6500 (2b) | = | 153.1700 | (1b) - (3b) |
| First floor | 57.8000 (1c) | x | 2.6500 (2c) | = | 153.1700 | (1c) - (3c) |
| Second floor | 26.0000 (1d) | x | 1.8000 (2d) | = | 46.8000 | (1d) - (3d) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 141.6000 | | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | | 353.1400 | (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) = | 0.1133 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3633 | (18) |
| Number of sides sheltered | | 2 | (19) |

Shelter factor (20) = 1 - [0.075 x (19)] = 0.8500 (20)
Infiltration rate adjusted to include shelter factor (21) = (18) x (20) = 0.3088 (21)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 4.0000 | 3.8000 | 3.8000 | 3.5000 | 3.6000 | 3.3000 | 3.5000 | 3.3000 | 3.2000 | 3.5000 | 3.4000 | 3.8000 | (22) |
| Wind factor | 1.0000 | 0.9500 | 0.9500 | 0.8750 | 0.9000 | 0.8250 | 0.8750 | 0.8250 | 0.8000 | 0.8750 | 0.8500 | 0.9500 | (22a) |
| Adj infilt rate | 0.3088 | 0.2933 | 0.2933 | 0.2702 | 0.2779 | 0.2547 | 0.2702 | 0.2547 | 0.2470 | 0.2702 | 0.2625 | 0.2933 | (22b) |
| Effective ac | 0.5477 | 0.5430 | 0.5430 | 0.5365 | 0.5386 | 0.5324 | 0.5365 | 0.5324 | 0.5305 | 0.5365 | 0.5344 | 0.5430 | (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 | | | | | | | | |
| Window | | | 32.7000 | 1.1450 | 37.4427 | | | (27) |
| External Door | | | 2.0000 | 1.2000 | 2.4000 | | | (26a) |
| Rooflight | | | 2.4000 | 1.1450 | 3.3962 | | | (27a) |
| Heatloss Floor 1 | | | 57.8000 | 0.1200 | 6.9360 | 110.0000 | 6358.0000 | (28a) |
| External Wall 1 | 141.5600 | 34.7000 | 106.8600 | 0.1800 | 19.2348 | 190.0000 | 20303.4000 | (29a) |
| External Roof 1 | 106.6100 | 2.4000 | 104.2100 | 0.1500 | 15.6315 | 9.0000 | 937.8900 | (30) |
| Total net area of external elements Aum(A, m2) | | | 305.9700 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 85.0413 | | | (33) |

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 27599.2900 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 194.9102 (35)
List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E2 Other lintels (including other steel lintels) | 16.6800 | 0.0310 | 0.5171 |
| E3 Sill | 21.6900 | 0.0280 | 0.6073 |
| E4 Jamb | 55.6400 | 0.0230 | 1.2797 |
| E5 Ground floor (normal) | 21.5300 | 0.0550 | 1.1842 |
| E6 Intermediate floor within a dwelling | 21.5300 | 0.0010 | 0.0215 |
| E11 Eaves (insulation at rafter level) | 11.3900 | 0.0200 | 0.2278 |
| E13 Gable (insulation at rafter level) | 9.9700 | 0.0420 | 0.4187 |
| E16 Corner (normal) | 15.9000 | 0.0390 | 0.6201 |
| E18 Party wall between dwellings | 15.9000 | 0.0420 | 0.6678 |
| P1 Party wall - Ground floor | 11.3900 | 0.0430 | 0.4898 |
| P2 Party wall - Intermediate floor within a dwelling | 11.3900 | 0.0000 | 0.0000 |
| P5 Party wall - Roof (insulation at rafter level) | 11.3900 | 0.0380 | 0.4328 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 6.4668 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 91.5081 (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 | 63.8236 | 63.2820 | 63.2820 | 62.5216 | 62.7681 | 62.0493 | 62.5216 | 62.0493 | 61.8236 | 62.5216 | 62.2820 | 63.2820 | (38) |
| Heat transfer coeff | 155.3317 | 154.7901 | 154.7901 | 154.0297 | 154.2762 | 153.5574 | 154.0297 | 153.5574 | 153.3318 | 154.0297 | 153.7901 | 154.7901 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 154.1920 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.0970 | 1.0932 | 1.0932 | 1.0878 | 1.0895 | 1.0844 | 1.0878 | 1.0844 | 1.0829 | 1.0878 | 1.0861 | 1.0932 | (40) |
| HLP (average) | | | | | | | | | | | | 1.0889 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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

