Otterfield Road, West Drayton, UB7 8EY

Energy & Sustainability Strategy

March 2025

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1.0 Executive Summary

This report describes the energy and sustainability strategy for the proposed LOT2 Otterfield Road development, in order to be used as part of a planning application to the London Borough of Hillingdon.

The scheme the construction of a new 5-storey mixed-use building with commercial space at the ground floor and residential flats to the floors above.

This document seeks to address the measures of Sustainability and demonstrate the design intention in relation to policies at National, Regional and Local level as appropriate.

Full SAP 10.2 calculations and IES thermal modelling have been carried out for the scheme and viability of many options have been explored. These options are presented in this report.

Requirements, Energy Efficient Features and Approach

In accordance with Building Regulations Part L1 (2021 edition) the residential units of the development are required to achieve a Dwelling CO2 Emission Rate (DER) below the notional Target CO2 Emission Rate (TER), a Dwelling Fabric Energy Efficiency (DFEE) rate below the notional Target Fabric Energy Efficiency (TFEE) rate and a Dwelling Primary Energy (DPER) rate below the notional Target Primary Energy Rate (TPER).

New developments should be assessed for their potential to contribute to the local community, and to ensure that they provide a sufficient and balanced contribution across each of the social, economic and environmental sectors to underpin the necessary integration required to ensure the sustained success of the development, and quality of life for the people it is designed to support.

The proposed strategy follows a best practice approach, based on the Mayor of London's Energy Hierarchy:

- Use less energy 'Be Lean'
- Supply energy efficiently 'Be Clean'
- Use Renewable Energy 'Be Green'
- Monitor, verify and report on energy performance 'Be Seen'

The development is subject to Zero Carbon Policy, as per the London Plan, with minimum 35% CO2 reduction over Part L2 2021 building regulations to be achieved on site and the remaining, to 100 per cent, are to be off-set through a cash in lieu contribution to the Hillingdon council.

A fabric first approach will be followed, incorporating passive design measures such as low u-values, low air leakage and high-performance glazing.

Active design measures have then incorporated via energy efficient building services, such as 100% low energy lighting. The development will cover the heating and hot water needs via a high efficient communal air source heat pumps and will be ventilated utilising individual MVHR units to minimise distribution loss. Highly efficient air source heat pump system (ASHP) will be used for the provision of heating and cooling needs of the non-residential property.

Roof mounted photovoltaic panels will be also used based on the available roof space as an option to generate a portion of the electricity demand.

The SAP 10.2 methodology has been used to calculate the energy consumption and resultant CO_2 emissions for the proposed residential units and SBEM methodology has been used utilizing IES VE software for the proposed commercial units.

Summary of the Results

By incorporating a combination of all the feasible passive measures along with the use of the highly efficient ASHP systems, the proposed Otterfield Road development achieved a CO2 reduction of 66.29 % over Part L, which fulfils the planning requirements (to comply with Part L of Building Regulations). The site wide results are presented in the table & graph below:

Site Wide CO2 Emissions			
Energy Hierarchy	**Regulated CO2 Emissions / Annum (tonnes)**	**% Improvements by Energy Hierarchy**	**% Cumulative Improvements**
Baseline	42.907	-	-
Be Lean	33.492	21.94%	21.94%
Be Clean	33.492	0.00%	0.00%
Be Green	14.463	44.35%	66.29%
		Overall CO2 Emissions Reduction:	66.29%

2.0 Site Location and Development Proposal

This report has been produced for the Otterfield Road development, which consists of 45 residential units and a library at the ground floor.

The site is located in West London, within the London Borough of Hillingdon. It is situated off Falling Lane, adjacent to Yiewsley Recreation Ground to the east. The site is in close proximity to High Street, with nearby access to key roads such as St. Stephens Road and Trout Road (Figure 1). The surrounding area primarily consists of high-density residential buildings, including semi-detached houses and apartment blocks, along with a mix of commercial properties, such as supermarkets and retail stores.

Figure 1. Location of the proposed Otterfield Road development; source Google maps

3.0 Policy Context

In this section of the report, National, Regional and Local planning policies and requirements are presented. The energy and sustainability strategies to meet the policies have also briefly been introduced. The details of how the scheme incorporates these policies have been presented in the body of this report.

The following policies will apply to the development:

National Planning Policy Framework (December 2024)

The purpose of the planning system is to contribute to the achievement of sustainable development, including the provision of homes, commercial development, and supporting infrastructure in a sustainable manner.

The planning system has three overarching objectives, which are interdependent and need to be pursued in mutually supportive ways, as set out below:

a) **an economic objective** – to help build a strong, responsive and competitive economy, by ensuring that sufficient land of the right types is available in the right places and at the right time to support growth, innovation and improved productivity; and by identifying and coordinating the provision of infrastructure;
b) **a social objective** – to support strong, vibrant and healthy communities, by ensuring that a sufficient number and range of homes can be provided to meet the needs of present and future generations; and by fostering well-designed, beautiful and safe places, with accessible services and open spaces that reflect current and future needs and support communities' health, social and cultural well-being; and
c) **an environmental objective** – to protect and enhance our natural, built and historic environment; including making effective use of land, improving biodiversity, using natural resources prudently, minimising waste and pollution, and mitigating and adapting to climate change, including moving to a low carbon economy.

161. The planning system should support the transition to net zero by 2050 and take full account of all climate impacts… support renewable and low carbon energy and associated infrastructure.

164. New development should be planned for in ways that:

a) avoid increased vulnerability to the range of impacts arising from climate change. When new development is brought forward in areas which are vulnerable, care should be taken to ensure that risks can be managed through suitable adaptation measures, including through incorporating green infrastructure and sustainable drainage systems; and
b) help to reduce greenhouse gas emissions, such as through its location, orientation and design. Any local requirements for the sustainability of buildings in plans should reflect the Government's policy for national technical standards.

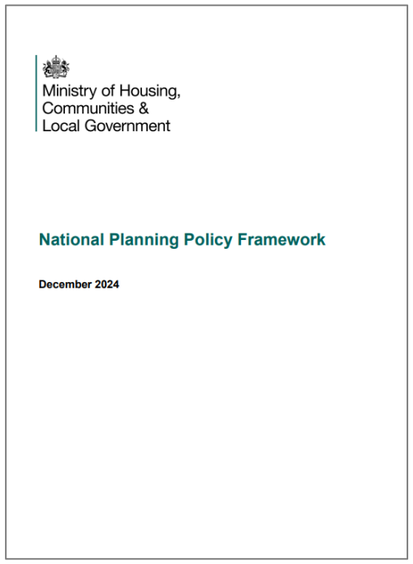
165. To help increase the use and supply of renewable and low carbon energy and heat, plans should:

a) provide a positive strategy for energy from these sources, that maximises the potential for suitable development, and their future re-powering and life extension, while ensuring that adverse impacts are addressed appropriately (including cumulative landscape and visual impacts);
b) consider identifying suitable areas for renewable and low carbon energy sources, and supporting infrastructure, where this would help secure their development; and
c) identify opportunities for development to draw its energy supply from decentralised, renewable or low carbon energy supply systems and for co-locating potential heat customers and suppliers.

166. In determining planning applications, local planning authorities should expect new development to:

a) comply with any development plan policies on local requirements for decentralised energy supply unless it can be demonstrated by the applicant, having regard to the type of development involved and its design, that this is not feasible or viable; and

b) take account of landform, layout, building orientation, massing and landscaping to minimise energy consumption.



London Plan (March 2021)

According to London Plan, an application is referable to the Mayor if it meets the criteria set out in the Mayor of London Order (2008), which include development of 150 residential units or more, development over 30 metres in height (outside the City of London) or development on Green Belt or Metropolitan Open Land.

Therefore, the application for Otterfield Road development forms a referable application and the policies of the London plan applicable to referable applications will apply on this development.

The London Plan suggests that major developments are:

- For dwellings: where 10 or more are to be constructed (or if number not given, area is more than 0.5 hectares).
- For all other uses: where the floor space will be 1000 sq. metres or more (or the site area is 1 hectare or more). The site area is that directly involved in some aspect of the development. Floor space is defined as the sum of floor area within the building measured externally to the external wall faces at each level. Basement car parks, rooftop plant rooms, caretakers' flats etc. should be included in the floor space figure.

Therefore, Otterfield Road development is considered a major development and the policies of the London plan applicable to major developments will apply on this development.

Further to the above clarifications, in Chapter 9 Sustainable Infrastructure of the London Plan, the relevant policies mentioned are the following:

Policy SI 2: Minimising greenhouse gas emission

Major development proposals should be net zero-carbon in accordance with the following energy hierarchy:

1. Be lean: use less energy.

2. Be clean: supply energy efficiently and cleanly, exploit local energy resource.

3. Be green: maximise use of renewable energy.

4. Be seen: monitor, verify and report on energy performance.

Major development proposals should include a detailed energy strategy to demonstrate how the **zero-carbon target** will be met within the framework of the energy hierarchy.

Zero carbon target definition: The development needs to achieve at least a 35 per cent reduction in regulated carbon dioxide emissions (beyond Part L 2013) on-site. Residential development should aim to achieve 10 per cent, and non-residential development should aim to achieve 15 per cent through energy efficiency measures. The remaining regulated carbon dioxide emissions, to 100 per cent, are to be off-set through a cash in lieu contribution to the relevant borough to be ring fenced to secure delivery of carbon dioxide savings elsewhere. The carbon price for the cash in lieu contribution, in the new London Plan 2021, has been set as £95 per tonne per year for a fixed period of 30 years. This new carbon price is more than 50% higher than the one previously suggested by GLA and most of the councils (£60/tonne).

Boroughs are encouraged to produce energy strategies to contain the following information:

a) calculation of the energy demand and carbon emissions covered by Building Regulations and, separately, the energy demand and carbon emissions from any other part of the development, including plant or equipment, that are not covered by the Building Regulations (i.e. the unregulated emissions), at each stage of the energy hierarchy
b) proposals to reduce carbon emissions beyond Building Regulations through the energy efficient design of the site, buildings and services, whether it is categorised as a new build, a major refurbishment or a consequential improvement
c) proposals to further reduce carbon emissions through the use of zero or low-emission decentralised energy where feasible, prioritising connection to district heating and cooling networks and utilising local secondary heat sources. (Development in Heat Network Priority Areas should follow the heating hierarchy in Policy SI 3 Energy infrastructure)
d) proposals to further reduce carbon emissions by maximising opportunities to produce and use renewable energy on-site, utilising storage technologies where appropriate
e) proposals to address air quality risks (see Policy SI 1 Improving air quality). Where an air quality assessment has been undertaken, this could be referenced instead.
f) the results of dynamic overheating modelling which should be undertaken in line with relevant Chartered Institution of Building Services Engineers (CIBSE) guidance, along with any mitigating actions (see Policy SI 4 Managing heat risk)
g) proposals for demand-side response, specifically through installation of smart meters, minimising peak energy demand and promoting short-term energy storage, as well as consideration of smart grids and local micro grids where feasible
h) a plan for monitoring and annual reporting of energy demand and carbon emissions post-construction for at least five years
i) proposals explaining how the site has been future-proofed to achieve zero carbon on-site emissions by 2050
j) confirmation of offsetting arrangements, if required
k) a whole life-cycle carbon emissions assessment, and actions to reduce lifecycle carbon emissions (for development proposals referable to the Mayor)
l) analysis of the expected cost to occupants associated with the proposed energy strategy
m) proposals that connect to or create new heat networks should include details of the design and specification criteria and standards for their systems as set out in Policy SI 3 Energy infrastructure.

‘Be Seen’ Energy Monitoring Guidance

(Part of GLA Draft SPGs and of Policy SI 2 of New London Plan)

Policy SI 2 ‘Minimising greenhouse gas emissions’ now includes ‘Be Seen: monitor, verify and report on energy performance’.

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

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

Policy SI 3: Energy infrastructure

Major development proposals within Heat Network Priority Areas should have a communal low-temperature heating system:

1) The heat source for the communal heating system should be selected in accordance with the following heating hierarchy:

a) connect to local existing or planned heat networks;

b) use zero-emission or local secondary heat sources (in conjunction with heat pump, if required);

c) use low-emission combined heat and power (CHP) (only where there is a case for CHP to enable the delivery of an area-wide heat network, meet the development’s electricity demand and provide demand response to the local electricity network);

d) use ultra-low NOx gas boilers.

2) CHP and ultra-low NOx gas boiler communal or district heating systems should be designed to ensure that they meet the requirements in Part B of Policy SI 1 Improving air quality.

3) Where a heat network is planned but not yet in existence the development should be designed to allow for the cost-effective connection at a later date.

Heat networks should achieve good practice design and specification standards for primary, secondary and tertiary systems comparable to those set out in the CIBSE/ADE Code of Practice CP1 or equivalent.

Policy SI 4: Managing heat risk

The policy stresses the same cooling hierarchy as previous London Plan, as below:

Major development proposals should demonstrate through an energy strategy how they will reduce the potential for internal overheating and reliance on air conditioning systems in accordance with the following cooling hierarchy:

1) Reduce the amount of heat entering a building through orientation, shading, high albedo materials, fenestration, insulation and the provision of green infrastructure.

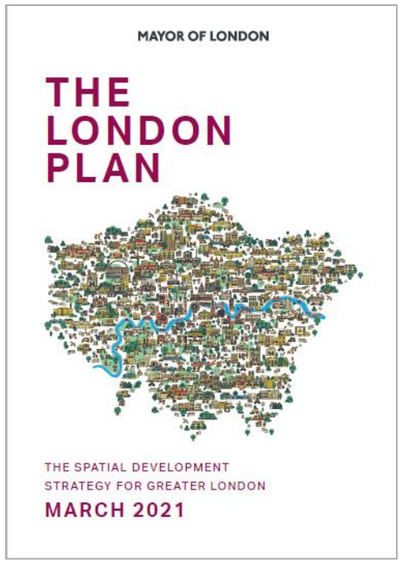
2) Minimise internal heat generation through energy efficient design.

3) Manage the heat within the building through exposed internal thermal mass and high ceilings.

4) Provide passive ventilation.

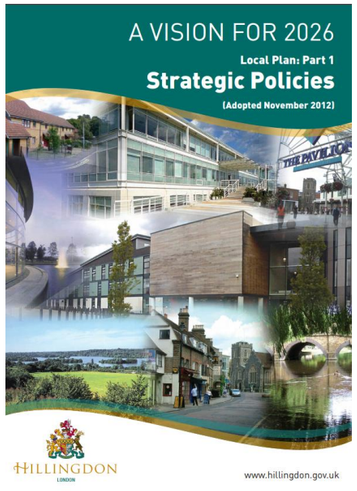
5) Provide mechanical ventilation.

6) Provide active cooling systems.



London Borough of Hillingdon Local Policy

The London Borough of Hillingdon adopted its Local Plan in November 2012. The polices therein relating to energy and sustainability are as follows:



Policy EM1: Climate Change Adaptation and Mitigation

Working with developers of major schemes to identify the opportunities to help provide efficiency initiatives that can benefit the existing building stock.

Promoting the use of decentralised energy within large scale development whilst improving local air quality levels.

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

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

Policy BE1: Built Environment

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

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

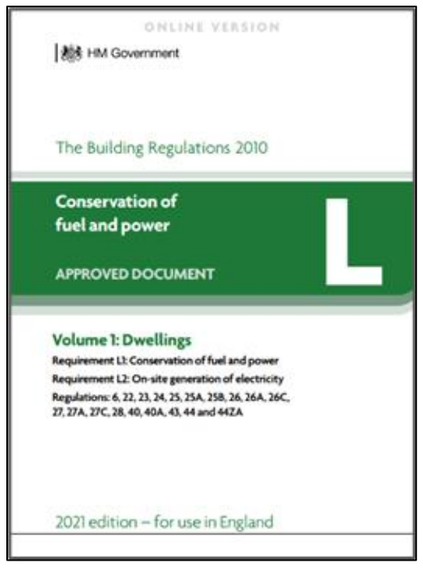
B. Improve the quality of the public realm and provide for public and private spaces that are attractive, safe, functional, diverse, sustainable, accessible to all, respect the local character and landscape, integrate with the development, enhance and protect biodiversity through the inclusion of living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

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

Approved Document Part L1 2021

Approved document Part L1 2021 sets the standard for energy performance for new buildings and took effect on 15 June 2022. The proposed new build residential units must comply with the criteria set out in the Approved Documents, as follows:

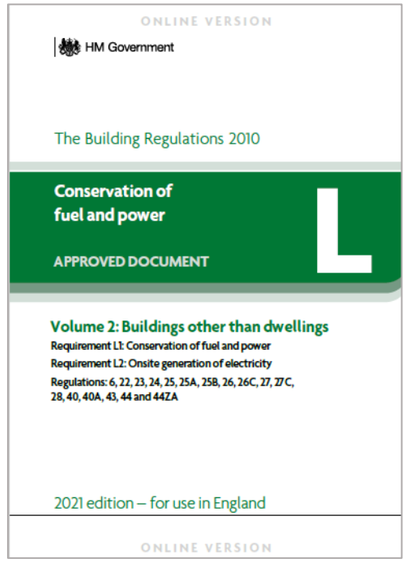
- For domestic units, the calculated Dwelling CO_2 Emission Rate (DER) must not be greater than the Target CO_2 Emission Rate (TER).
- For domestic units, the calculated Dwelling Fabric Energy Efficiency (DFEE) rate must not be greater than the Target Fabric Energy Efficiency (TFEE).
- For domestic units, the calculated Dwelling Primary Energy Rate (DPER) must not be greater than the Target Primary Energy Rate (TPER).
- The performance of the individual building fabric elements and fixed building services should achieve reasonable overall standards of energy efficiency.
- The dwellings should have appropriate passive control measures to limit the effect of heat gains on indoor temperatures in summer, irrespective of whether the dwelling has mechanical cooling.
- For domestic units, the performance of the buildings as-built should be consistent with the DER rates.
- All the units should be air tested at the end of the construction.



Approved Document Part L2 2021

The new Approved document Part L2 2021 sets the standard for energy performance for new buildings proposals and took effect on 15 June 2022. The proposed new buildings must comply with the criteria set out in the Approved Document, as follows:

- For non-domestic units, the calculated Building CO2 Emission Rate (BER) must not be greater than the Target CO2 Emission Rate (TER).
- The calculated Building Primary Energy Rate (BPER) must not be greater than the Target Primary Energy Rate (TPER).
- The performance of the individual building fabric elements and fixed building services should achieve reasonable overall standards of energy efficiency.
- The buildings should have appropriate passive control measures to limit the effect of heat gains on indoor temperatures in summer, irrespective of whether the building has mechanical cooling.
- For non-domestic units, the performance of the buildings as built should be consistent with the BER rates.



4.0 Energy Efficient Design

Carbon reduction and energy performance have been maximised through measures developed in line with the energy hierarchy. This includes:

Passive Design: Facades developed to find balance between daylight and reducing heat losses. Elevations therefore have a reasonable window to wall area ratio. Low U-values will reduce the heat loss through the building envelope.

Energy Efficient Fabric: Opaque elements will target excellent U-values, whilst envelope air permeability will be reduced to a target rate of ≤ 3 m^3/hm^2 at 50 Pa for the residential and ≤3 m^3/hm^2 at 50 Pa for the commercial floorspace, through an airtight layer on the warm side of the insulation, and efficient windows are proposed for all the facades of the development.

Energy Efficient Lighting: All lighting will be energy efficient. All flats will be equipped with 100% energy efficient lighting.

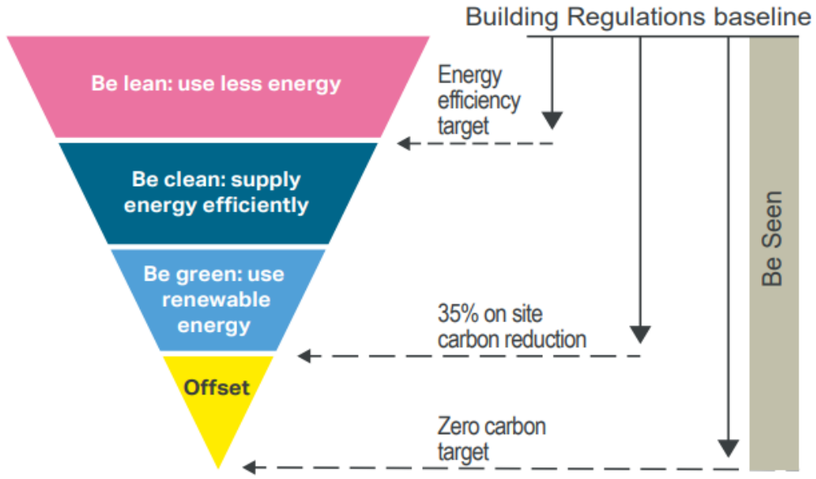
Efficient Ventilation Strategy: All flats will have individual Mechanical Ventilation system with Heat Recovery (MVHR). The proposed specification includes a high Heat Recovery efficiency and a reduced energy consumption associated with fans through low velocity ductwork and reduced pressure drops. The commercial spaces will be ventilated with Mechanical Ventilation system with Heat Recovery (MVHR).

Low and Zero Carbon Technologies: The development will achieve carbon offsetting through the use of an efficient communal Air Source Heat Pump (ASHP) system for the heating and the hot water for all the residential areas of the development and the concierge. The commercial property will be heated via a VRF system and the hot water will be provided via an instantaneous electric system.

Mechanical Cooling: Mechanical cooling will be provided to the commercial space via an efficient Air Source Heat Pump (ASHP) system.

Methodology:

The energy strategy is based on the following energy hierarchy, as per the GLA (Greater London Authority) energy hierarchy:



Government Approved Software **Elmhurst Design SAP 10.2** have been used to calculate energy consumption and resultant CO_2 emissions.

From this, the Target Emissions Rate (TER) and the potential improvement through energy efficiency, the Dwellings Emissions Rate (DER) & Building Emissions Rate (BER), are established.

Government Approved Software **IES VE 2023** has been used for the SBEM Calculation of the Otterfield Road development.

From this, the Target Emissions Rate (TER) and the Target Primary Energy Rate (TPER) along with the potential improvement through energy efficiency, the Building Emissions Rate (BER) and the Building Primary Energy Rate (BPER), are established.

5.0 Design Specifications

MWL has carried out sample SAP and SBEM calculations with the listed fabric and system specifications set out below.

Passive Design

New-Build Residential Units (45 Apartments):

Building Element	Limiting Fabric Parameters Part L1A 2021	Proposed Fabric Parameters
External	0.26 W/m²K	0.15 W/m²K
Sheltered Walls	0.26	0.15 W/m²K
Party Walls	0.20 W/m²K	0 W/m²K (Fully Filled Cavity)
Roofs	0.16 W/m²K	0.10 W/m²K
Floors	0.18 W/m²K	0.10 W/m²K
Glazed Doors: U-value/ G-value/ FF	1.60 W/m²K	1.40 W/m²K / 45% / 0.70
Glazed Windows: U-value/ G-value/ FF	1.60 W/m²K	1.10 W/m²K / 45% / 0.70
Doors	1.60 W/m²K	1.40 W/m²K
Air permeability	8.00 m³/m².h @ 50pa	3.00 m³/m².h @ 50pa
Ψ values (Thermal Bridging)	Bespoken Thermal Bridges Calculations	

Active Design

New-Build Residential Units (45 Apartments):

Services	Proposals
Space Heating	Joule Green Comfort ASHP / COP = 285
Network Distribution Losses	1.50
Hot Water	From Air Source Heat Pump
Heat Emitter	Radiators from ASHP
Mechanical Cooling	None
Renewables	0.25kWp per apartment (11.25kWp in total)
Ventilation	Titon HVR1.6 Q Plus Eco / SFP 0.7 / Efficiency 86

Thermal Bridging

The thermal junctions that have been assigned in SAP calculations, along with the thermal bridging values are presented in the following table.

The thermal properties of the proposed junction details should be assessed by a suitably qualified professional and made available to the SAP assessor upon completion.

Junction Ref	Bridge type	Ψ [W/m.K]	Description
E1	Steel Lintel	0.05	Independently Assessed
E3	Sill	0.05	Independently Assessed
E4	Jamb	0.05	Independently Assessed
E5	Ground floor (normal)	0.16	Independently Assessed
E7	Party Floor between dwellings	0.07	Independently Assessed
E9	Balcony between dwellings, wall insulation continuous	0.02	Independently Assessed
E11	Eaves	0.04	Independently Assessed
E13	Gable (rafters)	0.08	Independently Assessed
E14	Flat Roof	0.08	Independently Assessed
E15	Flat roof with parapet	0.56	Independently Assessed
E16	Corner (normal)	0.09	Independently Assessed
E17	Corner (inverted – internal area greater than external area)	-0.09	Independently Assessed
E18	Party wall between dwellings	0.06	Independently Assessed
E20	Exposed floor (normal)	0.32	Independently Assessed
E21	Exposed floor (inverted)	0.32	Independently Assessed
E24	Eaves (insulation at ceiling inverted)	0.24	Independently Assessed
E25	Staggered party wall	0.06	Independently Assessed
P1	Ground floor	0.08	Independently Assessed
P3	Intermediate floor between dwellings	0.00	Independently Assessed
P4	Roof (insulation at ceiling)	0.08	Independently Assessed
P7	Exposed floor	0.16	Independently Assessed
P8	Exposed floor (inverted)	0.24	Independently Assessed

The above specifications (both for fabric and systems) comply with Part L1 2021 of the Building Regulations, as required by Hillingdon Local Plan policies, meeting the 10% reduction target for residential development through the use of energy efficient measures.

Passive Design

New -Build Commercial Space (Library):

Building Element	Limiting Fabric Parameters Part L2A 2021	Proposed Fabric Parameters
External Walls	0.35 W/m²K	0.15 W/m²K
Sheltered Walls	0.26	0.15 W/m²K
Roofs	0.25 W/m²K	0.10 W/m²K
Floors	0.25 W/m²K	0.10 W/m²K
Windows: U-value/G-value /LTg	2.20 W/m²K	1.10 W/m²K / 30% / 0.71
Doors	2.20 W/m²K	1.40 W/m²K
Air permeability	10.00 m³/m².h @ 50 Pa	3.00 m³/m².h @ 50 Pa
Ψ values (Thermal Bridging)	SBEM Default, Accredited Construction Details Not Used	

Active Design

Services	Retail Space
Space Heating/Cooling	VRF system with condensers SCOP=4.5 SEER=7.2 Heating system controls: Central time control Optimum start/stop control
Hot Water	Instantaneous Electric
Renewables	PVs = 3.6kWp
Ventilation	MVHR SFP=1.0 W/l/s HR = 80% Extract to Changing Facilities & WC SFP=0.3W/l/s Flow Rate15l/s
Lighting	LED - 110lm/cw Dimmable lights to Meeting, Flexible and Multi-Function Rooms Photoelectric Parasitic Power= 0.05 W/m2 Occupancy Sensing = AUTO-ON-OFF Occupancy Parasitic Power= 0.05 W/m2 Display lighting = 90lm/cw Electric power factor = 09-0.95 Lighting systems have provision for metering - Yes Lighting systems metering warns of 'out-of-range' values - Yes

The above specifications (both for fabric and systems) comply with Part L1 2021 of Building Regulations, as required by Hillingdon Local Plan policies, meeting the 15% reduction target for non-residential development through the use of energy efficient measures.

6.0 District Energy Network Connection

As detailed under London Plan and Hillingdon's Local Plan, consideration should be made to provision of a Decentralised Energy Network, including specifically:

- Require developers to prioritise connection to existing or planned decentralised energy networks where feasible.

A review of documentation at the time of writing has been undertaken based on the following:

- London Heat Map: https://maps.london.gov.uk/heatmap

Figure 2. The London Heat Map with illustrated existing and proposed energy centres around the proposed development

As part of the approved energy strategy an investigation was carried out using the London Heat Map. The study found that there is neither an existing nor a proposed heat network transmission line and thus a connection to a district heating network is not considered feasible.

7.0 Low and Zero Carbon Technologies

This section of the report defines all LZC technologies and identifies the one which is considered feasible.

Wind Energy

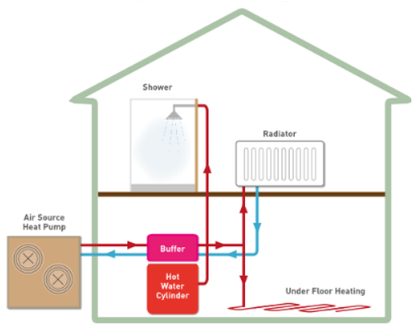
Although wind turbines can generate up to 3MW of electricity, smaller units are available generating between 0.5 kW to 6.0 kW. The area would need to be accessed to establish the practicality of installing a wind turbine. Electricity is generated in DC and requires an inverter to convert to AC to operate domestic appliances. Where electricity is generated but not required, it can be sold to the local electricity company.

Given the location and the wind speed available provides minimal feasible electrical generation and as such has been discounted. It should also be noted there are a number of considerations with regards to daylight impact on the surrounding buildings, further providing rational for discounting wind technology.

This technology is not considered feasible for the development.

Air Source Heat Pump

Air Source Heat Pumps (ASHP) provide an efficient method of providing space heating and cooling requirements. Heat is absorbed from the air into liquid via a heat exchanger where 'useful' heat is extracted and absorbed. Low grade heat is then extracted by a refrigeration system, compressed and concentrated to temperatures suitable for space heating and hot water requirements.



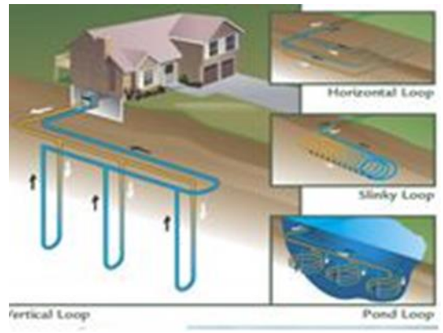
While ASHP utilise electricity to generate this process, the heat gained is taken directly from the available air and produces fewer greenhouse gases when compared to a conventional gas system.

ASHP have been classified as a renewable system under the European Directive on 'Promotion of Renewable Energy Sources' and of the Hillingdon Borough Council and London Plan policies.

ASHP and associated plant require annual maintenance and adequate space for condensing units. Expected lifetimes range from 7-10 years.

Air Source Heat Pumps have been considered as a viable option to provide hot water for the whole residential development. An efficient communal ASHP will also provide heating to all residential areas of the development too. An efficient ASHP will provide heating and cooling to the commercial library unit.

Ground Source Heat Pump



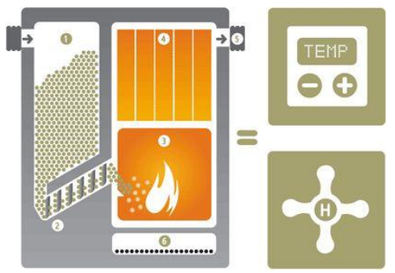
A Ground Source Heat Pump (GSHP) transfers energy from the ground to the building to provide space heating or pre-heating of domestic hot water. Unlike wind and solar heating, it requires an electrical input, however, the heat recovered is three to four times the required electrical input. Heat is transferred from the ground using a ground loop, which can either be within a vertical borehole arrangement or laid as coils in a horizontal trench. The heat pump works in the same way as a domestic refrigerator in reverse, by extracting heat from the borehole/trench to evaporate the refrigerant on the heat pump circuit. Heat is then input to the building as the refrigerant condenses.