Assumed occupancy 2.9201 (42)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hot water usage for mixer showers | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (42a) |
| Hot water usage for baths | 84.4179 | 83.1642 | 81.3987 | 78.1434 | 75.7059 | 73.0031 | 71.5432 | 73.2963 | 75.2052 | 78.0973 | 81.4196 | 84.1325 | (42b) |
| Hot water usage for other uses | 44.5344 | 42.9150 | 41.2956 | 39.6761 | 38.0567 | 36.4373 | 36.4373 | 38.0567 | 39.6761 | 41.2956 | 42.9150 | 44.5344 | (42c) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 118.7546 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 128.9523 | 126.0792 | 122.6942 | 117.8195 | 113.7626 | 109.4403 | 107.9804 | 111.3530 | 114.8813 | 119.3928 | 124.3346 | 128.6670 | (44) |
| Energy conte | 204.2290 | 179.5351 | 188.5765 | 161.2891 | 153.1463 | 134.5697 | 130.5930 | 137.8783 | 141.6601 | 162.0150 | 177.1374 | 201.4614 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1972.0907 | |
| Distribution loss (46)m = 0.15 x (45)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (46) |
| Water storage loss: | | | | | | | | | | | | | |
| Total storage 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 | (56) |
| If cylinder contains dedicated solar storage | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (57) |
| Primary 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 | (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 | 173.5946 | 152.6048 | 160.2900 | 137.0957 | 130.1744 | 114.3842 | 111.0040 | 117.1965 | 120.4111 | 137.7127 | 150.5668 | 171.2422 | (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 | 173.5946 | 152.6048 | 160.2900 | 137.0957 | 130.1744 | 114.3842 | 111.0040 | 117.1965 | 120.4111 | 137.7127 | 150.5668 | 171.2422 | (64) |
| | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | | 1676.2771 | (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 | 43.3987 | 38.1512 | 40.0725 | 34.2739 | 32.5436 | 28.5961 | 27.7510 | 29.2991 | 30.1028 | 34.4282 | 37.6417 | 42.8105 | (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 | 175.2042 | 175.2042 | 175.2042 | 175.2042 | 175.2042 | 175.2042 | 175.2042 | 175.2042 | 175.2042 | 175.2042 | 175.2042 | 175.2042 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 37.6161 | 33.4103 | 27.1711 | 20.5703 | 15.3765 | 12.9815 | 14.0270 | 18.2328 | 24.4720 | 31.0728 | 36.2666 | 38.6616 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 464.5134 | 469.3336 | 457.1868 | 431.3279 | 398.6856 | 368.0064 | 347.5109 | 342.6907 | 354.8374 | 380.6964 | 413.3387 | 444.0178 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 55.4405 | 55.4405 | 55.4405 | 55.4405 | 55.4405 | 55.4405 | 55.4405 | 55.4405 | 55.4405 | 55.4405 | 55.4405 | 55.4405 | (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) | | | | | | | | | | | | | |
| | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 58.3315 | 56.7726 | 53.8609 | 47.6027 | 43.7414 | 39.7167 | 37.2997 | 39.3806 | 41.8094 | 46.2744 | 52.2801 | 57.5410 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 677.3029 | 676.3584 | 655.0607 | 616.3427 | 574.6453 | 534.5465 | 512.6794 | 514.1459 | 534.9607 | 574.8855 | 618.7273 | 657.0623 | (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 | |
|---|---|---|---|---|---|---|---|
| East | 6.9000 | 23.0580 | 0.6000 | 0.0000 | 0.7700 | 73.5042 | (76) |
| South | 2.8000 | 52.5273 | 0.6000 | 0.0000 | 0.7700 | 67.9493 | (78) |
| West | 23.0000 | 23.0580 | 0.6000 | 0.0000 | 0.7700 | 245.0139 | (80) |
| South | 2.4000 | 56.0148 | 0.6000 | 0.0000 | 1.0000 | 80.6613 | (82) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 467.1287 | 747.8690 | 1184.9994 | 1697.0190 | 1976.1393 | 2146.2004 | 2028.6194 | 1803.8159 | 1449.7335 | 957.1740 | 555.3278 | 373.0829 | (83) |
| Total gains | 1144.4316 | 1424.2273 | 1840.0601 | 2313.3616 | 2550.7846 | 2680.7470 | 2541.2988 | 2317.9618 | 1984.6942 | 1532.0595 | 1174.0551 | 1030.1453 | (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 | 49.3555 | 49.5282 | 49.5282 | 49.7727 | 49.6931 | 49.9257 | 49.7727 | 49.9257 | 49.9992 | 49.7727 | 49.8502 | 49.5282 | |
| alpha | 4.2904 | 4.3019 | 4.3019 | 4.3182 | 4.3129 | 4.3284 | 4.3182 | 4.3284 | 4.3333 | 4.3182 | 4.3233 | 4.3019 | |
| util living area | | | | | | | | | | | | | |
| | 0.9785 | 0.9500 | 0.8539 | 0.6557 | 0.4508 | 0.2629 | 0.1575 | 0.1854 | 0.4189 | 0.7693 | 0.9527 | 0.9852 | (86) |
| MIT | 19.7910 | 20.0862 | 20.5475 | 20.8780 | 20.9791 | 20.9985 | 20.9999 | 20.9998 | 20.9888 | 20.8070 | 20.2239 | 19.7004 | (87) |
| Th 2 | 20.0033 | 20.0064 | 20.0064 | 20.0108 | 20.0094 | 20.0136 | 20.0108 | 20.0136 | 20.0149 | 20.0108 | 20.0122 | 20.0064 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9730 | 0.9383 | 0.8252 | 0.6080 | 0.3951 | 0.2068 | 0.0976 | 0.1201 | 0.3464 | 0.7153 | 0.9390 | 0.9812 | (89) |
| MIT 2 | 18.6287 | 18.9971 | 19.5459 | 19.9044 | 19.9953 | 20.0130 | 20.0108 | 20.0135 | 20.0092 | 19.8463 | 19.1785 | 18.5171 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.1723 | (91) |
| MIT | 18.8290 | 19.1848 | 19.7185 | 20.0722 | 20.1648 | 20.1828 | 20.1812 | 20.1835 | 20.1780 | 20.0118 | 19.3586 | 18.7210 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 18.8290 | 19.1848 | 19.7185 | 20.0722 | 20.1648 | 20.1828 | 20.1812 | 20.1835 | 20.1780 | 20.0118 | 19.3586 | 18.7210 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9641 | 0.9262 | 0.8158 | 0.6111 | 0.4040 | 0.2165 | 0.1080 | 0.1314 | 0.3586 | 0.7154 | 0.9275 | 0.9741 | (94) |
| Useful gains | 1103.4033 | 1319.0570 | 1501.1376 | 1413.7016 | 1030.4712 | 580.2701 | 274.3487 | 304.5366 | 711.6995 | 1096.0505 | 1088.9777 | 1003.4268 | (95) |
| Ext temp. | 5.4000 | 5.9000 | 7.7000 | 10.3000 | 13.4000 | 16.4000 | 18.4000 | 18.2000 | 15.5000 | 12.0000 | 8.3000 | 5.4000 | (96) |
| Heat loss rate W | | | | | | | | | | | | | |
| | 2085.9468 | 2056.3562 | 1860.3476 | 1505.2095 | 1043.6510 | 580.8773 | 274.3651 | 304.5771 | 717.2909 | 1234.0601 | 1700.7071 | 2061.9648 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 731.0124 | 495.4651 | 267.2522 | 65.8857 | 9.8057 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 102.6791 | 440.4452 | 787.5523 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 2900.0977 | |
| 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 | | | | | | | | | | | | | |
| | 731.0124 | 495.4651 | 267.2522 | 65.8857 | 9.8057 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 102.6791 | 440.4452 | 787.5523 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 2900.0977 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 20.4809 | (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 %) | | | | | | | | | | | | 100.0000 | (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 | | | | | | | | | | | | | |
| | 731.0124 | 495.4651 | 267.2522 | 65.8857 | 9.8057 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 102.6791 | 440.4452 | 787.5523 | (98) |
| Space heating efficiency (main heating system 1) | | | | | | | | | | | | | |
| | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 100.0000 | 100.0000 | 100.0000 | (210) |
| Space heating fuel (main heating system) | | | | | | | | | | | | | |
| | 731.0124 | 495.4651 | 267.2522 | 65.8857 | 9.8057 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 102.6791 | 440.4452 | 787.5523 | (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 | | | | | | | | | | | | | |
| | 173.5946 | 152.6048 | 160.2900 | 137.0957 | 130.1744 | 114.3842 | 111.0040 | 117.1965 | 120.4111 | 137.7127 | 150.5668 | 171.2422 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 100.0000 | (216) |
| (217)m | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 | (217) |
| Fuel for water heating, kWh/month | | | | | | | | | | | | | |
| | 173.5946 | 152.6048 | 160.2900 | 137.0957 | 130.1744 | 114.3842 | 111.0040 | 117.1965 | 120.4111 | 137.7127 | 150.5668 | 171.2422 | (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 | 3.4822 | 3.1452 | 3.4822 | 3.3699 | 3.4822 | 3.3699 | 3.4822 | 3.4822 | 3.3699 | 3.4822 | 3.3699 | 3.4822 | (231) |
| Lighting | 32.9252 | 26.4138 | 23.7827 | 17.4242 | 13.4590 | 10.9961 | 12.2777 | 15.9591 | 20.7292 | 27.1979 | 30.7199 | 33.8403 | (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233a)m | -112.8476 | -137.9166 | -184.4389 | -184.2574 | -182.4534 | -170.7720 | -167.5264 | -162.8813 | -150.2584 | -145.2294 | -116.8145 | -95.1728 | (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 | -47.5991 | -83.3867 | -180.2111 | -294.4143 | -376.5788 | -410.7493 | -402.8829 | -355.3869 | -271.2747 | -160.8817 | -65.2530 | -34.7322 | (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 | 2900.0977 | (211) |
| Space heating fuel - main system 2 | 0.0000 | (213) |
| Space heating fuel - secondary | 0.0000 | (215) |
| Efficiency of water heater | 100.0000 | |
| Water heating fuel used | 1676.2771 | (219) |
| Space cooling fuel | 0.0000 | (221) |
| | | |
| Electricity for pumps and fans: | | |
| central heating pump | 41.0000 | (230c) |
| Total electricity for the above, kWh/year | 41.0000 | (231) |
| Electricity for lighting (calculated in Appendix L) | 265.7250 | (232) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -4493.9194 | (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 | 389.1805 | (238) |