Any proposed GSHP would require the use of a large number of vertical boreholes across the site. Given the site's size, the piling of the foundations and the network pipes that run below ground, this has been discounted owing to practical constraints associated with GSHP.

In order to meet the anticipated heating and cooling demand it has been estimated that 54 bore holes will be required. Each bore hole will need to be spaced at 10 m apart, with each bore hole being 150 m in depth.

This technology is not feasible for the development.

Biomass



Biomass boilers burn renewable fuel to generate hot water for direct use, or for heating purposes. The fuel they burn is renewable because it is in a constant carbon cycle. There are three main forms of biomass boilers available, namely those using wood chips as fuel, those using wood pellets as fuel and those using wood logs.

The operation and installation of Biomass requires additional plant space for the storage of solid fuel and design of access routes for delivery of fuel. Given the urban location of the development, this has been discounted owing to practical constraints associated with Biomass.

This technology is considered not feasible for this scheme.

Combined Heat & Power (CHP)

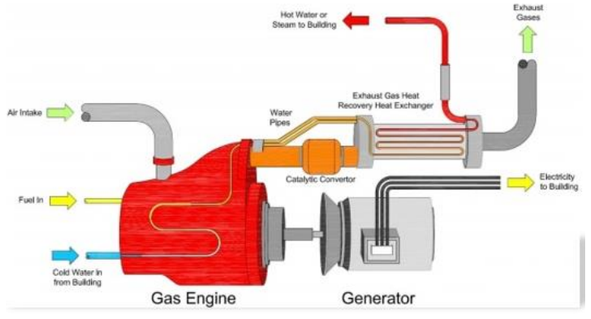
CHP effectively uses waste heat from the electricity generation process to provide useful heat for space and water heating; the advantage of this system is that it leads to higher system efficiencies when compared to a typical supply arrangement of grid-imported electricity and conventional boilers. A further advantage is that because electricity is generated close to the point of use, the losses incurred in High Voltage (HV) transmission are avoided. CHP is considered as a low carbon technology when fired by gas or fuel oil to generate electricity and provide heating and hot water. At this scale, a gas-fired reciprocating engine CHP is the preferred technology due to efficiency, maintenance and plant space considerations, and is well-proven with many successful installations in UK. CHP systems offer optimum carbon and cost savings when matched to the site electricity and heat load profiles such that the units see a high utilisation and make a significant contribution to the site's annual energy demands.

CHP units should be replaced every 15-17 years, with replacement timeframes subject to alteration pending regular maintenance and part failure.

Once an understanding of the site's heat and electricity demand profile has been established the designer is then faced with the task of deciding on the size of the CHP. There is no straightforward way to size a CHP. Some guidance recommends sizing only to meet the lowest demand that occurs — the base-load that will result in the longest running hours and the shortest payback period. However, this is not necessarily the most economically advantageous approach and certainly would limit the amount of CO_2 savings that could be achieved on a given site.

The most accurate models are hourly models simulated over a whole year with occupancy, heat, DHW and electricity demand profiles representing an average year. This is the recommended approach for new buildings where dynamic simulation modelling can be carried out.

Whereas in most engineering calculations it is possible to make simplifications that result in a conservative or a worst-case scenario, simplifying a CHP model generally will result in a more optimistic result (best case scenario) with respect to the CHP operating hours and hence the economic payback and efficiency, which is usually not the case.



A CHP unit is considered not feasible because of the use of Air Source Heat Pumps for the hot water, heating and cooling needs of the development.

Photovoltaics (PV Panels)

Photovoltaic (PV) panels create electricity from solar radiation with efficiency ranging between 5 and 19%. PV modules generally require minimal maintenance, usually consisting of a visual inspection and associated electrical testing. They have no moving parts and an expected lifetime of over 30-40 years. Manufacturers typically offer a warranty on power output of 20-25 years. PV modules have no operating emissions and produce no noise, making them the most benign zero-carbon technology.

The development will comply with the current version of Part L of Building Regulations by introducing improved fabric measures, Air Source Heat Pumps and Photovoltaic Panels.

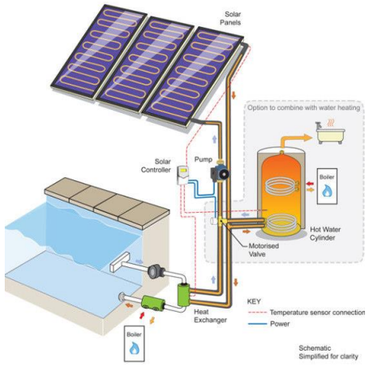
PV should be considered as a viable system to generate electricity for use on-site, with the installation at the available roof space 3.6 kWp for the commercial and 11.25 kWp for the residential properties

Solar Thermal Collectors

Solar thermal collectors utilise solar radiation to heat water for use in water heating of a building. The radiation is converted using a solar collector, of which there are two main types available: Flat Plate and Evacuated Tube collectors. Evacuated tube systems occupy a smaller area and are more efficient, but also generally more expensive. Flat plate systems are cheaper to install but generally less efficient.

The solar coverage indicates what percentage of the annual domestic hot water energy requirement can be covered by a solar water heating system. The higher the solar coverage, the more conventional energy usage can be offset, but can cause excess heat generation in the peak summer months and generally lower the average collector efficiency. Therefore, solar coverage of 40-70% are recommended for most domestic applications and up to 40% in non-domestic buildings.

Solar thermal systems in the UK normally operate with a back-up fuel source, such as gas or electricity. The solar system pre-heats the water up to a maximum hot water temperature. If there is not enough solar power available to fully meet the required hot water load, then the back-up fuel system fires up to meet this short fall. The optimum orientation for a solar collector in the UK is a south facing surface, tilted at an angle of 30º from the horizontal. However, orientation is not critical, with azimuths of +/-30o



from South and angles of +/-20o from 30o still achieve reasonable outputs.

For the solar water heating system to run safely and efficiently, a series of temperature sensors are connected to a digital solar controller to switch the system on or off according to the solar energy available. The roof area required depends on the efficiency of the modules specified and will vary depending on the product selected. This will be determined by the relevant contractor.

The development will comply with the current version of Part L of Building Regulations by introducing improved fabric measures and Air Source Heat Pumps and photovoltaic panels, which makes solar hot water a non-viable option for the development.

Summary of LZC feasibility study

Table 1 presents the result of the feasibility study carried out for the scheme, the outcome of which is dependent on a range of factors, including the surrounding buildings and environment, site size and layout, geology, conservation and biodiversity.

Table 1. Summary of LZC Technologies that are not feasible for the current development

Technology	End Use	Unfeasible due to:
Wind Turbine	Electricity	Impact to surrounding urban environment due to size and appearance, extensive noise, selection of appropriate positioning, unpredictable and varying wind speeds, high cost for design, installation and maintenance
Ground Source Heat Pumps (GSHP)	Thermal Energy	Extraction licences would need to be applied for from the Environment Agency and local water-way management body to use any source of water required for the heating process. High risk to contaminate underground water sources. High cost of centralised heating / cooling generation and distribution systems. Dependant on the suitability of the ground conditions and the usable area available.
Biomass	Thermal Energy	High risk of air pollution issues associated with the flue emissions. Risk and reliability of fuel supply. Impact on air quality of the Borough. Large area for fuel storage or frequent deliveries.
Combined Heat & Power (CHP)	Electricity & Thermal Energy	Space limitations and ASHP will cover the needs for heating and hot water.
Solar Hot Water	Thermal Energy	The number of PV panels has been maximised and thus the roof space will be occupied by photovoltaics, as they offer the greatest savings. The hot water needs will be covered by highly efficient communal ASHP.

8.0 Results Analysis

As mentioned in the above chapters, the energy strategy for the Otterfield Road development is based on the Energy Hierarchy as follows:

- Use less energy (be lean)
- Supply energy efficiently (be clean) and
- Use renewable energy (be green)
- Monitor, verify and report on energy performance "Be Seen".

This section of the report shows how the proposed scheme will meet the requirements of the Energy Hierarchy, the Building Regulations and the CO2 reduction target. As mentioned in the previous chapters, this development will need to prove compliance with SAP 10.2 and SBEM Part L2 2021. Those results are analysed in the following paragraphs.

Be Lean Results

For the Be Lean scenario, a combination of all feasible passive measures has been incorporated to all the units of the development (fabric first approach).

Residential Units

The result of the SAP calculations for the two flats is illustrated in Figure 3, which compares the Target Emission Rate (TER) with the Dwelling Emission Rate (DER).

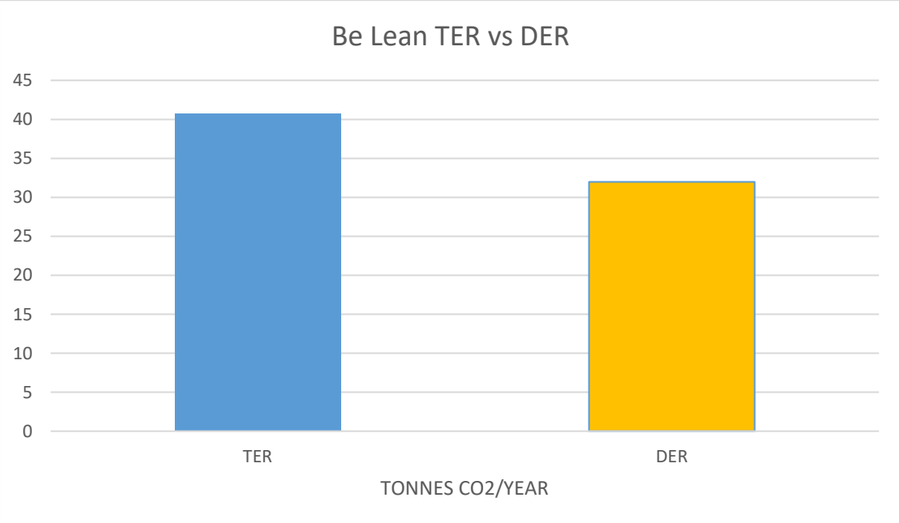


Figure 3. 'Be Lean'- TER vs DER for residential properties

A reduction of 21.54% in CO2 emissions, over the Building Regulations Part L 2021 Baseline, has been achieved for the new-build residential units for the "Be Lean" case of the Energy Hierarchy, meeting the target of 10% reduction through the use of energy efficient measures quite significantly.

The total regulated carbon dioxide (CO_2) emissions of the residential units by incorporating energy efficiency measures and including the notional PV savings, have been calculated to 31.972 CO_2 tonnes per annum, compared to 40.753 CO_2 tonnes per annum of the Part L 2021 building regulations baseline emissions.

Commercial Unit

The results of the SBEM calculations for the commercial unit are illustrated in Figure 4, which compares the Target Emission Rate (TER) with the Building Emission Rate (BER).

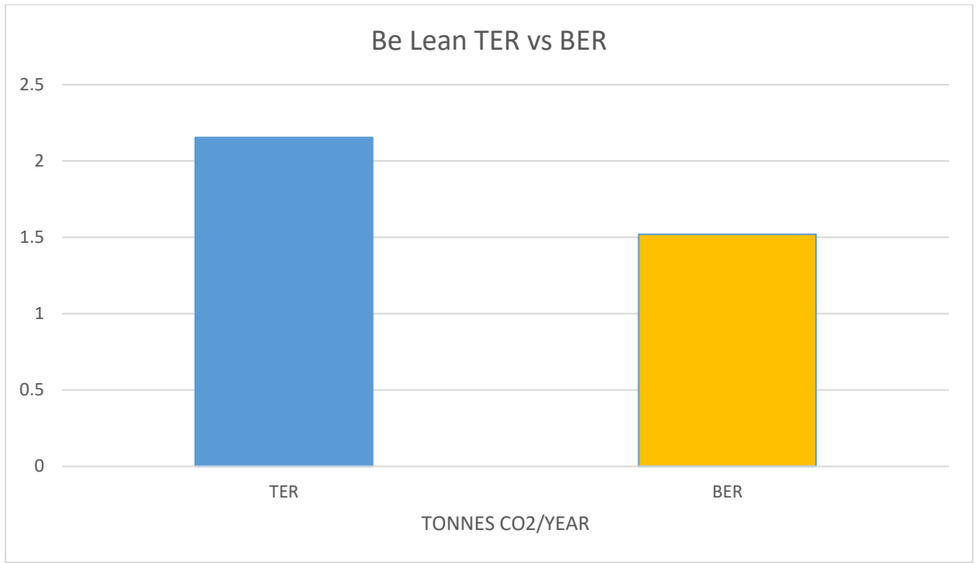


Figure 4. 'Be Lean'- TER vs BER for commercial property

A reduction of 29.43 % in CO2 emissions, over the Building Regulations Part L 2021 Baseline, has been achieved for the new-build commercial units for the "Be Lean" case of the Energy Hierarchy, amply meeting the target of 15% reduction through the use of energy efficiency measures.

The total regulated carbon dioxide (CO_2) emissions of the commercial unit by incorporating energy efficient measures and including the notional PV savings, have been calculated to 1.52 CO_2 tonnes per annum, compared to 2.154 CO_2 tonnes per annum of the Part L 2021 building regulations baseline emissions.

Be Clean Results

There are not any Be Clean results as the implemented system of this development is Air Source Heat Pumps and not CHP.

Be Green Results

At the Be Green scenario, PV panels have been selected as the most suitable technology to reduce carbon dioxide emissions further to meet the Building Regulations requirements. The number of PVs has been maximised on the available roof space resulting to 14.85 kWp PV in total.

Residential Units

The result of the SAP calculations for the two flats is illustrated in Figure 5, which compares the Target Emission Rate (TER) with the Dwelling Emission Rate (DER).

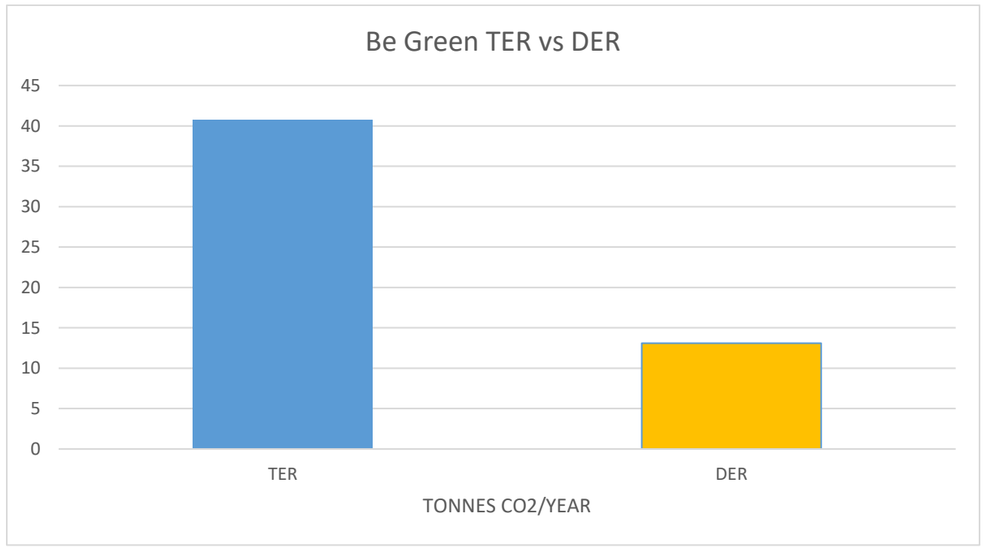


Figure 5. 'Be Green- TER vs DER for residential properties

A reduction of 67.86% in CO2 emissions, over the Building Regulations Part L 2021 Baseline, has been achieved for the new-build residential units for the "Be Green" case of the Energy Hierarchy.

The total regulated carbon dioxide (CO_2) emissions of the residential units by incorporating energy efficiency measures and including the notional PV savings, have been calculated to 13.095 CO_2 tonnes per annum, compared to 40.753 CO_2 tonnes per annum of the Part L 2021 building regulations baseline emissions.

Commercial Unit

The results of the SBEM calculations for the commercial unit are illustrated in Figure 6, which compares the Target Emission Rate (TER) with the Building Emission Rate (BER).

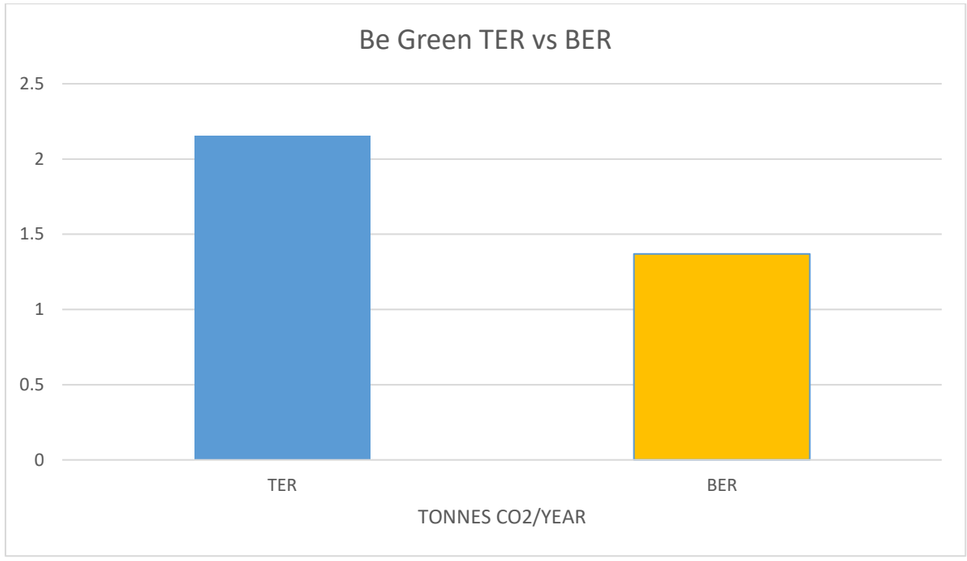


Figure 6. 'Be Green- TER vs BER for commercial property

A reduction of 36.44 % in CO2 emissions, over the Building Regulations Part L 2021 Baseline, has been achieved for the new-build commercial units for the "Be Green" case of the Energy Hierarchy.

The total regulated carbon dioxide (CO_2) emissions of the commercial units by incorporating energy efficient measures and including the notional PV savings, have been calculated to 1.369 CO_2 tonnes per annum, compared to 2.154 CO_2 tonnes per annum of the Part L 2021 building regulations baseline emissions.

Site Wide Residential CO_2 Emissions

The following table details the total site wide reduction in regulated CO2 emissions for the residential units of the Otterfield Road development, as a result of the implemented Energy Hierarchy, along with the required targets of Part L 2021 and the statutory planning policies.

The following table shows that 66.29 % CO_2 reduction has been achieved for the development through the use of renewables (PV Panels).

Site Wide CO2 Emissions			
Energy Hierarchy	**Regulated CO2 Emissions / Annum (tonnes)**	**% Improvements by Energy Hierarchy**	**% Cumulative Improvements**
Baseline	42.907	-	-
Be Lean	33.492	21.94%	21.94%
Be Clean	33.492	0.00%	0.00%
Be Green	14.463	44.35%	66.29%
		Overall CO2 Emissions Reduction:	66.29%

The proposed strategy for the Otterfield Road development achieves a total reduction of 66.29% in CO2 emissions when compared to the target of Part L of the 2021 Building Regulations, which is 35%, as set by Hillingdon Local Plan policies.

Comparison with the London Plan Target

The zero-carbon policy applies to both the residential and commercial components of the proposed development. This means that the remaining regulated carbon dioxide emissions, to 100%, are to be off-set through a cash in lieu financial contribution to the London Borough of Hillingdon.

'Be Seen' Energy Monitoring

For the Be Seen policy, the following actions should be implemented:

- A suitable metering strategy will be developed to record energy consumption and energy generation from PV upon occupation of the development.
- The developer or an ongoing management company will monitor and report the energy consumption and generation as presented in the draft 'Be Seen' energy monitoring guidance (April 2020).

The 'Be Seen' energy hierarchy requires all major development proposals to monitor and report on their actual operational energy performance for at least five years post construction. The 'Be Seen' policy will help the GLA, owners and operators to understand the performance gap and identify ways of closing it while ensuring compliance with London's net zero-carbon target.

The GLA's guidance sets out what each responsible party needs to do to comply with the policy from the inception stage of a development to full occupancy. It provides information on the reporting template and the 'be seen' monitoring portal and explains how and when to report to the GLA.

Local authorities will secure the as-built and in-use stage data through a legal agreement with the applicant.

At this early master planning stage there is minimal information available to us to complete the 'Be Seen' template. Local authorities do occasionally require energy monitoring secured by way of planning condition. It is proposed to provide a completed template for this development to support the scheme if required and when further details are available.

This section presents the measures for the proposed development in response to the new GLA Be Seen requirements. The figure below presents the sequence of the Be Seen process with associated responsibilities.

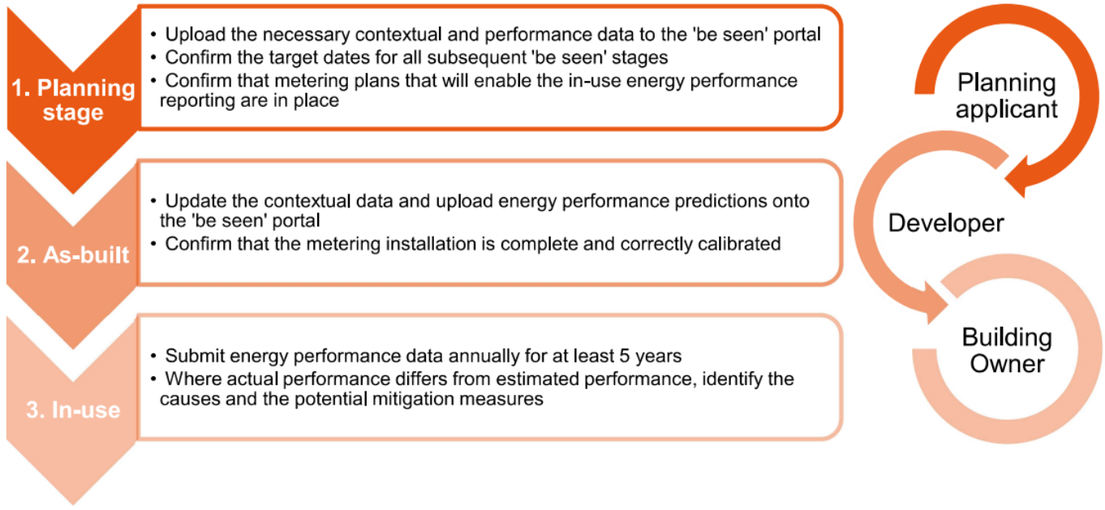


Figure 8. Be Seen process and responsibilities; source 'Be Seen' energy monitoring guidance, September 2021

The proposed development is fully committed in recording, monitoring, and reporting actual energy consumption figures, with the aim of aligning design and in use operational energy in the path to Net Zero Carbon. Under the requirements of the GLA Plan, the following details the reporting responsibilities at the different stages.

Table 2. Responsibility for providing data associated with non-residential Rus; source 'Be Seen' energy monitoring guidance, September 2021

Be Seen Stage	Owner Occupied	Private rented sector	Social Housing
Planning	Planning Applicant		
As-built	Developer		
In-use	Building Owner		

For the first step of the Be Seen process, the following information is to be gathered and submitted once planning consent is awarded on all subsequent reserve matters applications. The key performance indicators that are required are detailed in the table below.

Table 3. Be Seen Performance Indicators; source 'Be Seen' energy monitoring guidance, September 2021

Performance Indicator Group	Description
Contextual data	Contextual data relating to the development's reportable units (RUs) includes non-energy information such as data on location and typology/use of buildings.
Building energy use	The energy and fuel imports into each RU of a development including data from national energy grids (for example, electricity, gas etc.) and district heating connections. This information will enable the building owner to report on the amount of energy being consumed on-site for distinct building uses. Otterfield Road Development, Energy Uses: **Electricity**
Renewable energy	The renewable energy generation within the development will identify how much energy is being generated on-site and where this is used. Otterfield Road Development, Renewable Energy generation: **Photovoltaic Panels**
Energy storage equipment	Data on the building's energy storage equipment. **No Energy Storage Equipment** for the Otterfield Road development
Plant parameters	Plant parameters relate to the performance of heat or cooling generation plant within energy centres that form part of a development. This will include energy inputs and outputs of energy centres, energy use and contribution of heating and cooling technologies, and network efficiency data to monitor losses in district and communal energy networks.
Carbon emissions	The development's estimated carbon emissions at planning stage based on the appropriate carbon emission factors, as set out in the GLA's Energy Assessment Guidance. When on-site carbon reductions have been maximised, but a carbon shortfall still exists, applicants will be expected to report on and confirm the carbon offsetting contribution to the relevant local authority's fund in line with the net zero carbon target.

Cooling Hierarchy

Major development proposals should demonstrate through an energy strategy how they will reduce the potential for internal overheating and reliance on air conditioning systems in accordance with the following cooling hierarchy:

London Plan 2021- Cooling Hierarchy	Otterfield Road development preliminary measures
1) Reduce the amount of heat entering a building through orientation, shading, high albedo materials, fenestration, insulation and the provision of green infrastructure	-Proposed U-values are the lowest possible to meet construction requirements and allow for the maximum demand reductions on the Be Lean scenario. -Adjustment of G-values to limit solar gains
2) Minimise internal heat generation through energy efficient design	-Installation of low energy and LED lighting throughout. -All hot water distribution pipework will be fully insulated throughout to minimise unwanted heat gains
3) Manage the heat within the building through exposed internal thermal mass and high ceilings	-High ceilings where possible. -The internal thermal mass will be explored with the selection of appropriate materials.
4) Provide passive ventilation	The windows are openable were available.
5) Provide mechanical ventilation	Mechanical ventilation details
6) Provide active cooling systems.	The development has prioritized the use of passive design measures, trying to minimise the need for active cooling.

9.0 Conclusion

The Energy & Sustainability strategy seeks to address the measures of Sustainability (where applicable) and demonstrate the design intention in relation to policies at National, Regional and Local level as appropriate.

Inclusion of Energy Hierarchy has been addressed in this report.

The SAP 10.2 methodology has been used to calculate the energy consumption and resultant CO_2 emissions for the proposed residential units and SBEM methodology has been used utilizing IES VE software for the proposed commercial area.

By incorporating a combination of all the feasible passive measures along with the use of highly efficient Air Source Heat Pumps and PV Panels, **the CO2 emissions of the proposed Otterfield Road development have been reduced by 66.29 % over Part L2 2021 of Building Regulations, which fulfils the planning requirements (of minimum 35% CO2 reduction achieved on site) set by London Plan and Hillingdon Borough Council policies.**

The Carbon Offset Payment to Hillingdon London Borough, which will be required in order to comply with the London Plan's Zero Carbon policy, is £41,221 (produced tonnes of 14.46 CO2 X £95 per tonne X 30 years).

Appendices A to B include the SAP results and Appendix C and D the SBEM results for the Be Lean and Be Green Scenarios of the Energy Hierarchy, respectively.

Appendix A – Be Lean SAP

Full SAP Calculation Printout

Property Reference	01 Unit 06	**Issued on Date**	08/01/2025
Assessment Reference	Be Lean MVHR	**Prop Type Ref**	
Property			

SAP Rating	86 B	**DER**	10.19	**TER**	11.49
Environmental	91 B	**% DER < TER**			11.31
CO_2 Emissions (t/year)	1.01	**DFEE**	35.45	**TFEE**	35.91
Compliance Check	See BREL	**% DFEE < TFEE**			1.29
% DPER < TPER	2.63	**DPER**	58.95	**TPER**	60.54

Assessor Details	Mr. Andreas Athanasi	**Assessor ID**	BD95-0001
Client			

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	114.0600	(1b)	x 2.5000	(2b) =	285.1500	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	114.0600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		285.1500	(5)

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2. Ventilation rate

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

	Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		3.0000 (17)
Infiltration rate		0.1500 (18)
Number of sides sheltered		4 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1050 (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	0.1339	0.1313	0.1286	0.1155	0.1129	0.0997	0.0997	0.0971	0.1050	0.1129	0.1181	0.1234	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation	0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	77.4000 (23c)

Effective ac	0.2469	0.2442	0.2416	0.2285	0.2259	0.2127	0.2127	0.2101	0.2180	0.2259	0.2311	0.2364	(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	
Windows (Uw = 1.10)			30.5800	1.0536	32.2203			(27)
Door			2.1000	1.4000	2.9400			(26)
External Wall 1	79.5800	30.5800	49.0000	0.1500	7.3500	140.0000	6860.0003	(29a)
Sheltered	17.2300	2.1000	15.1300	0.1500	2.2695	140.0000	2118.1999	(29a)
Total net area of external elements Aum(A, m2)			96.8100					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	44.7798			(33)
Party Wall 1			20.7800	0.0000	0.0000	140.0000	2909.2001	(32)
Party Floor 1			114.0600			80.0000	9124.8000	(32d)
Party Ceiling 1			114.0600			100.0000	11406.0000	(32b)
Internal Wall 1			202.2300			9.0000	1820.0700	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	34238.2702 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		300.1777 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total

E7 Party floor between dwellings (in blocks of flats)	20.8800	0.0350	0.7308	
E9 Balcony between dwellings, wall insulation continuous	8.6300	0.0100	0.0863	
E17 Corner (inverted - internal area greater than external area)	2.5000	-0.0900	-0.2250	
E1 Steel lintel with perforated steel base plate	14.5300	0.0500	0.7265	
E3 Sill	13.5300	0.0500	0.6765	
E4 Jamb	35.8400	0.0500	1.7920	
E16 Corner (normal)	7.5000	0.0900	0.6750	
E18 Party wall between dwellings	5.0000	0.0300	0.1500	
P7 Party Wall - Exposed floor (normal)	8.3100	0.0800	0.6648	
E20 Exposed floor (normal)	38.7200	0.3200	12.3904	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)				17.6673 (36)
Point Thermal bridges			(36a) =	0.0000
Total fabric heat loss			(33) + (36) + (36a) =	62.4471 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	23.2308	22.9838	22.7368	21.5017	21.2547	20.0197	20.0197	19.7727	20.5137	21.2547	21.7487	22.2428	(38)
Heat transfer coeff	85.6779	85.4309	85.1839	83.9488	83.7018	82.4668	82.4668	82.2198	82.9608	83.7018	84.1959	84.6899	(39)
Average = Sum(39)m / 12 =												83.8871	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7512	0.7490	0.7468	0.7360	0.7338	0.7230	0.7230	0.7208	0.7273	0.7338	0.7382	0.7425	(40)
HLP (average)												0.7355	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.8371 (42)

Hot water usage for mixer showers

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
71.7890	70.7102	69.1381	66.1302	63.9104	61.4349	60.0279	61.5881	63.2983	65.9562	69.0288	71.5140	(42a)

Hot water usage for baths

30.9949	30.5345	29.8863	28.6911	27.7962	26.8038	26.2678	26.9115	27.6123	28.6742	29.8940	30.8901	(42b)

Hot water usage for other uses

43.6850	42.0964	40.5079	38.9193	37.3308	35.7423	35.7423	37.3308	38.9193	40.5079	42.0964	43.6850	(42c)