10a. Fuel costs - using BEDF prices (567)

| | Fuel kWh/year | Fuel price p/kWh | Fuel cost £/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 2900.0977 | 26.0600 | 755.7655 | (240) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 1676.2771 | 26.0600 | 436.8378 | (247) |
| Energy for instantaneous electric shower(s) | 0.0000 | 26.0600 | 0.0000 | (247a) |
| Pumps, fans and electric keep-hot | 41.0000 | 26.0600 | 10.6846 | (249) |
| Energy for lighting | 265.7250 | 26.0600 | 69.2479 | (250) |
| Additional standing charges | | | 0.0000 | (251) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -1810.5687 | 26.0600 | -471.8342 | |
| PV Unit electricity exported | -2683.3506 | 5.8100 | -155.9027 | |
| Total | | | -627.7369 | (252) |
| Total energy cost | | | 644.7989 | (255) |

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 | 2900.0977 | 0.1582 | 458.8776 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 1676.2771 | 0.1415 | 237.2655 | (264) |
| Space and water heating | | | 696.1431 | (265) |
| Pumps, fans and electric keep-hot | 41.0000 | 0.1387 | 5.6872 | (267) |
| Energy for lighting | 265.7250 | 0.1443 | 38.3523 | (268) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -1810.5687 | 0.1368 | -247.6783 | |
| PV Unit electricity exported | -2683.3506 | 0.1244 | -333.9014 | |
| Total | | | -581.5797 | (269) |
| Total CO2, kg/year | | | 158.6030 | (272) |

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 | 2900.0977 | 1.5857 | 4598.6723 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 1676.2771 | 1.5234 | 2553.6517 | (278) |
| Space and water heating | | | 7152.3240 | (279) |
| Pumps, fans and electric keep-hot | 41.0000 | 1.5128 | 62.0248 | (281) |
| Energy for lighting | 265.7250 | 1.5338 | 407.5779 | (282) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -1810.5687 | 1.5057 | -2726.1549 | |
| PV Unit electricity exported | -2683.3506 | 0.4567 | -1225.4593 | |
| Total | | | -3951.6142 | (283) |
| Total Primary energy kWh/year | | | 3670.3125 | (286) |

SAP 10 EPC IMPROVEMENTS

00001

Current energy efficiency rating: B 84
Current environmental impact rating: A 98

| | | |
|---|---|---|
| N Solar water heating | | Recommended |
| U Solar photovoltaic panels | | Already installed |
| V2 Wind turbine | | Not applicable |

| Recommended measures: | SAP change | Cost change | CO2 change |
|---|---|---|---|
| N Solar water heating | + 2.1 | -£ 111 | -64 kg (40.4%) |

| | Typical annual savings | | Energy efficiency | Environmental impact |
|---|---|---|---|---|
| Recommended measures | | | | |
| Solar water heating | £111 | 0.45 kg/m² | B 86 | A 98 |
| Total Savings | £111 | 0.45 kg/m² | | |

Potential energy efficiency rating: B 86
Potential environmental impact rating: A 98

Fuel prices for cost data on this page from database revision number 567 TEST (07 Mar 2025)
Recommendation texts revision number 6.1 (11 Jun 2019)

Typical heating and lighting costs of this home (per year, Thames Valley):

| | Current | Potential | Saving |
|---|---|---|---|
| Electricity | £1273 | £1138 | £134 |
| Space heating | £766 | £787 | -£21 |
| Water heating | £437 | £282 | £155 |
| Lighting | £69 | £69 | £0 |
| Generated (PV) | -£628 | -£604 | -£23 |
| Total cost of fuels | £645 | £534 | £111 |
| Total cost of uses | £644 | £534 | £111 |
| Delivered energy | 3 kWh/m² | -1 kWh/m² | 4 kWh/m² |
| Carbon dioxide emissions | 0.2 tonnes | 0.1 tonnes | 0.1 tonnes |
| CO2 emissions per m² | 1 kg/m² | 1 kg/m² | 0 kg/m² |
| Primary energy | 26 kWh/m² | 21 kWh/m² | 4 kWh/m² |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF ENERGY RATING FOR IMPROVED DWELLING

## 1. Overall dwelling characteristics

| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 57.8000 (1b) | x | 2.6500 (2b) | = | 153.1700 | (1b) - (3b) |
| First floor | 57.8000 (1c) | x | 2.6500 (2c) | = | 153.1700 | (1c) - (3c) |
| Second floor | 26.0000 (1d) | x | 1.8000 (2d) | = | 46.8000 | (1d) - (3d) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 141.6000 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = | 353.1400 | (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) = | 0.1133 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3633 | (18) |
| Number of sides sheltered | | 2 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.8500 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.3088 | (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 | 0.3937 | 0.3860 | 0.3783 | 0.3397 | 0.3319 | 0.2933 | 0.2933 | 0.2856 | 0.3088 | 0.3319 | 0.3474 | 0.3628 | (22b) |
| Effective ac | 0.5775 | 0.5745 | 0.5715 | 0.5577 | 0.5551 | 0.5430 | 0.5430 | 0.5408 | 0.5477 | 0.5551 | 0.5603 | 0.5658 | (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 | |
| Window | | | 32.7000 | 1.1450 | 37.4427 | | | (27) |
| External Door | | | 2.0000 | 1.2000 | 2.4000 | | | (26a) |
| Rooflight | | | 2.4000 | 1.1450 | 3.3962 | | | (27a) |
| Heatloss Floor 1 | | | 57.8000 | 0.1200 | 6.9360 | 110.0000 | 6358.0000 | (28a) |
| External Wall 1 | 141.5600 | 34.7000 | 106.8600 | 0.1800 | 19.2348 | 190.0000 | 20303.4000 | (29a) |
| External Roof 1 | 106.6100 | 2.4000 | 104.2100 | 0.1500 | 15.6315 | 9.0000 | 937.8900 | (30) |
| Total net area of external elements Aum(A, m2) | | | 305.9700 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 85.0413 | | | (33) |

| | | |
|---|---|---|
| Heat capacity Cm = Sum(A x k) | (28)...(30) + (32) + (32a)...(32e) = | 27599.2900 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | | 194.9102 (35) |

List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E2 Other lintels (including other steel lintels) | 16.6800 | 0.0310 | 0.5171 |
| E3 Sill | 21.6900 | 0.0280 | 0.6073 |
| E4 Jamb | 55.6400 | 0.0230 | 1.2797 |
| E5 Ground floor (normal) | 21.5300 | 0.0550 | 1.1842 |
| E6 Intermediate floor within a dwelling | 21.5300 | 0.0010 | 0.0215 |
| E11 Eaves (insulation at rafter level) | 11.3900 | 0.0200 | 0.2278 |
| E13 Gable (insulation at rafter level) | 9.9700 | 0.0420 | 0.4187 |
| E16 Corner (normal) | 15.9000 | 0.0390 | 0.6201 |
| E18 Party wall between dwellings | 15.9000 | 0.0420 | 0.6678 |
| P1 Party wall - Ground floor | 11.3900 | 0.0430 | 0.4898 |
| P2 Party wall - Intermediate floor within a dwelling | 11.3900 | 0.0000 | 0.0000 |
| P5 Party wall - Roof (insulation at rafter level) | 11.3900 | 0.0380 | 0.4328 |

| | | |
|---|---|---|
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | 6.4668 (36) |
| Point Thermal bridges | (36a) = | 0.0000 |
| Total fabric heat loss | (33) + (36) + (36a) = | 91.5081 (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 | 67.2993 | 66.9486 | 66.6049 | 64.9903 | 64.6882 | 63.2820 | 63.2820 | 63.0216 | 63.8236 | 64.6882 | 65.2993 | 65.9382 | (38) |
| Heat transfer coeff | 158.8074 | 158.4567 | 158.1130 | 156.4984 | 156.1963 | 154.7901 | 154.7901 | 154.5297 | 155.3317 | 156.1963 | 156.8074 | 157.4463 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 156.4970 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.1215 | 1.1190 | 1.1166 | 1.1052 | 1.1031 | 1.0932 | 1.0932 | 1.0913 | 1.0970 | 1.1031 | 1.1074 | 1.1119 | (40) |
| HLP (average) | | | | | | | | | | | | 1.1052 | |
| 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 | 2.9201 | (42) |