Average daily hot water use (litres/day) 134.6378 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	146.4689	143.3412	139.5323	133.7406	129.0374	123.9810	122.0379	125.8303	129.8300	135.1383	141.0192	146.0890	(44)
Energy conte	231.9709	204.1159	214.4560	183.0842	173.7091	152.4491	147.5943	155.8042	160.0934	183.3814	200.9077	228.7401	(45)
Energy content (annual)											Total = Sum(45)m =	2236.3063	
Distribution loss (46)m = 0.15 x (45)m	34.7956	30.6174	32.1684	27.4626	26.0564	22.8674	22.1391	23.3706	24.0140	27.5072	30.1362	34.3110	(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	31.0061	28.0012	30.9921	29.9728	30.9595	29.9483	30.9386	30.9452	29.9544	30.9672	29.9870	31.0035	(61)
Total heat required for water heating calculated for each month	262.9770	232.1171	245.4480	213.0570	204.6686	182.3973	178.5329	186.7494	190.0478	214.3486	230.8947	259.7436	(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	262.9770	232.1171	245.4480	213.0570	204.6686	182.3973	178.5329	186.7494	190.0478	214.3486	230.8947	259.7436	(64)
										Total per year (kWh/year) = Sum(64)m =		2600.9820	(64)
12Total per year (kWh/year)												2601	(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	84.8818	74.8688	79.0546	68.3687	65.4981	58.1764	56.8097	59.5412	60.7196	68.7161	74.2986	83.8070	(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	141.8562	141.8562	141.8562	141.8562	141.8562	141.8562	141.8562	141.8562	141.8562	141.8562	141.8562	141.8562	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	139.9859	154.9844	139.9859	144.6521	139.9859	144.6521	139.9859	139.9859	144.6521	139.9859	144.6521	139.9859	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	277.2649	280.1421	272.8917	257.4567	237.9727	219.6606	207.4269	204.5497	211.8001	227.2351	246.7191	265.0312	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.1856	37.1856	37.1856	37.1856	37.1856	37.1856	37.1856	37.1856	37.1856	37.1856	37.1856	37.1856	(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)	-113.4849	-113.4849	-113.4849	-113.4849	-113.4849	-113.4849	-113.4849	-113.4849	-113.4849	-113.4849	-113.4849	-113.4849	(71)
Water heating gains (Table 5)	114.0885	111.4120	106.2562	94.9565	88.0351	80.8005	76.3572	80.0285	84.3328	92.3604	103.1925	112.6438	(72)
Total internal gains	599.8962	615.0953	587.6907	565.6222	534.5506	510.6700	489.3268	490.1210	506.3418	528.1382	563.1205	586.2178	(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	
North	8.1400	10.6334	0.4500	0.7000	0.5400	13.2508	(74)
East	14.2600	19.6403	0.4500	0.7000	0.5400	42.8759	(76)
South	8.1800	46.7521	0.4500	0.7000	0.5400	58.5465	(78)

Solar gains	114.6733	205.0815	303.2985	408.6144	483.8461	490.8447	468.9326	411.8703	339.9749	233.0878	139.2054	96.8952	(83)
Total gains	714.5694	820.1768	890.9893	974.2366	1018.3967	1001.5148	958.2594	901.9913	846.3168	761.2260	702.3259	683.1130	(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	111.0045	111.3254	111.6482	113.2908	113.6251	115.3268	115.3268	115.6733	114.6401	113.6251	112.9584	112.2995	
alpha	8.4003	8.4217	8.4432	8.5527	8.5750	8.6885	8.6885	8.7116	8.6427	8.5750	8.5306	8.4866	
util living area													
	0.9985	0.9948	0.9815	0.9130	0.7449	0.5260	0.3786	0.4192	0.6687	0.9450	0.9948	0.9990	(86)
MIT	20.3793	20.5156	20.6876	20.8904	20.9828	20.9992	21.0000	20.9999	20.9944	20.8689	20.5910	20.3584	(87)
Th 2	20.2959	20.2978	20.2996	20.3091	20.3110	20.3205	20.3205	20.3225	20.3167	20.3110	20.3072	20.3034	(88)
util rest of house													
	0.9980	0.9929	0.9748	0.8875	0.6967	0.4707	0.3202	0.3575	0.6061	0.9224	0.9926	0.9986	(89)
MIT 2	19.7270	19.8639	20.0338	20.2283	20.3012	20.3202	20.3205	20.3224	20.3143	20.2150	19.9474	19.7127	(90)
Living area fraction										fLA = Living area / (4) =		0.4477	(91)
MIT	20.0190	20.1557	20.3266	20.5248	20.6064	20.6242	20.6247	20.6258	20.6188	20.5078	20.2356	20.0018	(92)
Temperature adjustment												-0.1500	
adjusted MIT	19.8690	20.0057	20.1766	20.3748	20.4564	20.4742	20.4747	20.4758	20.4688	20.3578	20.0856	19.8518	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9975	0.9919	0.9734	0.8902	0.7071	0.4832	0.3334	0.3715	0.6203	0.9242	0.9917	0.9983	(94)
Useful gains	712.8120	813.5110	867.3307	867.2562	720.1410	483.9735	319.5226	335.0708	524.9407	703.5230	696.4817	681.9179	(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													
	1333.9227	1290.4950	1165.0242	963.2955	732.9272	484.4285	319.5379	335.1086	528.3613	816.7426	1093.3315	1325.5477	(97)
Space heating kWh													
	462.1063	320.5333	221.4840	69.1483	9.5129	0.0000	0.0000	0.0000	0.0000	84.2354	285.7318	478.8606	(98a)
Space heating requirement - total per year (kWh/year)												1931.6126	
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													
	462.1063	320.5333	221.4840	69.1483	9.5129	0.0000	0.0000	0.0000	0.0000	84.2354	285.7318	478.8606	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1931.6126	
Space heating per m2											(98c) / (4) =	16.9351	(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 %)												88.7000	(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													
	462.1063	320.5333	221.4840	69.1483	9.5129	0.0000	0.0000	0.0000	0.0000	84.2354	285.7318	478.8606	(98)
Space heating efficiency (main heating system 1)													
	88.7000	88.7000	88.7000	88.7000	88.7000	0.0000	0.0000	0.0000	0.0000	88.7000	88.7000	88.7000	(210)
Space heating fuel (main heating system)													
	520.9767	361.3679	249.7001	77.9575	10.7248	0.0000	0.0000	0.0000	0.0000	94.9666	322.1328	539.8654	(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													
	262.9770	232.1171	245.4480	213.0570	204.6686	182.3973	178.5329	186.7494	190.0478	214.3486	230.8947	259.7436	(64)
Efficiency of water heater												88.2000	(216)
(217)m	88.5180	88.4893	88.4365	88.3220	88.2221	88.2000	88.2000	88.2000	88.2000	88.3405	88.4758	88.5235	(217)
Fuel for water heating, kWh/month													
	297.0887	262.3109	277.5417	241.2276	231.9924	206.7997	202.4182	211.7340	215.4736	242.6392	260.9693	293.4177	(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	33.1571	29.9483	33.1571	32.0875	33.1571	32.0875	33.1571	33.1571	32.0875	33.1571	32.0875	33.1571	(231)
Lighting	27.9633	22.4332	20.1986	14.7984	11.4307	9.3390	10.4275	13.5540	17.6053	23.0991	26.0904	28.7405	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(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												2177.6918	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												88.2000	
Water heating fuel used												2943.6129	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.8750)													
mechanical ventilation fans (SFP = 0.8750)												304.3976	(230a)
central heating pump												41.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												390.3976	(231)
Electricity for lighting (calculated in Appendix L)												225.6802	(232)

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

PV generation	0.0000	(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	5737.3825	(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	2177.6918	0.2100	457.3153	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2943.6129	0.2100	618.1587	(264)
Space and water heating			1075.4740	(265)
Pumps, fans and electric keep-hot	390.3976	0.1387	54.1530	(267)
Energy for lighting	225.6802	0.1443	32.5726	(268)
Total CO2, kg/year			1162.1996	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			10.1900	(273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2177.6918	1.1300	2460.7917	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2943.6129	1.1300	3326.2826	(278)
Space and water heating			5787.0743	(279)
Pumps, fans and electric keep-hot	390.3976	1.5128	590.5935	(281)
Energy for lighting	225.6802	1.5338	346.1559	(282)
Total Primary energy kWh/year			6723.8237	(286)
Dwelling Primary energy Rate (DPER)			58.9500	(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)	
Ground floor	114.0600	(1b)	x 2.5000	(2b) =	285.1500	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	114.0600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		285.1500	(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) = 0.1403	(8)
Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design AP50	5.0000	(17)
Infiltration rate	0.3903	(18)
Number of sides sheltered	4	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 0.7000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.2732	(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	0.3483	0.3415	0.3347	0.3005	0.2937	0.2595	0.2595	0.2527	0.2732	0.2937	0.3073	0.3210	(22b)
Effective ac	0.5607	0.5583	0.5560	0.5452	0.5431	0.5337	0.5337	0.5319	0.5373	0.5431	0.5472	0.5515	(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	
TER Opaque door			2.1000	1.0000	2.1000			(26)

TER Opening Type (Uw = 1.20)			26.4200	1.1450	30.2519	(27)
External Wall 1	79.5800	26.4200	53.1600	0.1800	9.5688	(29a)
Sheltered	17.2300	2.1000	15.1300	0.1800	2.7234	(29a)
Total net area of external elements Aum(A, m2)			96.8100			(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		44.6441	(33)
Party Wall 1			20.7800	0.0000	0.0000	(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 280.1777 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E7 Party floor between dwellings (in blocks of flats)	20.8800	0.0700	1.4616
E9 Balcony between dwellings, wall insulation continuous	8.6300	0.0200	0.1726
E17 Corner (inverted - internal area greater than external area)	2.5000	-0.0900	-0.2250
E1 Steel lintel with perforated steel base plate	14.5300	0.0500	0.7265
E3 Sill	13.5300	0.0500	0.6765
E4 Jamb	35.8400	0.0500	1.7920
E16 Corner (normal)	7.5000	0.0900	0.6750
E18 Party wall between dwellings	5.0000	0.0600	0.3000
P7 Party Wall - Exposed floor (normal)	8.3100	0.1600	1.3296
E20 Exposed floor (normal)	38.7200	0.3200	12.3904

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 19.2992 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 63.9433 (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	52.7582	52.5366	52.3193	51.2987	51.1078	50.2189	50.2189	50.0543	50.5613	51.1078	51.4941	51.8979	(38)
Heat transfer coeff	116.7015	116.4799	116.2626	115.2420	115.0511	114.1622	114.1622	113.9976	114.5046	115.0511	115.4374	115.8412	(39)
Average = Sum(39)m / 12 =												115.2411	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0232	1.0212	1.0193	1.0104	1.0087	1.0009	1.0009	0.9995	1.0039	1.0087	1.0121	1.0156	(40)
HLP (average)												1.0104	
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 2.8371 (42)

Hot water usage for mixer showers

71.7890	70.7102	69.1381	66.1302	63.9104	61.4349	60.0279	61.5881	63.2983	65.9562	69.0288	71.5140	(42a)

Hot water usage for baths

30.9949	30.5345	29.8863	28.6911	27.7962	26.8038	26.2678	26.9115	27.6123	28.6742	29.8940	30.8901	(42b)

Hot water usage for other uses

43.6850	42.0964	40.5079	38.9193	37.3308	35.7423	35.7423	37.3308	38.9193	40.5079	42.0964	43.6850	(42c)

Average daily hot water use (litres/day) 134.6378 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	146.4689	143.3412	139.5323	133.7406	129.0374	123.9810	122.0379	125.8303	129.8300	135.1383	141.0192	146.0890	(44)
Energy conte	231.9709	204.1159	214.4560	183.0842	173.7091	152.4491	147.5943	155.8042	160.0934	183.3814	200.9077	228.7401	(45)
Energy content (annual)											Total = Sum(45)m =	2236.3063	
Distribution loss (46)m = 0.15 x (45)m	34.7956	30.6174	32.1684	27.4626	26.0564	22.8674	22.1391	23.3706	24.0140	27.5072	30.1362	34.3110	(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	50.9589	46.0274	50.9589	49.3151	50.9589	49.3151	50.9589	50.9589	49.3151	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month	282.9298	250.1433	265.4149	232.3993	224.6680	201.7642	198.5532	206.7631	209.4084	234.3403	250.2228	279.6990	(62)
WWHRS	-32.8190	-29.0254	-30.3937	-25.1672	-23.4549	-20.0705	-18.8129	-20.0056	-20.7657	-24.4805	-27.7334	-32.2112	(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	250.1109	221.1180	235.0212	207.2321	201.2131	181.6936	179.7403	186.7575	188.6427	209.8598	222.4893	247.4878	(64)
										Total per year (kWh/year) = Sum(64)m =		2531.3663	(64)
12Total per year (kWh/year)												2531	(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	89.8701	79.3754	84.0463	73.2043	70.4980	63.0181	61.8148	64.5446	65.5598	73.7140	79.1306	88.7958	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	141.8562	141.8562	141.8562	141.8562	141.8562	141.8562	141.8562	141.8562	141.8562	141.8562	141.8562	141.8562	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	142.0154	157.2313	142.0154	146.7492	142.0154	146.7492	142.0154	142.0154	146.7492	142.0154	146.7492	142.0154	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	277.2649	280.1421	272.8917	257.4567	237.9727	219.6606	207.4269	204.5497	211.8001	227.2351	246.7191	265.0312	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.1856	37.1856	37.1856	37.1856	37.1856	37.1856	37.1856	37.1856	37.1856	37.1856	37.1856	37.1856	(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)	-113.4849	-113.4849	-113.4849	-113.4849	-113.4849	-113.4849	-113.4849	-113.4849	-113.4849	-113.4849	-113.4849	-113.4849	(71)
Water heating gains (Table 5)	120.7931	118.1181	112.9655	101.6726	94.7554	87.5251	83.0844	86.7535	91.0553	99.0780	109.9036	119.3492	(72)
Total internal gains	608.6302	624.0484	596.4295	574.4354	543.3004	519.4918	498.0836	498.8755	515.1614	536.8854	571.9287	594.9527	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W

North			7.0300		10.6334		0.6300		0.7000		0.5400		16.0215 (74)
East			12.3200		19.6403		0.6300		0.7000		0.5400		51.8600 (76)
South			7.0700		46.7521		0.6300		0.7000		0.5400		70.8427 (78)
Solar gains	138.7242	248.0892	366.8912	494.2707	585.2583	593.7179	567.2158	498.2035	411.2514	281.9653	168.4007	117.2181	(83)
Total gains	747.3544	872.1375	963.3207	1068.7061	1128.5587	1113.2097	1065.2993	997.0790	926.4129	818.8507	740.3294	712.1708	(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	76.0655	76.2103	76.3527	77.0289	77.1567	77.7574	77.7574	77.8697	77.5249	77.1567	76.8985	76.6305	
alpha	6.0710	6.0807	6.0902	6.1353	6.1438	6.1838	6.1838	6.1913	6.1683	6.1438	6.1266	6.1087	
util living area	0.9982	0.9949	0.9855	0.9463	0.8361	0.6388	0.4691	0.5212	0.7838	0.9671	0.9953	0.9986	(86)
MIT	19.9457	20.1166	20.3542	20.6635	20.8889	20.9828	20.9978	20.9959	20.9437	20.6445	20.2380	19.9163	(87)
Th 2	20.0641	20.0657	20.0673	20.0747	20.0761	20.0826	20.0826	20.0838	20.0801	20.0761	20.0733	20.0703	(88)
util rest of house	0.9975	0.9930	0.9801	0.9263	0.7840	0.5551	0.3727	0.4200	0.7054	0.9507	0.9932	0.9981	(89)
MIT 2	18.8335	19.0527	19.3546	19.7391	19.9872	20.0737	20.0820	20.0825	20.0448	19.7247	19.2144	18.8006	(90)
Living area fraction									fLA = Living area / (4) =			0.4477	(91)
MIT	19.3315	19.5290	19.8022	20.1530	20.3909	20.4807	20.4920	20.4914	20.4473	20.1365	19.6727	19.3001	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.3315	19.5290	19.8022	20.1530	20.3909	20.4807	20.4920	20.4914	20.4473	20.1365	19.6727	19.3001	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9968	0.9916	0.9781	0.9283	0.8030	0.5923	0.4160	0.4655	0.7386	0.9520	0.9920	0.9975	(94)
Useful gains	744.9344	864.8227	942.2556	992.0697	906.2817	659.3575	443.1562	464.1570	684.2771	779.5780	734.4133	710.4238	(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	1754.1962	1703.9878	1546.5446	1296.8143	999.9017	671.3574	444.3194	466.4156	726.7947	1097.1869	1451.3594	1749.2157	(97)
Space heating kWh	750.8908	563.9190	449.5910	219.4161	69.6533	0.0000	0.0000	0.0000	0.0000	236.3010	516.2012	772.8612	(98a)
Space heating requirement - total per year (kWh/year)												3578.8336	
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	750.8908	563.9190	449.5910	219.4161	69.6533	0.0000	0.0000	0.0000	0.0000	236.3010	516.2012	772.8612	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3578.8336	
Space heating per m2											(98c) / (4) =	31.3768	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												92.4000	(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	750.8908	563.9190	449.5910	219.4161	69.6533	0.0000	0.0000	0.0000	0.0000	236.3010	516.2012	772.8612	(98)
Space heating efficiency (main heating system 1)	92.4000	92.4000	92.4000	92.4000	92.4000	0.0000	0.0000	0.0000	0.0000	92.4000	92.4000	92.4000	(210)
Space heating fuel (main heating system)	812.6524	610.3019	486.5704	237.4634	75.3823	0.0000	0.0000	0.0000	0.0000	255.7370	558.6593	836.4299	(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	250.1109	221.1180	235.0212	207.2321	201.2131	181.6936	179.7403	186.7575	188.6427	209.8598	222.4893	247.4878	(64)
Efficiency of water heater												80.3000	(216)
(217)m	86.5831	86.2968	85.7474	84.5041	82.3485	80.3000	80.3000	80.3000	80.3000	84.6364	86.1219	86.6491	(217)
Fuel for water heating, kWh/month	288.8681	256.2297	274.0854	245.2332	244.3433	226.2685	223.8359	232.5747	234.9224	247.9546	258.3423	285.6207	(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	29.5080	23.6724	21.3144	15.6158	12.0621	9.8549	11.0035	14.3027	18.5778	24.3751	27.5316	30.3281	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-29.7148	-43.5750	-65.1088	-76.1689	-84.6767	-79.9196	-78.8998	-73.2078	-63.6345	-51.0957	-33.2462	-25.4945	(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	-12.0368	-25.7462	-51.9850	-79.2957	-106.0699	-107.0628	-105.8457	-89.0934	-64.5856	-37.2630	-16.2089	-9.4900	(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												3873.1965	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												80.3000	

Water heating fuel used	3018.2790	(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)	238.1464	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-1409.4253	(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	5806.1966	(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	3873.1965	0.2100	813.3713	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3018.2790	0.2100	633.8386	(264)
Space and water heating			1447.2099	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	238.1464	0.1443	34.3719	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-704.7423	0.1338	-94.2823	
PV Unit electricity exported	-704.6830	0.1254	-88.3913	
Total			-182.6737	(269)
Total CO2, kg/year			1310.8373	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			11.4900	(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	3873.1965	1.1300	4376.7120	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3018.2790	1.1300	3410.6553	(278)
Space and water heating			7787.3673	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	238.1464	1.5338	365.2769	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-704.7423	1.4944	-1053.1619	
PV Unit electricity exported	-704.6830	0.4604	-324.4408	
Total			-1377.6027	(283)
Total Primary energy kWh/year			6905.1423	(286)
Target Primary Energy Rate (TPER)			60.5400	(287)

Full SAP Calculation Printout

Property Reference	03 Unit 36	**Issued on Date**	08/01/2025
Assessment Reference	Be Lean MVHR	**Prop Type Ref**	
Property			

SAP Rating	85 B	**DER**	12.84	**TER**	15.15
Environmental	91 B	**% DER < TER**			15.25
CO_2 Emissions (t/year)	0.61	**DFEE**	30.18	**TFEE**	34.96
Compliance Check	See BREL	**% DFEE < TFEE**			13.69
% DPER < TPER	7.85	**DPER**	74.39	**TPER**	80.73

Assessor Details	Mr. Andreas Athanasi	**Assessor ID**	BD95-0001
Client			

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	52.6100	(1b)	x 2.5000	(2b) =	131.5250	(1b) - (3b) (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	52.6100					
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		131.5250	(5)

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2. Ventilation rate

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

	Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		3.0000 (17)
Infiltration rate		0.1500 (18)
Number of sides sheltered		3 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1162 (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	0.1482	0.1453	0.1424	0.1279	0.1250	0.1104	0.1104	0.1075	0.1162	0.1250	0.1308	0.1366	(22b)
Balanced mechanical ventilation with heat recovery													
If mechanical ventilation												0.5000	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.5000	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												77.4000	(23c)
Effective ac	0.2612	0.2583	0.2554	0.2409	0.2380	0.2234	0.2234	0.2205	0.2292	0.2380	0.2438	0.2496	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Windows (Uw = 1.10)			10.1700	1.0536	10.7155			(27)
Door			2.1000	1.4000	2.9400			(26)
External Wall 1	43.0500	10.1700	32.8800	0.1500	4.9320	140.0000	4603.1999	(29a)
Sheltered	34.0000	2.1000	31.9000	0.1500	4.7850	140.0000	4466.0000	(29a)
External Roof 1	6.3500		6.3500	0.1000	0.6350	9.0000	57.1500	(30)
Total net area of external elements Aum(A, m2)			83.4000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		24.0075			(33)
Party Floor 1			52.6100			40.0000	2104.4000	(32d)
Party Ceiling 1			46.2600			100.0000	4626.0000	(32b)
Internal Wall 1			99.6500			9.0000	896.8500	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		16753.5999	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							318.4490	(35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total

E9 Balcony between dwellings, wall insulation continuous	8.8200	0.0100	0.0882	
E17 Corner (inverted – internal area greater than external area)	2.5000	-0.0900	-0.2250	
E7 Party floor between dwellings (in blocks of flats)	42.1900	0.0350	1.4767	
E1 Steel lintel with perforated steel base plate	5.5000	0.0500	0.2750	
E3 Sill	4.5000	0.0500	0.2250	
E4 Jamb	13.2400	0.0500	0.6620	
E16 Corner (normal)	12.5000	0.0900	1.1250	
E24 Eaves (insulation at ceiling level - inverted)	8.3700	0.0800	0.6696	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 4.2965 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 28.3040 (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	11.3377	11.2116	11.0855	10.4548	10.3286	9.6979	9.6979	9.5718	9.9502	10.3286	10.5809	10.8332	(38)

Heat transfer coeff

	39.6417	39.5156	39.3894	38.7587	38.6326	38.0019	38.0019	37.8757	38.2542	38.6326	38.8849	39.1371	(39)

Average = Sum(39)m / 12 = 38.7272

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7535	0.7511	0.7487	0.7367	0.7343	0.7223	0.7223	0.7199	0.7271	0.7343	0.7391	0.7439	(40)
HLP (average)												0.7361	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 1.7671 (42)
Hot water usage for mixer showers

53.8474	53.0381	51.8589	49.6028	47.9378	46.0810	45.0256	46.1958	47.4787	49.4723	51.7769	53.6410	(42a)

Hot water usage for baths

23.2794	22.9336	22.4468	21.5491	20.8769	20.1316	19.7290	20.2124	20.7388	21.5364	22.4525	23.2007	(42b)

Hot water usage for other uses

32.7265	31.5364	30.3464	29.1563	27.9663	26.7762	26.7762	27.9663	29.1563	30.3464	31.5364	32.7265	(42c)

Average daily hot water use (litres/day) 100.9805 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	109.8532	107.5082	104.6521	100.3082	96.7809	92.9888	91.5308	94.3745	97.3738	101.3551	105.7659	109.5682	(44)
Energy conte	173.9806	153.0902	160.8464	137.3169	130.2858	114.3405	110.6985	116.8554	120.0717	137.5378	150.6829	171.5573	(45)
Energy content (annual)										Total = Sum(45)m =		1677.2641	
Distribution loss (46)m = 0.15 x (45)m													
	26.0971	22.9635	24.1270	20.5975	19.5429	17.1511	16.6048	17.5283	18.0108	20.6307	22.6024	25.7336	(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	30.9597	27.9604	30.9492	29.9362	30.9214	29.9114	30.9016	30.9087	29.9198	30.9305	29.9468	30.9578	(61)
Total heat required for water heating calculated for each month													
	204.9403	181.0506	191.7956	167.2530	161.2071	144.2519	141.6001	147.7641	149.9915	168.4684	180.6298	202.5151	(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													
	204.9403	181.0506	191.7956	167.2530	161.2071	144.2519	141.6001	147.7641	149.9915	168.4684	180.6298	202.5151	(64)
										Total per year (kWh/year) = Sum(64)m =		2041.4675	(64)
12Total per year (kWh/year)												2041	(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													
	65.5885	57.8926	61.2187	53.1419	51.0504	45.4961	44.5327	46.5816	47.4038	53.4640	57.5888	64.7822	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	88.3532	88.3532	88.3532	88.3532	88.3532	88.3532	88.3532	88.3532	88.3532	88.3532	88.3532	88.3532	(66)

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

78.5324	86.9465	78.5324	81.1501	78.5324	81.1501	78.5324	78.5324	81.1501	78.5324	81.1501	78.5324	(67)

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

154.0075	155.6056	151.5784	143.0049	132.1825	122.0110	115.2158	113.6176	117.6448	126.2183	137.0407	147.2122	(68)

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

31.8353	31.8353	31.8353	31.8353	31.8353	31.8353	31.8353	31.8353	31.8353	31.8353	31.8353	31.8353	(69)
Pumps, fans 3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)

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

-70.6825	-70.6825	-70.6825	-70.6825	-70.6825	-70.6825	-70.6825	-70.6825	-70.6825	-70.6825	-70.6825	-70.6825	(71)

Water heating gains (Table 5)

88.1566	86.1497	82.2832	73.8082	68.6161	63.1890	59.8557	62.6097	65.8386	71.8602	79.9844	87.0729	(72)

Total internal gains

373.2023	381.2078	364.8999	350.4692	331.8369	315.8560	303.1098	304.2656	314.1395	329.1168	350.6812	365.3235	(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	
West	10.1700	19.6403	0.4500	0.7000	0.7700	43.6026	(80)

Solar gains	43.6026	85.2959	140.4702	204.8673	251.0726	257.0175	244.6911	210.1861	163.3726	101.2107	54.3673	35.8566	(83)
Total gains	416.8049	466.5036	505.3700	555.3365	582.9095	572.8735	547.8009	514.4517	477.5121	430.3275	405.0484	401.1801	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	117.3960	117.7707	118.1479	120.0705	120.4625	122.4618	122.4618	122.8696	121.6542	120.4625	119.6810	118.9095	
alpha	8.8264	8.8514	8.8765	9.0047	9.0308	9.1641	9.1641	9.1913	9.1103	9.0308	8.9787	8.9273	
util living area													
	0.9937	0.9820	0.9446	0.8094	0.6133	0.4245	0.3052	0.3387	0.5517	0.8667	0.9801	0.9952	(86)
MIT	20.5587	20.6828	20.8329	20.9652	20.9969	20.9999	21.0000	21.0000	20.9990	20.9485	20.7438	20.5394	(87)
Th 2	20.2938	20.2959	20.2980	20.3085	20.3106	20.3211	20.3211	20.3233	20.3169	20.3106	20.3064	20.3022	(88)
util rest of house													
	0.9914	0.9760	0.9282	0.7730	0.5691	0.3795	0.2581	0.2888	0.4976	0.8285	0.9723	0.9935	(89)
MIT 2	19.9006	20.0232	20.1654	20.2855	20.3090	20.3211	20.3211	20.3233	20.3166	20.2773	20.0928	19.8891	(90)
Living area fraction										fLA = Living area / (4) =		0.4210	(91)
MIT	20.1777	20.3009	20.4464	20.5716	20.5986	20.6069	20.6070	20.6082	20.6039	20.5599	20.3669	20.1629	(92)
Temperature adjustment												-0.1500	
adjusted MIT	20.0277	20.1509	20.2964	20.4216	20.4486	20.4569	20.4570	20.4582	20.4539	20.4099	20.2169	20.0129	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9903	0.9745	0.9282	0.7792	0.5780	0.3885	0.2676	0.2988	0.5085	0.8344	0.9711	0.9926	(94)
Useful gains	412.7761	454.6250	469.0736	432.7158	336.9425	222.5497	146.5711	153.7048	242.8088	359.0571	393.3494	398.1959	(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													
	623.4719	602.6486	543.4333	446.5640	337.9812	222.5732	146.5717	153.7064	243.0632	378.9827	510.0486	618.8721	(97)
Space heating kWh													
	156.7577	99.4719	55.3236	9.9707	0.7728	0.0000	0.0000	0.0000	0.0000	14.8246	84.0234	164.1831	(98a)
Space heating requirement - total per year (kWh/year)												585.3278	
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													
	156.7577	99.4719	55.3236	9.9707	0.7728	0.0000	0.0000	0.0000	0.0000	14.8246	84.0234	164.1831	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												585.3278	
Space heating per m2											(98c) / (4) =	11.1258	(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 %)												88.7000	(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													
	156.7577	99.4719	55.3236	9.9707	0.7728	0.0000	0.0000	0.0000	0.0000	14.8246	84.0234	164.1831	(98)
Space heating efficiency (main heating system 1)													
	88.7000	88.7000	88.7000	88.7000	88.7000	0.0000	0.0000	0.0000	0.0000	88.7000	88.7000	88.7000	(210)
Space heating fuel (main heating system)													
	176.7279	112.1442	62.3716	11.2409	0.8712	0.0000	0.0000	0.0000	0.0000	16.7132	94.7276	185.0993	(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													
	204.9403	181.0506	191.7956	167.2530	161.2071	144.2519	141.6001	147.7641	149.9915	168.4684	180.6298	202.5151	(64)
Efficiency of water heater												88.2000	(216)
(217)m	88.4160	88.3767	88.3114	88.2280	88.2024	88.2000	88.2000	88.2000	88.2000	88.2402	88.3581	88.4232	(217)
Fuel for water heating, kWh/month													
	231.7910	204.8625	217.1809	189.5692	182.7696	163.5509	160.5443	167.5330	170.0584	190.9202	204.4292	229.0294	(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	19.2287	17.3679	19.2287	18.6085	19.2287	18.6085	19.2287	19.2287	18.6085	19.2287	18.6085	19.2287	(231)
Lighting	17.1792	13.7818	12.4090	9.0914	7.0224	5.7374	6.4061	8.3269	10.8158	14.1909	16.0286	17.6567	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(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												659.8960	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												88.2000	
Water heating fuel used												2312.2385	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.8750)													
mechanical ventilation fans (SFP = 0.8750)												140.4029	(230a)
central heating pump												41.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												226.4029	(231)
Electricity for lighting (calculated in Appendix L)												138.6461	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												0.0000	(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	3337.1836	(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	659.8960	0.2100	138.5782	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2312.2385	0.2100	485.5701	(264)
Space and water heating			624.1483	(265)
Pumps, fans and electric keep-hot	226.4029	0.1387	31.4049	(267)
Energy for lighting	138.6461	0.1443	20.0109	(268)
Total CO2, kg/year			675.5641	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			12.8400	(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	659.8960	1.1300	745.6825	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2312.2385	1.1300	2612.8295	(278)
Space and water heating			3358.5120	(279)
Pumps, fans and electric keep-hot	226.4029	1.5128	342.5024	(281)
Energy for lighting	138.6461	1.5338	212.6601	(282)
Total Primary energy kWh/year			3913.6745	(286)
Dwelling Primary energy Rate (DPER)			74.3900	(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)	
Ground floor	52.6100	(1b) x	2.5000	(2b) =	131.5250	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	52.6100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		131.5250	(5)