Hot water usage for mixer showers

| 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 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 84.4179 | 83.1642 | 81.3987 | 78.1434 | 75.7059 | 73.0031 | 71.5432 | 73.2963 | 75.2052 | 78.0973 | 81.4196 | 84.1325 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 44.5344 | 42.9150 | 41.2956 | 39.6761 | 38.0567 | 36.4373 | 36.4373 | 38.0567 | 39.6761 | 41.2956 | 42.9150 | 44.5344 | (42c) |

| | | |
|---|---|---|
| Average daily hot water use (litres/day) | 118.7546 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 128.9523 | 126.0792 | 122.6942 | 117.8195 | 113.7626 | 109.4403 | 107.9804 | 111.3530 | 114.8813 | 119.3928 | 124.3346 | 128.6670 | (44) |
| Energy conte | 204.2290 | 179.5351 | 188.5765 | 161.2891 | 153.1463 | 134.5697 | 130.5930 | 137.8783 | 141.6601 | 162.0150 | 177.1374 | 201.4614 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1972.0907 | |
| Distribution loss (46)m = 0.15 x (45)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (46) |
| Water storage loss: | | | | | | | | | | | | | |
| Total storage 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 | (56) |
| If cylinder contains dedicated solar storage | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (57) |
| Primary 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 | (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 | 173.5946 | 152.6048 | 160.2900 | 137.0957 | 130.1744 | 114.3842 | 111.0040 | 117.1965 | 120.4111 | 137.7127 | 150.5668 | 171.2422 | (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) |

| | | |
|---|---|---|
| Aperture area of solar collector | 3.0000 | (H1) |
| Zero-loss collector efficiency | 0.8000 | (H2) |
| Collector linear heat loss coefficient | 1.8000 | (H3) |
| Collector 2nd order heat loss coefficient | 0.0000 | (H4) |
| Collector loop efficiency | 0.9000 | (H5) |
| Incidence angle modifier | 1.0000 | (H6) |
| Overshading factor | 0.8000 | (H8) |
| Overall heat loss coefficient of system | 6.5000 | (H10) |
| Heat loss coefficient of collector loop | 3.9667 | (H11) |
| Dedicated solar storage volume | 75.0000 | (H12) |
| Effective solar volume | 75.0000 | (H14) |
| Reference volume | 225.0000 | (H15) |
| Storage tank correction coefficient | 1.3161 | (H16) |
| Heat delivered to hot water | 544.3114 | (H24) |
| Heat delivered to space heating | 0.0000 | (H29) |
| Solar input | 544.3114 | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar input | -0.0000 | -16.3640 | -54.3694 | -71.4560 | -89.3686 | -80.8944 | -79.3783 | -72.0933 | -52.2592 | -28.1283 | -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 | 173.5946 | 136.2408 | 105.9207 | 65.6397 | 40.8057 | 33.4898 | 31.6258 | 45.1032 | 68.1519 | 109.5844 | 150.5668 | 171.2422 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 1131.9657 | (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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 43.3987 | 38.1512 | 40.0725 | 34.2739 | 32.5436 | 28.5961 | 27.7510 | 29.2991 | 30.1028 | 34.4282 | 37.6417 | 42.8105 | (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 | 175.2042 | 175.2042 | 175.2042 | 175.2042 | 175.2042 | 175.2042 | 175.2042 | 175.2042 | 175.2042 | 175.2042 | 175.2042 | 175.2042 | (66) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 37.6161 | 33.4103 | 27.1711 | 20.5703 | 15.3765 | 12.9815 | 14.0270 | 18.2328 | 24.4720 | 31.0728 | 36.2666 | 38.6616 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 464.5134 | 469.3336 | 457.1868 | 431.3279 | 398.6856 | 368.0064 | 347.5109 | 342.6907 | 354.8374 | 380.6964 | 413.3387 | 444.0178 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 55.4405 | 55.4405 | 55.4405 | 55.4405 | 55.4405 | 55.4405 | 55.4405 | 55.4405 | 55.4405 | 55.4405 | 55.4405 | 55.4405 | (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) | | | | | | | | | | | | | |
| | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 58.3315 | 56.7726 | 53.8609 | 47.6027 | 43.7414 | 39.7167 | 37.2997 | 39.3806 | 41.8094 | 46.2744 | 52.2801 | 57.5410 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 677.3029 | 676.3584 | 655.0607 | 616.3427 | 574.6453 | 534.5465 | 512.6794 | 514.1459 | 534.9607 | 574.8855 | 618.7273 | 657.0623 | (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 | |
|---|---|---|---|---|---|---|---|
| East | 6.9000 | 19.6403 | 0.6000 | 0.0000 | 0.7700 | 62.6092 | (76) |
| South | 2.8000 | 46.7521 | 0.6000 | 0.0000 | 0.7700 | 60.4785 | (78) |
| West | 23.0000 | 19.6403 | 0.6000 | 0.0000 | 0.7700 | 208.6974 | (80) |
| South | 2.4000 | 49.1253 | 0.6000 | 0.0000 | 1.0000 | 70.7404 | (82) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 402.5256 | 753.0720 | 1174.1259 | 1637.9904 | 1960.1031 | 1989.9359 | 1901.0192 | 1661.3627 | 1338.7553 | 874.4751 | 495.2678 | 335.5150 | (83) |
| Total gains | 1079.8285 | 1429.4303 | 1829.1866 | 2254.3331 | 2534.7484 | 2524.4824 | 2413.6986 | 2175.5085 | 1873.7160 | 1449.3606 | 1113.9951 | 992.5773 | (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 | 48.2753 | 48.3821 | 48.4873 | 48.9875 | 49.0823 | 49.5282 | 49.5282 | 49.6116 | 49.3555 | 49.0823 | 48.8910 | 48.6926 | |
| alpha | 4.2184 | 4.2255 | 4.2325 | 4.2658 | 4.2722 | 4.3019 | 4.3019 | 4.3074 | 4.2904 | 4.2722 | 4.2594 | 4.2462 | |
| util living area | | | | | | | | | | | | | |
| | 0.9865 | 0.9600 | 0.8879 | 0.7337 | 0.5491 | 0.3881 | 0.2813 | 0.3250 | 0.5485 | 0.8535 | 0.9711 | 0.9902 | (86) |
| MIT | 19.5361 | 19.9119 | 20.3826 | 20.7780 | 20.9438 | 20.9899 | 20.9980 | 20.9964 | 20.9591 | 20.6411 | 19.9841 | 19.4632 | (87) |
| Th 2 | 19.9833 | 19.9853 | 19.9873 | 19.9966 | 19.9983 | 20.0064 | 20.0064 | 20.0079 | 20.0033 | 19.9983 | 19.9948 | 19.9911 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9831 | 0.9509 | 0.8654 | 0.6925 | 0.4967 | 0.3296 | 0.2182 | 0.2557 | 0.4775 | 0.8155 | 0.9629 | 0.9877 | (89) |
| MIT 2 | 18.2916 | 18.7640 | 19.3360 | 19.7881 | 19.9541 | 20.0006 | 20.0057 | 20.0065 | 19.9767 | 19.6583 | 18.8675 | 18.2047 | (90) |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.1723 | (91) |
| MIT | 18.5061 | 18.9618 | 19.5163 | 19.9587 | 20.1247 | 20.1711 | 20.1767 | 20.1771 | 20.1460 | 19.8276 | 19.0599 | 18.4216 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 18.5061 | 18.9618 | 19.5163 | 19.9587 | 20.1247 | 20.1711 | 20.1767 | 20.1771 | 20.1460 | 19.8276 | 19.0599 | 18.4216 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9762 | 0.9391 | 0.8533 | 0.6909 | 0.5035 | 0.3394 | 0.2291 | 0.2676 | 0.4880 | 0.8081 | 0.9528 | 0.9822 | (94) |
| Useful gains | 1054.1215 | 1342.3446 | 1560.9063 | 1557.4384 | 1276.1989 | 856.7451 | 552.8826 | 582.1963 | 914.3040 | 1171.1752 | 1061.4071 | 974.8646 | (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 | | | | | | | | | | | | | |
| | 2256.0291 | 2228.1825 | 2058.0536 | 1730.6718 | 1315.9025 | 862.3539 | 553.6401 | 583.6743 | 939.1370 | 1441.3201 | 1875.4034 | 2239.1336 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 894.2193 | 595.2830 | 369.8776 | 124.7280 | 29.5395 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 200.9878 | 586.0774 | 940.6161 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 3741.3287 | |
| 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 | | | | | | | | | | | | | |
| | 894.2193 | 595.2830 | 369.8776 | 124.7280 | 29.5395 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 200.9878 | 586.0774 | 940.6161 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 3741.3287 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 26.4218 | (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 %) | 100.0000 | (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 | | | | | | | | | | | | | |
| | 894.2193 | 595.2830 | 369.8776 | 124.7280 | 29.5395 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 200.9878 | 586.0774 | 940.6161 | (98) |
| Space heating efficiency (main heating system 1) | | | | | | | | | | | | | |
| | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 100.0000 | 100.0000 | 100.0000 | (210) |
| Space heating fuel (main heating system) | | | | | | | | | | | | | |
| | 894.2193 | 595.2830 | 369.8776 | 124.7280 | 29.5395 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 200.9878 | 586.0774 | 940.6161 | (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 | | | | | | | | | | | | | |
| | 173.5946 | 136.2408 | 105.9207 | 65.6397 | 40.8057 | 33.4898 | 31.6258 | 45.1032 | 68.1519 | 109.5844 | 150.5668 | 171.2422 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 100.0000 | (216) |
| (217)m | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 | (217) |
| Fuel for water heating, kWh/month | | | | | | | | | | | | | |
| | 173.5946 | 136.2408 | 105.9207 | 65.6397 | 40.8057 | 33.4898 | 31.6258 | 45.1032 | 68.1519 | 109.5844 | 150.5668 | 171.2422 | (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 | 10.2767 | 9.2822 | 10.2767 | 9.9452 | 10.2767 | 9.9452 | 10.2767 | 10.2767 | 9.9452 | 10.2767 | 9.9452 | 10.2767 | (231) |
| Lighting | 32.9252 | 26.4138 | 23.7827 | 17.4242 | 13.4590 | 10.9961 | 12.2777 | 15.9591 | 20.7292 | 27.1979 | 30.7199 | 33.8403 | (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233a)m | -102.7969 | -142.7698 | -188.8207 | -180.7276 | -167.4642 | -146.4149 | -144.2572 | -142.3506 | -136.7405 | -144.5618 | -111.2523 | -89.3429 | (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 | -37.1117 | -82.7497 | -176.4089 | -285.0843 | -390.1756 | -395.1964 | -392.9519 | -338.3843 | -256.3904 | -138.3908 | -53.0778 | -28.8606 | (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 | 3741.3287 | (211) |
| Space heating fuel - main system 2 | 0.0000 | (213) |
| Space heating fuel - secondary | 0.0000 | (215) |
| Efficiency of water heater | 100.0000 | |
| Water heating fuel used | 1131.9657 | (219) |
| Space cooling fuel | 0.0000 | (221) |
| | | |
| Electricity for pumps and fans: | | |
| central heating pump | 41.0000 | (230c) |
| pump for solar water heating | 80.0000 | (230g) |
| Total electricity for the above, kWh/year | 121.0000 | (231) |
| Electricity for lighting (calculated in Appendix L) | 265.7250 | (232) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -4272.2819 | (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 | 987.7375 | (238) |

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10a. Fuel costs - using Table 12 prices

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| | Fuel kWh/year | Fuel price p/kWh | Fuel cost £/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 3741.3287 | 16.4900 | 616.9451 | (240) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 1131.9657 | 16.4900 | 186.6611 | (247) |
| Energy for instantaneous electric shower(s) | 0.0000 | 16.4900 | 0.0000 | (247a) |
| Pumps, fans and electric keep-hot | 41.0000 | 16.4900 | 6.7609 | (249) |
| Pump for solar water heating | 80.0000 | 16.4900 | 13.1920 | (249) |
| Energy for lighting | 265.7250 | 16.4900 | 43.8181 | (250) |
| Additional standing charges | | | 0.0000 | (251) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -1697.4996 | 16.4900 | -279.9177 | |
| PV Unit electricity exported | -2574.7824 | 5.5900 | -143.9303 | |
| Total | | | -423.8480 | (252) |
| Total energy cost | | | 443.5292 | (255) |

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11a. SAP rating - Individual heating systems

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| | | | |
|---|---|---|---|
| Energy cost deflator (Table 12): | | 0.3600 | (256) |
| Energy cost factor (ECF) | [(255) x (256)] / [(4) + 45.0] = | 0.8557 | (257) |
| SAP value | | 86.1294 | |
| SAP rating (Section 12) | | 86 | (258) |
| SAP band | | B | |

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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 | 3741.3287 | 0.1573 | 588.4821 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 1131.9657 | 0.1480 | 167.5200 | (264) |
| Space and water heating | | | 756.0021 | (265) |
| Pumps, fans and electric keep-hot | 121.0000 | 0.1387 | 16.7842 | (267) |
| Energy for lighting | 265.7250 | 0.1443 | 38.3523 | (268) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -1697.4996 | 0.1377 | -233.6683 | |
| PV Unit electricity exported | -2574.7824 | 0.1240 | -319.2871 | |
| Total | | | -552.9555 | (269) |
| Total CO2, kg/year | | | 258.1832 | (272) |
| CO2 emissions per m2 | | | 1.8200 | (273) |
| EI value | | | 98.1460 | |
| EI rating | | | 98 | (274) |
| EI band | | | A | |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING

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## 1. Overall dwelling characteristics

| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 57.8000 (1b) | x | 2.6500 (2b) | = | 153.1700 (1b) - (3b) | |
| First floor | 57.8000 (1c) | x | 2.6500 (2c) | = | 153.1700 (1c) - (3c) | |
| Second floor | 26.0000 (1d) | x | 1.8000 (2d) | = | 46.8000 (1d) - (3d) | |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 141.6000 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = | 353.1400 | (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) = | 0.1133 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3633 | (18) |
| Number of sides sheltered | | 2 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.8500 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.3088 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 4.0000 | 3.8000 | 3.8000 | 3.5000 | 3.6000 | 3.3000 | 3.5000 | 3.3000 | 3.2000 | 3.5000 | 3.4000 | 3.8000 | (22) |
| Wind factor | 1.0000 | 0.9500 | 0.9500 | 0.8750 | 0.9000 | 0.8250 | 0.8750 | 0.8250 | 0.8000 | 0.8750 | 0.8500 | 0.9500 | (22a) |
| Adj infilt rate | 0.3088 | 0.2933 | 0.2933 | 0.2702 | 0.2779 | 0.2547 | 0.2702 | 0.2547 | 0.2470 | 0.2702 | 0.2625 | 0.2933 | (22b) |
| Effective ac | 0.5477 | 0.5430 | 0.5430 | 0.5365 | 0.5386 | 0.5324 | 0.5365 | 0.5324 | 0.5305 | 0.5365 | 0.5344 | 0.5430 | (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 | | | 32.7000 | 1.1450 | 37.4427 | | | (27) |
| External Door | | | 2.0000 | 1.2000 | 2.4000 | | | (26a) |
| Rooflight | | | 2.4000 | 1.1450 | 3.3962 | | | (27a) |
| Heatloss Floor 1 | | | 57.8000 | 0.1200 | 6.9360 | 110.0000 | 6358.0000 | (28a) |
| External Wall 1 | 141.5600 | 34.7000 | 106.8600 | 0.1800 | 19.2348 | 190.0000 | 20303.4000 | (29a) |
| External Roof 1 | 106.6100 | 2.4000 | 104.2100 | 0.1500 | 15.6315 | 9.0000 | 937.8900 | (30) |
| Total net area of external elements Aum(A, m2) | | | 305.9700 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 85.0413 | | | (33) |
| Heat capacity Cm = Sum(A x k) | | | | | (28)...(30) + (32) + (32a)...(32e) = | | 27599.2900 | (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | | | | | | | 194.9102 | (35) |

List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E2 Other lintels (including other steel lintels) | 16.6800 | 0.0310 | 0.5171 |
| E3 Sill | 21.6900 | 0.0280 | 0.6073 |
| E4 Jamb | 55.6400 | 0.0230 | 1.2797 |
| E5 Ground floor (normal) | 21.5300 | 0.0550 | 1.1842 |
| E6 Intermediate floor within a dwelling | 21.5300 | 0.0010 | 0.0215 |
| E11 Eaves (insulation at rafter level) | 11.3900 | 0.0200 | 0.2278 |
| E13 Gable (insulation at rafter level) | 9.9700 | 0.0420 | 0.4187 |
| E16 Corner (normal) | 15.9000 | 0.0390 | 0.6201 |
| E18 Party wall between dwellings | 15.9000 | 0.0420 | 0.6678 |
| P1 Party wall - Ground floor | 11.3900 | 0.0430 | 0.4898 |
| P2 Party wall - Intermediate floor within a dwelling | 11.3900 | 0.0000 | 0.0000 |
| P5 Party wall - Roof (insulation at rafter level) | 11.3900 | 0.0380 | 0.4328 |

| | | | |
|---|---|---|---|
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | 6.4668 | (36) |
| Point Thermal bridges | (36a) = | 0.0000 | |
| Total fabric heat loss | (33) + (36) + (36a) = | 91.5081 | (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 | 63.8236 | 63.2820 | 63.2820 | 62.5216 | 62.7681 | 62.0493 | 62.5216 | 62.0493 | 61.8236 | 62.5216 | 62.2820 | 63.2820 | (38) |
| Heat transfer coeff | 155.3317 | 154.7901 | 154.7901 | 154.0297 | 154.2762 | 153.5574 | 154.0297 | 153.5574 | 153.3318 | 154.0297 | 153.7901 | 154.7901 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 154.1920 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.0970 | 1.0932 | 1.0932 | 1.0878 | 1.0895 | 1.0844 | 1.0878 | 1.0844 | 1.0829 | 1.0878 | 1.0861 | 1.0932 | (40) |
| HLP (average) | | | | | | | | | | | | 1.0889 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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

| | | |
|---|---|---|
| Assumed occupancy | 2.9201 | (42) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hot water usage for mixer showers | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (42a) |
| Hot water usage for baths | 84.4179 | 83.1642 | 81.3987 | 78.1434 | 75.7059 | 73.0031 | 71.5432 | 73.2963 | 75.2052 | 78.0973 | 81.4196 | 84.1325 | (42b) |
| Hot water usage for other uses | 44.5344 | 42.9150 | 41.2956 | 39.6761 | 38.0567 | 36.4373 | 36.4373 | 38.0567 | 39.6761 | 41.2956 | 42.9150 | 44.5344 | (42c) |