2. Ventilation rate

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	2 * 10 =	20.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1521	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.4021	(18)
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3116	(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	0.3973	0.3895	0.3817	0.3428	0.3350	0.2960	0.2960	0.2882	0.3116	0.3350	0.3505	0.3661	(22b)
Effective ac	0.5789	0.5759	0.5729	0.5587	0.5561	0.5438	0.5438	0.5415	0.5485	0.5561	0.5614	0.5670	(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	
TER Opaque door			2.1000	1.0000	2.1000			(26)
TER Opening Type (Uw = 1.20)			10.1700	1.1450	11.6450			(27)
External Wall 1	43.0500	10.1700	32.8800	0.1800	5.9184			(29a)
Sheltered	34.0000	2.1000	31.9000	0.1800	5.7420			(29a)
External Roof 1	6.3500		6.3500	0.1100	0.6985			(30)

Total net area of external elements Aum(A, m2) 83.4000 (31)
Fabric heat loss, W/K = Sum (A x U) (26)...(30) + (32) = 26.1039 (33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 300.8629 (35)
List of Thermal Bridges

	K1 Element	Length	Psi-value	Total
E9	Balcony between dwellings, wall insulation continuous	8.8200	0.0200	0.1764
E17	Corner (inverted - internal area greater than external area)	2.5000	-0.0900	-0.2250
E7	Party floor between dwellings (in blocks of flats)	42.1900	0.0700	2.9533
E1	Steel lintel with perforated steel base plate	5.5000	0.0500	0.2750
E3	Sill	4.5000	0.0500	0.2250
E4	Jamb	13.2400	0.0500	0.6620
E16	Corner (normal)	12.5000	0.0900	1.1250
E24	Eaves (insulation at ceiling level - inverted)	8.3700	0.2400	2.0088

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 7.2005 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 33.3044 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	25.1270	24.9939	24.8636	24.2512	24.1366	23.6033	23.6033	23.5045	23.8087	24.1366	24.3684	24.6107	(38)
Heat transfer coeff	58.4314	58.2984	58.1680	57.5556	57.4411	56.9077	56.9077	56.8089	57.1132	57.4411	57.6728	57.9152	(39)

Average = Sum(39)m / 12 = 57.5551

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1107	1.1081	1.1056	1.0940	1.0918	1.0817	1.0817	1.0798	1.0856	1.0918	1.0962	1.1008	(40)
HLP (average)												1.0940	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 1.7671 (42)
Hot water usage for mixer showers

53.8474	53.0381	51.8589	49.6028	47.9378	46.0810	45.0256	46.1958	47.4787	49.4723	51.7769	53.6410	(42a)

Hot water usage for baths

23.2794	22.9336	22.4468	21.5491	20.8769	20.1316	19.7290	20.2124	20.7388	21.5364	22.4525	23.2007	(42b)

Hot water usage for other uses

32.7265	31.5364	30.3464	29.1563	27.9663	26.7762	26.7762	27.9663	29.1563	30.3464	31.5364	32.7265	(42c)

Average daily hot water use (litres/day) 100.9805 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.8532	107.5082	104.6521	100.3082	96.7809	92.9888	91.5308	94.3745	97.3738	101.3551	105.7659	109.5682	(44)
Energy conte	173.9806	153.0902	160.8464	137.3169	130.2858	114.3405	110.6985	116.8554	120.0717	137.5378	150.6829	171.5573	(45)

Energy content (annual) Total = Sum(45)m = 1677.2641

Distribution loss (46)m = 0.15 x (45)m	26.0971	22.9635	24.1270	20.5975	19.5429	17.1511	16.6048	17.5283	18.0108	20.6307	22.6024	25.7336	(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 50.9589	46.0274	50.9589	49.3151	49.3185	45.8575	46.6431	48.0922	48.0200	50.9589	49.3151	50.9589	(61)

Total heat required for water heating calculated for each month

224.9395	199.1176	211.8053	186.6319	179.6043	160.1980	157.3416	164.9476	168.0916	188.4968	199.9980	222.5162	(62)
WWHRS -24.6168	-21.7713	-22.7976	-18.8773	-17.5930	-15.0544	-14.1111	-15.0058	-15.5759	-18.3623	-20.8022	-24.1609	(63a)
PV diverter -0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	200.3228	177.3464	189.0077	167.7546	162.0113	145.1436	143.2305	149.9419	152.5157	170.1345	179.1958	198.3553	(64)

Total per year (kWh/year) = Sum(64)m = 2034.9599 (64)
12Total per year (kWh/year) 2035 (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

70.5883	62.4094	66.2211	57.9866	55.6496	49.4826	48.4680	50.8775	51.9288	58.4711	62.4308	69.7825	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	88.3532	88.3532	88.3532	88.3532	88.3532	88.3532	88.3532	88.3532	88.3532	88.3532	88.3532	88.3532	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	78.5324	86.9465	78.5324	81.1501	78.5324	81.1501	78.5324	78.5324	81.1501	78.5324	81.1501	78.5324	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	154.0075	155.6056	151.5784	143.0049	132.1825	122.0110	115.2158	113.6176	117.6448	126.2183	137.0407	147.2122	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.8353	31.8353	31.8353	31.8353	31.8353	31.8353	31.8353	31.8353	31.8353	31.8353	31.8353	31.8353	(69)
Pumps, fans 3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-70.6825	-70.6825	-70.6825	-70.6825	-70.6825	-70.6825	-70.6825	-70.6825	-70.6825	-70.6825	-70.6825	-70.6825	(71)
Water heating gains (Table 5)	94.8767	92.8711	89.0069	80.5370	74.7979	68.7258	65.1452	68.3837	72.1234	78.5901	86.7095	93.7937	(72)
Total internal gains	379.9225	387.9291	371.6236	357.1980	338.0187	321.3929	308.3993	310.0397	320.4243	335.8467	357.4063	372.0443	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
West	10.1700	19.6403	0.6300	0.7000	0.7700	61.0436	(80)

Solar gains 61.0436	119.4142	196.6582	286.8143	351.5017	359.8245	342.5676	294.2605	228.7216	141.6950	76.1142	50.1993	(83)
Total gains 440.9661	507.3433	568.2818	644.0123	689.5204	681.2174	650.9669	604.3002	549.1459	477.5418	433.5204	422.2436	(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	75.2468	75.4185	75.5876	76.3918	76.5442	77.2615	77.2615	77.3959	76.9836	76.5442	76.2365	75.9176	
alpha	6.0165	6.0279	6.0392	6.0928	6.1029	6.1508	6.1508	6.1597	6.1322	6.1029	6.0824	6.0612	
util living area	0.9954	0.9886	0.9680	0.8903	0.7308	0.5293	0.3840	0.4310	0.6884	0.9357	0.9889	0.9964	(86)
MIT	20.0518	20.2278	20.4815	20.7821	20.9463	20.9935	20.9992	20.9985	20.9715	20.7333	20.3398	20.0231	(87)
Th 2	19.9921	19.9942	19.9962	20.0057	20.0075	20.0158	20.0158	20.0174	20.0126	20.0075	20.0039	20.0001	(88)
util rest of house	0.9936	0.9844	0.9563	0.8558	0.6677	0.4505	0.2985	0.3398	0.6025	0.9064	0.9841	0.9950	(89)
MIT 2	18.9071	19.1314	19.4482	19.8056	19.9694	20.0129	20.0156	20.0170	19.9971	19.7631	19.2825	18.8767	(90)
Living area fraction										fLA = Living area / (4) =		0.4210	(91)
MIT	19.3890	19.5930	19.8832	20.2167	20.3807	20.4258	20.4297	20.4302	20.4074	20.1716	19.7277	19.3594	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.3890	19.5930	19.8832	20.2167	20.3807	20.4258	20.4297	20.4302	20.4074	20.1716	19.7277	19.3594	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9922	0.9822	0.9547	0.8638	0.6924	0.4837	0.3345	0.3783	0.6381	0.9121	0.9823	0.9938	(94)
Useful gains	437.5285	498.3151	542.5379	556.3138	477.4124	329.4902	217.7691	228.5909	350.4089	435.5449	425.8458	419.6353	(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	881.6739	856.5778	778.4761	651.3412	498.6291	331.5306	217.9423	228.9515	360.2342	549.8030	728.2729	877.9585	(97)
Space heating kWh	330.4442	240.7525	175.5380	68.4197	15.7853	0.0000	0.0000	0.0000	0.0000	85.0080	217.7475	340.9924	(98a)
Space heating requirement - total per year (kWh/year)												1474.6876	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	330.4442	240.7525	175.5380	68.4197	15.7853	0.0000	0.0000	0.0000	0.0000	85.0080	217.7475	340.9924	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1474.6876	
Space heating per m2										(98c) / (4) =		28.0306	(99)

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

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

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

Efficiency of main space heating system 1 (in %) 92.4000 (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	330.4442	240.7525	175.5380	68.4197	15.7853	0.0000	0.0000	0.0000	0.0000	85.0080	217.7475	340.9924	(98)
Space heating efficiency (main heating system 1)	92.4000	92.4000	92.4000	92.4000	92.4000	0.0000	0.0000	0.0000	0.0000	92.4000	92.4000	92.4000	(210)
Space heating fuel (main heating system)	357.6236	260.5547	189.9762	74.0473	17.0836	0.0000	0.0000	0.0000	0.0000	92.0000	235.6575	369.0394	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	200.3228	177.3464	189.0077	167.7546	162.0113	145.1436	143.2305	149.9419	152.5157	170.1345	179.1958	198.3553	(64)
Efficiency of water heater												80.3000	(216)
(217)m	85.4462	85.0369	84.2233	82.6153	80.9956	80.3000	80.3000	80.3000	80.3000	82.9743	84.8001	85.5311	(217)
Fuel for water heating, kWh/month	234.4433	208.5522	224.4126	203.0552	200.0247	180.7516	178.3692	186.7271	189.9324	205.0447	211.3156	231.9101	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	16.3175	13.0905	11.7865	8.6353	6.6702	5.4496	6.0847	7.9092	10.2733	13.4791	15.2246	16.7710	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-14.2298	-21.1553	-32.0542	-38.0673	-42.8544	-40.6850	-40.2092	-37.0692	-31.8359	-25.0883	-16.0344	-12.1797	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-5.0280	-10.8190	-21.9551	-33.6405	-45.1272	-45.5603	-45.0043	-37.7919	-27.3055	-15.6671	-6.7767	-3.9569	(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 1595.9823 (211)

Space heating fuel - main system 2 0.0000 (213)

Space heating fuel - secondary 0.0000 (215)

Efficiency of water heater 80.3000

Water heating fuel used 2454.5386 (219)

Space cooling fuel 0.0000 (221)

Electricity for pumps and fans:

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

Electricity for lighting (calculated in Appendix L) 131.6913 (232)

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

PV generation	-650.0953	(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	3618.1170	(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	1595.9823	0.2100	335.1563	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2454.5386	0.2100	515.4531	(264)
Space and water heating			850.6094	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	131.6913	0.1443	19.0071	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-351.4627	0.1335	-46.9087	
PV Unit electricity exported	-298.6325	0.1253	-37.4265	
Total			-84.3352	(269)
Total CO2, kg/year			797.2106	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			15.1500	(273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	1595.9823	1.1300	1803.4600	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2454.5386	1.1300	2773.6287	(278)
Space and water heating			4577.0886	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	131.6913	1.5338	201.9926	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-351.4627	1.4932	-524.8067	
PV Unit electricity exported	-298.6325	0.4600	-137.3732	
Total			-662.1800	(283)
Total Primary energy kWh/year			4247.0020	(286)
Target Primary Energy Rate (TPER)			80.7300	(287)

Appendix B – Be Green SAP

Full SAP Calculation Printout

Property Reference	01 Unit 06	**Issued on Date**	08/01/2025
Assessment Reference	Be Green MVHR	**Prop Type Ref**	
Property			

SAP Rating	83 B	**DER**	3.73	**TER**	11.14
Environmental	97 A	**% DER < TER**			66.52
CO_2 Emissions (t/year)	0.37	**DFEE**	35.45	**TFEE**	35.91
Compliance Check	See BREL	**% DFEE < TFEE**			1.29
% DPER < TPER	32.72	**DPER**	39.46	**TPER**	58.65

Assessor Details	Mr. Andreas Athanasi	**Assessor ID**	BD95-0001
Client			

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	114.0600	(1b)	x 2.5000	(2b) =	285.1500	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	114.0600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		285.1500	(5)

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2. Ventilation rate

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	m3 per hour		
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	0 * 10 =	0.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		3.0000	(17)
Infiltration rate		0.1500	(18)
Number of sides sheltered		4	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1050	(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	0.1339	0.1313	0.1286	0.1155	0.1129	0.0997	0.0997	0.0971	0.1050	0.1129	0.1181	0.1234	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation		0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)		0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =		77.4000 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2469	0.2442	0.2416	0.2285	0.2259	0.2127	0.2127	0.2101	0.2180	0.2259	0.2311	0.2364	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Windows (Uw = 1.10)			30.5800	1.0536	32.2203			(27)
Door			2.1000	1.4000	2.9400			(26)
External Wall 1	79.5800	30.5800	49.0000	0.1500	7.3500	140.0000	6860.0003	(29a)
Sheltered	17.2300	2.1000	15.1300	0.1500	2.2695	140.0000	2118.1999	(29a)
Total net area of external elements Aum(A, m2)			96.8100					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	44.7798			(33)
Party Wall 1			20.7800	0.0000	0.0000	140.0000	2909.2001	(32)
Party Floor 1			114.0600			80.0000	9124.8000	(32d)
Party Ceiling 1			114.0600			100.0000	11406.0000	(32b)
Internal Wall 1			202.2300			9.0000	1820.0700	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	34238.2702 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		300.1777 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total