Average daily hot water use (litres/day) 118.7546 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 128.9523 | 126.0792 | 122.6942 | 117.8195 | 113.7626 | 109.4403 | 107.9804 | 111.3530 | 114.8813 | 119.3928 | 124.3346 | 128.6670 | (44) |
| Energy conte | 204.2290 | 179.5351 | 188.5765 | 161.2891 | 153.1463 | 134.5697 | 130.5930 | 137.8783 | 141.6601 | 162.0150 | 177.1374 | 201.4614 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1972.0907 | |
| Distribution loss (46)m = 0.15 x (45)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (46) |
| Water storage loss: | | | | | | | | | | | | | |
| Total storage 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 | (56) |
| If cylinder contains dedicated solar storage | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (57) |
| Primary 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 | (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 | 173.5946 | 152.6048 | 160.2900 | 137.0957 | 130.1744 | 114.3842 | 111.0040 | 117.1965 | 120.4111 | 137.7127 | 150.5668 | 171.2422 | (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) |
| Aperture area of solar collector | | | | | | | | | | | | 3.0000 | (H1) |
| Zero-loss collector efficiency | | | | | | | | | | | | 0.8000 | (H2) |
| Collector linear heat loss coefficient | | | | | | | | | | | | 1.8000 | (H3) |
| Collector 2nd order heat loss coefficient | | | | | | | | | | | | 0.0000 | (H4) |
| Collector loop efficiency | | | | | | | | | | | | 0.9000 | (H5) |
| Incidence angle modifier | | | | | | | | | | | | 1.0000 | (H6) |
| Overshading factor | | | | | | | | | | | | 0.8000 | (H8) |
| Overall heat loss coefficient of system | | | | | | | | | | | | 6.5000 | (H10) |
| Heat loss coefficient of collector loop | | | | | | | | | | | | 3.9667 | (H11) |
| Dedicated solar storage volume | | | | | | | | | | | | 75.0000 | (H12) |
| Effective solar volume | | | | | | | | | | | | 75.0000 | (H14) |
| Reference volume | | | | | | | | | | | | 225.0000 | (H15) |
| Storage tank correction coefficient | | | | | | | | | | | | 1.3161 | (H16) |
| Heat delivered to hot water | | | | | | | | | | | | 595.3854 | (H24) |
| Heat delivered to space heating | | | | | | | | | | | | 0.0000 | (H29) |
| Solar input | | | | | | | | | | | | 595.3854 | |
| Solar input | -1.0480 | -16.9294 | -56.3614 | -75.8686 | -91.7908 | -88.2127 | -85.6625 | -80.1017 | -59.3569 | -35.3687 | -4.6848 | -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 | 172.5466 | 135.6755 | 103.9287 | 61.2271 | 38.3836 | 26.1715 | 25.3415 | 37.0949 | 61.0542 | 102.3440 | 145.8820 | 171.2422 | (64) |
| | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | | 1080.8917 | (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 | 43.3987 | 38.1512 | 40.0725 | 34.2739 | 32.5436 | 28.5961 | 27.7510 | 29.2991 | 30.1028 | 34.4282 | 37.6417 | 42.8105 | (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 | 175.2042 | 175.2042 | 175.2042 | 175.2042 | 175.2042 | 175.2042 | 175.2042 | 175.2042 | 175.2042 | 175.2042 | 175.2042 | 175.2042 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 37.6161 | 33.4103 | 27.1711 | 20.5703 | 15.3765 | 12.9815 | 14.0270 | 18.2328 | 24.4720 | 31.0728 | 36.2666 | 38.6616 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 464.5134 | 469.3336 | 457.1868 | 431.3279 | 398.6856 | 368.0064 | 347.5109 | 342.6907 | 354.8374 | 380.6964 | 413.3387 | 444.0178 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 55.4405 | 55.4405 | 55.4405 | 55.4405 | 55.4405 | 55.4405 | 55.4405 | 55.4405 | 55.4405 | 55.4405 | 55.4405 | 55.4405 | (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) | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | -116.8028 | (71) |
| Water heating gains (Table 5) | 58.3315 | 56.7726 | 53.8609 | 47.6027 | 43.7414 | 39.7167 | 37.2997 | 39.3806 | 41.8094 | 46.2744 | 52.2801 | 57.5410 | (72) |
| Total internal gains | 677.3029 | 676.3584 | 655.0607 | 616.3427 | 574.6453 | 534.5465 | 512.6794 | 514.1459 | 534.9607 | 574.8855 | 618.7273 | 657.0623 | (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 | |
|---|---|---|---|---|---|---|---|
| East | 6.9000 | 23.0580 | 0.6000 | 0.0000 | 0.7700 | 73.5042 | (76) |
| South | 2.8000 | 52.5273 | 0.6000 | 0.0000 | 0.7700 | 67.9493 | (78) |
| West | 23.0000 | 23.0580 | 0.6000 | 0.0000 | 0.7700 | 245.0139 | (80) |
| South | 2.4000 | 56.0148 | 0.6000 | 0.0000 | 1.0000 | 80.6613 | (82) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 467.1287 | 747.8690 | 1184.9994 | 1697.0190 | 1976.1393 | 2146.2004 | 2028.6194 | 1803.8159 | 1449.7335 | 957.1740 | 555.3278 | 373.0829 | (83) |
| Total gains | 1144.4316 | 1424.2273 | 1840.0601 | 2313.3616 | 2550.7846 | 2680.7470 | 2541.2988 | 2317.9618 | 1984.6942 | 1532.0595 | 1174.0551 | 1030.1453 | (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 | 49.3555 | 49.5282 | 49.5282 | 49.7727 | 49.6931 | 49.9257 | 49.7727 | 49.9257 | 49.9992 | 49.7727 | 49.8502 | 49.5282 | |
| alpha | 4.2904 | 4.3019 | 4.3019 | 4.3182 | 4.3129 | 4.3284 | 4.3182 | 4.3284 | 4.3333 | 4.3182 | 4.3233 | 4.3019 | |
| util living area | 0.9785 | 0.9500 | 0.8539 | 0.6557 | 0.4508 | 0.2629 | 0.1575 | 0.1854 | 0.4189 | 0.7693 | 0.9527 | 0.9852 | (86) |
| MIT | 19.7910 | 20.0862 | 20.5475 | 20.8780 | 20.9791 | 20.9985 | 20.9999 | 20.9998 | 20.9888 | 20.8070 | 20.2239 | 19.7004 | (87) |
| Th 2 | 20.0033 | 20.0064 | 20.0064 | 20.0108 | 20.0094 | 20.0136 | 20.0108 | 20.0136 | 20.0149 | 20.0108 | 20.0122 | 20.0064 | (88) |
| util rest of house | 0.9730 | 0.9383 | 0.8252 | 0.6080 | 0.3951 | 0.2068 | 0.0976 | 0.1201 | 0.3464 | 0.7153 | 0.9390 | 0.9812 | (89) |
| MIT 2 | 18.6287 | 18.9971 | 19.5459 | 19.9044 | 19.9953 | 20.0130 | 20.0108 | 20.0135 | 20.0092 | 19.8463 | 19.1785 | 18.5171 | (90) |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.1723 | (91) |
| MIT | 18.8290 | 19.1848 | 19.7185 | 20.0722 | 20.1648 | 20.1828 | 20.1812 | 20.1835 | 20.1780 | 20.0118 | 19.3586 | 18.7210 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 18.8290 | 19.1848 | 19.7185 | 20.0722 | 20.1648 | 20.1828 | 20.1812 | 20.1835 | 20.1780 | 20.0118 | 19.3586 | 18.7210 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9641 | 0.9262 | 0.8158 | 0.6111 | 0.4040 | 0.2165 | 0.1080 | 0.1314 | 0.3586 | 0.7154 | 0.9275 | 0.9741 | (94) |
| Useful gains | 1103.4033 | 1319.0570 | 1501.1376 | 1413.7016 | 1030.4712 | 580.2701 | 274.3487 | 304.5366 | 711.6995 | 1096.0505 | 1088.9777 | 1003.4268 | (95) |
| Ext temp. | 5.4000 | 5.9000 | 7.7000 | 10.3000 | 13.4000 | 16.4000 | 18.4000 | 18.2000 | 15.5000 | 12.0000 | 8.3000 | 5.4000 | (96) |
| Heat loss rate W | 2085.9468 | 2056.3562 | 1860.3476 | 1505.2095 | 1043.6510 | 580.8773 | 274.3651 | 304.5771 | 717.2909 | 1234.0601 | 1700.7071 | 2061.9648 | (97) |
| Space heating kWh | 731.0124 | 495.4651 | 267.2522 | 65.8857 | 9.8057 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 102.6791 | 440.4452 | 787.5523 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 2900.0977 | |
| 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 | 731.0124 | 495.4651 | 267.2522 | 65.8857 | 9.8057 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 102.6791 | 440.4452 | 787.5523 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 2900.0977 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 20.4809 | (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 %) | 100.0000 | (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 | 731.0124 | 495.4651 | 267.2522 | 65.8857 | 9.8057 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 102.6791 | 440.4452 | 787.5523 | (98) |
| Space heating efficiency (main heating system 1) | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 100.0000 | 100.0000 | 100.0000 | (210) |
| Space heating fuel (main heating system) | 731.0124 | 495.4651 | 267.2522 | 65.8857 | 9.8057 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 102.6791 | 440.4452 | 787.5523 | (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 | 172.5466 | 135.6755 | 103.9287 | 61.2271 | 38.3836 | 26.1715 | 25.3415 | 37.0949 | 61.0542 | 102.3440 | 145.8820 | 171.2422 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 100.0000 | (216) |
| (217)m | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 | (217) |
| Fuel for water heating, kWh/month | 172.5466 | 135.6755 | 103.9287 | 61.2271 | 38.3836 | 26.1715 | 25.3415 | 37.0949 | 61.0542 | 102.3440 | 145.8820 | 171.2422 | (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 | 10.2767 | 9.2822 | 10.2767 | 9.9452 | 10.2767 | 9.9452 | 10.2767 | 10.2767 | 9.9452 | 10.2767 | 9.9452 | 10.2767 | (231) |
| Lighting | 32.9252 | 26.4138 | 23.7827 | 17.4242 | 13.4590 | 10.9961 | 12.2777 | 15.9591 | 20.7292 | 27.1979 | 30.7199 | 33.8403 | (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233a)m | -112.9367 | -137.5580 | -180.3807 | -172.1995 | -161.9020 | -147.5048 | -145.0855 | -144.1042 | -139.5890 | -142.3895 | -116.8677 | -95.2490 | (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 | -47.5101 | -83.7453 | -184.2693 | -306.4721 | -397.1301 | -434.0165 | -425.3237 | -374.1640 | -281.9440 | -163.7216 | -65.1998 | -34.6560 | (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 | 2900.0977 | (211) |
| Space heating fuel - main system 2 | 0.0000 | (213) |
| Space heating fuel - secondary | 0.0000 | (215) |
| Efficiency of water heater | 100.0000 | |
| Water heating fuel used | 1080.8917 | (219) |
| Space cooling fuel | 0.0000 | (221) |
| Electricity for pumps and fans: | | |
| central heating pump | 41.0000 | (230c) |
| pump for solar water heating | 80.0000 | (230g) |
| Total electricity for the above, kWh/year | 121.0000 | (231) |
| Electricity for lighting (calculated in Appendix L) | 265.7250 | (232) |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -4493.9194 | (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 | -126.2050 | (238) |

## 10a. Fuel costs - using BEDF prices (567)

| | Fuel kWh/year | Fuel price p/kWh | Fuel cost £/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 2900.0977 | 26.0600 | 755.7655 | (240) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 1080.8917 | 26.0600 | 281.6804 | (247) |
| Energy for instantaneous electric shower(s) | 0.0000 | 26.0600 | 0.0000 | (247a) |
| Pumps, fans and electric keep-hot | 41.0000 | 26.0600 | 10.6846 | (249) |
| Pump for solar water heating | 80.0000 | 26.0600 | 20.8480 | (249) |
| Energy for lighting | 265.7250 | 26.0600 | 69.2479 | (250) |

| | | | | |
|---|---|---|---|---|
| Additional standing charges | | | 0.0000 | (251) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -1695.7667 | 26.0600 | -441.9168 | |
| PV Unit electricity exported | -2798.1527 | 5.8100 | -162.5727 | |
| Total | | | -604.4895 | (252) |
| Total energy cost | | | 533.7369 | (255) |

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 | 2900.0977 | 0.1582 | 458.8776 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 1080.8917 | 0.1489 | 160.9725 | (264) |
| Space and water heating | | | 619.8502 | (265) |
| Pumps, fans and electric keep-hot | 121.0000 | 0.1387 | 16.7842 | (267) |
| Energy for lighting | 265.7250 | 0.1443 | 38.3523 | (268) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -1695.7667 | 0.1377 | -233.5240 | |
| PV Unit electricity exported | -2798.1527 | 0.1240 | -346.9770 | |
| Total | | | -580.5009 | (269) |
| Total CO2, kg/year | | | 94.4857 | (272) |

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 | 2900.0977 | 1.5857 | 4598.6723 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 1080.8917 | 1.5510 | 1676.4739 | (278) |
| Space and water heating | | | 6275.1462 | (279) |
| Pumps, fans and electric keep-hot | 121.0000 | 1.5128 | 183.0488 | (281) |
| Energy for lighting | 265.7250 | 1.5338 | 407.5779 | (282) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -1695.7667 | 1.5091 | -2559.1268 | |
| PV Unit electricity exported | -2798.1527 | 0.4551 | -1273.3792 | |
| Total | | | -3832.5060 | (283) |
| Total Primary energy kWh/year | | | 3033.2669 | (286) |

# Predicted Energy Assessment

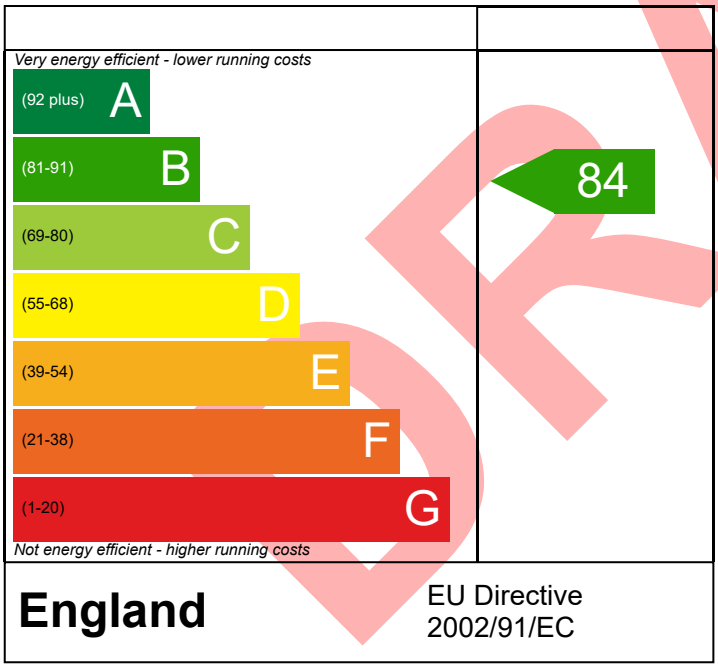
70 Hayman Crescent,
Hayes, London
UB4 8PP

| | |
|---|---|
| Dwelling type: | House, Semi-Detached |
| Date of assessment: | 24/03/2025 |
| Produced by: | Chris Law |
| Total floor area: | 141.6 m² |
| DRRN: | |

This document is a Predicted Energy Assessment for properties marketed when they are incomplete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, this rating will be updated and an official Energy Performance Certificate will be created for the property. This will include more detailed information about the energy performance of the completed property.

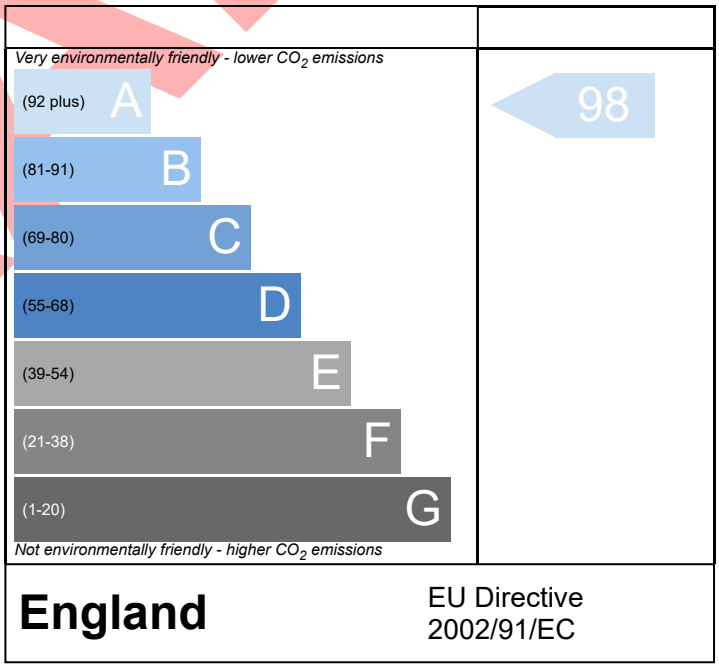
The energy performance has been assessed using the Government approved SAP 10 methodology and is rated in terms of the energy use per square meter of floor area; the energy efficiency is based on fuel costs and the environmental impact is based on carbon dioxide (CO2) emissions.

## Energy Efficiency Rating




The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

## Environmental Impact ($CO_2$) Rating




The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide ($CO_2$) emissions. The higher the rating the less impact it has on the environment.