E7 Party floor between dwellings (in blocks of flats)	20.8800	0.0350	0.7308	
E9 Balcony between dwellings, wall insulation continuous	8.6300	0.0100	0.0863	
E17 Corner (inverted - internal area greater than external area)	2.5000	-0.0900	-0.2250	
E1 Steel lintel with perforated steel base plate	14.5300	0.0500	0.7265	
E3 Sill	13.5300	0.0500	0.6765	
E4 Jamb	35.8400	0.0500	1.7920	
E16 Corner (normal)	7.5000	0.0900	0.6750	
E18 Party wall between dwellings	5.0000	0.0300	0.1500	
P7 Party Wall - Exposed floor (normal)	8.3100	0.0800	0.6648	
E20 Exposed floor (normal)	38.7200	0.3200	12.3904	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)				17.6673 (36)
Point Thermal bridges			(36a) =	0.0000
Total fabric heat loss			(33) + (36) + (36a) =	62.4471 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	23.2308	22.9838	22.7368	21.5017	21.2547	20.0197	20.0197	19.7727	20.5137	21.2547	21.7487	22.2428	(38)
Heat transfer coeff	85.6779	85.4309	85.1839	83.9488	83.7018	82.4668	82.4668	82.2198	82.9608	83.7018	84.1959	84.6899	(39)
Average = Sum(39)m / 12 =												83.8871	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7512	0.7490	0.7468	0.7360	0.7338	0.7230	0.7230	0.7208	0.7273	0.7338	0.7382	0.7425	(40)
HLP (average)												0.7355	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8371 (42)
Hot water usage for mixer showers												
	71.7890	70.7102	69.1381	66.1302	63.9104	61.4349	60.0279	61.5881	63.2983	65.9562	69.0288	71.5140 (42a)
Hot water usage for baths												
	30.9949	30.5345	29.8863	28.6911	27.7962	26.8038	26.2678	26.9115	27.6123	28.6742	29.8940	30.8901 (42b)
Hot water usage for other uses												
	43.6850	42.0964	40.5079	38.9193	37.3308	35.7423	35.7423	37.3308	38.9193	40.5079	42.0964	43.6850 (42c)
Average daily hot water use (litres/day)												134.6378 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	146.4689	143.3412	139.5323	133.7406	129.0374	123.9810	122.0379	125.8303	129.8300	135.1383	141.0192	146.0890	(44)
Energy conte	231.9709	204.1159	214.4560	183.0842	173.7091	152.4491	147.5943	155.8042	160.0934	183.3814	200.9077	228.7401	(45)
Energy content (annual)											Total = Sum(45)m =	2236.3063	
Distribution loss (46)m = 0.15 x (45)m													
	34.7956	30.6174	32.1684	27.4626	26.0564	22.8674	22.1391	23.3706	24.0140	27.5072	30.1362	34.3110	(46)
Water storage loss:													
Store volume												110.0000	(47)
b) If manufacturer declared loss factor is not known :													
Hot water storage loss factor from Table 2 (kWh/litre/day)												0.0152	(51)
Volume factor from Table 2a												1.0294	(52)
Temperature factor from Table 2b												0.6000	(53)
Enter (49) or (54) in (55)												1.0327	(55)
Total storage loss													
	32.0144	28.9162	32.0144	30.9817	32.0144	30.9817	32.0144	32.0144	30.9817	32.0144	30.9817	32.0144	(56)
If cylinder contains dedicated solar storage													
	32.0144	28.9162	32.0144	30.9817	32.0144	30.9817	32.0144	32.0144	30.9817	32.0144	30.9817	32.0144	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month													
	287.2477	254.0433	269.7328	236.5779	228.9859	205.9428	202.8711	211.0810	213.5871	238.6582	254.4014	284.0169	(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													
	287.2477	254.0433	269.7328	236.5779	228.9859	205.9428	202.8711	211.0810	213.5871	238.6582	254.4014	284.0169	(64)
											Total per year (kWh/year) = Sum(64)m =	2887.1461	(64)
12Total per year (kWh/year)												2887	(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													
	121.3518	107.8105	115.5280	103.6705	101.9797	93.4843	93.2965	96.0264	96.0260	105.1958	109.5968	120.2775	(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	141.8562	141.8562	141.8562	141.8562	141.8562	141.8562	141.8562	141.8562	141.8562	141.8562	141.8562	141.8562	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	139.9859	154.9844	139.9859	144.6521	139.9859	144.6521	139.9859	139.9859	144.6521	139.9859	144.6521	139.9859	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	277.2649	280.1421	272.8917	257.4567	237.9727	219.6606	207.4269	204.5497	211.8001	227.2351	246.7191	265.0312	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.1856	37.1856	37.1856	37.1856	37.1856	37.1856	37.1856	37.1856	37.1856	37.1856	37.1856	37.1856	(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)													
	-113.4849	-113.4849	-113.4849	-113.4849	-113.4849	-113.4849	-113.4849	-113.4849	-113.4849	-113.4849	-113.4849	-113.4849	(71)
Water heating gains (Table 5)													
	163.1072	160.4323	155.2796	143.9867	137.0695	129.8393	125.3986	129.0677	133.3694	141.3922	152.2177	161.6634	(72)
Total internal gains													
	645.9149	661.1156	633.7141	611.6524	580.5850	559.7088	538.3682	539.1602	555.3784	574.1700	609.1457	632.2374	(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	
North	8.1400	10.6334	0.4500	0.7000	0.5400	13.2508	(74)
East	14.2600	19.6403	0.4500	0.7000	0.5400	42.8759	(76)
South	8.1800	46.7521	0.4500	0.7000	0.5400	58.5465	(78)

Solar gains	114.6733	205.0815	303.2985	408.6144	483.8461	490.8447	468.9326	411.8703	339.9749	233.0878	139.2054	96.8952	(83)
Total gains	760.5882	866.1971	937.0127	1020.2668	1064.4311	1050.5535	1007.3008	951.0305	895.3534	807.2578	748.3512	729.1326	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	111.0045	111.3254	111.6482	113.2908	113.6251	115.3268	115.3268	115.6733	114.6401	113.6251	112.9584	112.2995	
alpha	8.4003	8.4217	8.4432	8.5527	8.5750	8.6885	8.6885	8.7116	8.6427	8.5750	8.5306	8.4866	
util living area	0.9977	0.9924	0.9747	0.8933	0.7172	0.5018	0.3602	0.3976	0.6344	0.9260	0.9919	0.9983	(86)
MIT	20.4185	20.5534	20.7213	20.9095	20.9869	20.9994	21.0000	20.9999	20.9962	20.8933	20.6288	20.3978	(87)
Th 2	20.2959	20.2978	20.2996	20.3091	20.3110	20.3205	20.3205	20.3225	20.3167	20.3110	20.3072	20.3034	(88)
util rest of house	0.9968	0.9897	0.9661	0.8649	0.6692	0.4488	0.3046	0.3391	0.5739	0.8986	0.9886	0.9977	(89)
MIT 2	19.6159	19.7888	19.9993	20.2252	20.3017	20.3203	20.3205	20.3224	20.3147	20.2137	19.8930	19.5958	(90)
Living area fraction									fLA = Living area / (4) =			0.4477	(91)
MIT	19.9752	20.1311	20.3226	20.5316	20.6085	20.6244	20.6248	20.6258	20.6198	20.5180	20.2225	19.9549	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.9752	20.1311	20.3226	20.5316	20.6085	20.6244	20.6248	20.6258	20.6198	20.5180	20.2225	19.9549	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9963	0.9889	0.9664	0.8746	0.6903	0.4725	0.3295	0.3653	0.6010	0.9076	0.9881	0.9973	(94)
Useful gains	757.7951	856.5834	905.5620	892.3425	734.7423	496.4181	331.8941	347.4088	538.1201	732.6959	739.4342	727.1665	(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	1343.0225	1301.2103	1177.4611	976.4585	745.6571	496.8096	331.9085	347.4430	540.8889	830.1522	1104.8580	1334.2788	(97)
Space heating kWh	435.4092	298.7893	202.2930	60.5635	8.1206	0.0000	0.0000	0.0000	0.0000	72.5074	263.1051	451.6916	(98a)
Space heating requirement - total per year (kWh/year)												1792.4797	
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	435.4092	298.7893	202.2930	60.5635	8.1206	0.0000	0.0000	0.0000	0.0000	72.5074	263.1051	451.6916	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1792.4797	
Space heating per m2											(98c) / (4) =	15.7152	(99)

9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(301)
Fraction of space heat from community system												1.0000	(302)
Fraction of heat from community Heat pump-Space and Water												1.0000	(303a)
Factor for control and charging method (Table 4c(3)) for space heating												1.0000	(305)
Factor for charging method (Table 4c(3)) for water heating												1.0000	(305a)
Distribution loss factor (Table 12c) for community heating system												1.5000	(306)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating:													
Space heating requirement													
	435.4092	298.7893	202.2930	60.5635	8.1206	0.0000	0.0000	0.0000	0.0000	72.5074	263.1051	451.6916	(98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.50													
307a	653.1138	448.1840	303.4394	90.8452	12.1809	0.0000	0.0000	0.0000	0.0000	108.7612	394.6577	677.5373	
Space heating requirement													
	653.1138	448.1840	303.4394	90.8452	12.1809	0.0000	0.0000	0.0000	0.0000	108.7612	394.6577	677.5373	(307)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)												0.0000	(308)
Space heating fuel for secondary/supplementary system													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(309)
Water heating													
Annual water heating requirement													
	287.2477	254.0433	269.7328	236.5779	228.9859	205.9428	202.8711	211.0810	213.5871	238.6582	254.4014	284.0169	(64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.50													
310a	430.8716	381.0650	404.5991	354.8669	343.4788	308.9141	304.3066	316.6216	320.3806	357.9873	381.6021	426.0254	
Water heating fuel													
	430.8716	381.0650	404.5991	354.8669	343.4788	308.9141	304.3066	316.6216	320.3806	357.9873	381.6021	426.0254	(310)
Cooling System Energy Efficiency Ratio												0.0000	(314)
Space coolin	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(315)
Pumps and Fa	25.8529	23.3511	25.8529	25.0190	25.8529	25.0190	25.8529	25.8529	25.0190	25.8529	25.0190	25.8529	(331)
Lighting	27.9633	22.4332	20.1986	14.7984	11.4307	9.3390	10.4275	13.5540	17.6053	23.0991	26.0904	28.7405	(332)
Electricity generated by PVs (Appendix M) (negative quantity)													
(333a)m	-4.4761	-7.1663	-11.7122	-15.0405	-17.9758	-17.4557	-17.2304	-15.3404	-12.4088	-8.9167	-5.2114	-3.7757	(333a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(334a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(334a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(335a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(335a)
Electricity generated by PVs (Appendix M) (negative quantity)													
(333b)m	-0.5326	-1.1917	-2.5224	-4.0367	-5.5925	-5.7157	-5.6348	-4.6370	-3.2375	-1.7679	-0.7296	-0.4157	(333b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(334b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(334b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(335b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(335b)
Annual totals kWh/year													
Space heating fuel - community heating												2688.7195	(307)
Space heating fuel - secondary												0.0000	(309)
Water heating fuel - community heating												4330.7191	(310)
Efficiency of water heater												0.0000	(311)
Electricity used for heat distribution												26.8872	(313)
Space cooling fuel												0.0000	(321)
Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.8750)													
mechanical ventilation fans (SFP = 0.8750)												304.3976	(330a)
Total electricity for the above, kWh/year												304.3976	(331)
Electricity for lighting (calculated in Appendix L)												225.6802	(332)

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

PV generation	-172.7239	(333)
Wind generation	0.0000	(334)
Hydro-electric generation (Appendix N)	0.0000	(335a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(335)
Appendix Q - special features		
Energy saved or generated	-0.0000	(336)
Energy used	0.0000	(337)
Total delivered energy for all uses	7376.7926	(338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of heat source Heat pump			285.0000	(367)
Space and Water heating from Heat pump	2462.9609	0.1577	148.7773	(367)
Electrical energy for heat distribution (space & water)	26.8872	0.0000	10.3435	(372)
Overall CO2 factor for heat network			0.0532	(386)
Total CO2 associated with community systems			373.2743	(373)
Space and water heating			373.2743	(376)
Pumps, fans and electric keep-hot	304.3976	0.1387	42.2237	(378)
Energy for lighting	225.6802	0.1443	32.5726	(379)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-136.7100	0.1320	-18.0461	
PV Unit electricity exported	-36.0140	0.1242	-4.4721	
Total			-22.5181	(380)
Total CO2, kg/year			425.5525	(383)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			3.7300	(384)

13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Efficiency of heat source Heat pump			285.0000	(467a)
Space and Water heating from Heat pump	2462.9609	1.5838	1494.1642	(467)
Electrical energy for heat distribution (space & water)	26.8872	0.0000	108.4590	(472)
Overall CO2 factor for heat network			0.5576	(486)
Total CO2 associated with community systems			3914.0382	(473)
Space and water heating			3914.0382	(476)
Pumps, fans and electric keep-hot	304.3976	1.5128	460.4927	(478)
Energy for lighting	225.6802	1.5338	346.1559	(479)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-136.7100	1.4877	-203.3845	
PV Unit electricity exported	-36.0140	0.4557	-16.4124	
Total			-219.7969	(480)
Total Primary energy kWh/year			4500.8899	(483)
Dwelling Primary energy Rate (DPER)			39.4600	(484)

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)	
Ground floor	114.0600 (1b)	x	2.5000 (2b)	=	285.1500	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 114.0600						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	285.1500	(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) =	0.1403	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3903	(18)
Number of sides sheltered		4	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2732	(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													

	0.3483	0.3415	0.3347	0.3005	0.2937	0.2595	0.2595	0.2527	0.2732	0.2937	0.3073	0.3210	(22b)
Effective ac	0.5607	0.5583	0.5560	0.5452	0.5431	0.5337	0.5337	0.5319	0.5373	0.5431	0.5472	0.5515	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1000	1.0000	2.1000			(26)
TER Opening Type (Uw = 1.20)			26.4200	1.1450	30.2519			(27)
External Wall 1	79.5800	26.4200	53.1600	0.1800	9.5688			(29a)
Sheltered	17.2300	2.1000	15.1300	0.1800	2.7234			(29a)
Total net area of external elements Aum(A, m2)			96.8100					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	44.6441			(33)
Party Wall 1			20.7800	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 280.1777 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E7 Party floor between dwellings (in blocks of flats)	20.8800	0.0700	1.4616
E9 Balcony between dwellings, wall insulation continuous	8.6300	0.0200	0.1726
E17 Corner (inverted - internal area greater than external area)	2.5000	-0.0900	-0.2250
E1 Steel lintel with perforated steel base plate	14.5300	0.0500	0.7265
E3 Sill	13.5300	0.0500	0.6765
E4 Jamb	35.8400	0.0500	1.7920
E16 Corner (normal)	7.5000	0.0900	0.6750
E18 Party wall between dwellings	5.0000	0.0600	0.3000
P7 Party Wall - Exposed floor (normal)	8.3100	0.1600	1.3296
E20 Exposed floor (normal)	38.7200	0.3200	12.3904

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 19.2992 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 63.9433 (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	52.7582	52.5366	52.3193	51.2987	51.1078	50.2189	50.2189	50.0543	50.5613	51.1078	51.4941	51.8979	(38)
Heat transfer coeff	116.7015	116.4799	116.2626	115.2420	115.0511	114.1622	114.1622	113.9976	114.5046	115.0511	115.4374	115.8412	(39)
Average = Sum(39)m / 12 =												115.2411	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0232	1.0212	1.0193	1.0104	1.0087	1.0009	1.0009	0.9995	1.0039	1.0087	1.0121	1.0156	(40)
HLP (average)												1.0104	
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 2.8371 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	71.7890	70.7102	69.1381	66.1302	63.9104	61.4349	60.0279	61.5881	63.2983	65.9562	69.0288	71.5140	(42a)
Hot water usage for baths	30.9949	30.5345	29.8863	28.6911	27.7962	26.8038	26.2678	26.9115	27.6123	28.6742	29.8940	30.8901	(42b)
Hot water usage for other uses	43.6850	42.0964	40.5079	38.9193	37.3308	35.7423	35.7423	37.3308	38.9193	40.5079	42.0964	43.6850	(42c)
Average daily hot water use (litres/day)												134.6378	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	146.4689	143.3412	139.5323	133.7406	129.0374	123.9810	122.0379	125.8303	129.8300	135.1383	141.0192	146.0890	(44)
Energy conte	231.9709	204.1159	214.4560	183.0842	173.7091	152.4491	147.5943	155.8042	160.0934	183.3814	200.9077	228.7401	(45)
Energy content (annual)										Total = Sum(45)m =		2236.3063	
Distribution loss (46)m = 0.15 x (45)m	34.7956	30.6174	32.1684	27.4626	26.0564	22.8674	22.1391	23.3706	24.0140	27.5072	30.1362	34.3110	(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	278.5658	246.2016	261.0509	228.1761	220.3040	197.5409	194.1892	202.3991	205.1852	229.9763	245.9996	275.3350	(62)
WWHRS	-32.8190	-29.0254	-30.3937	-25.1672	-23.4549	-20.0705	-18.8129	-20.0056	-20.7657	-24.4805	-27.7334	-32.2112	(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	245.7469	217.1763	230.6572	203.0089	196.8491	177.4704	175.3763	182.3935	184.4195	205.4958	218.2661	243.1238	(64)
										Total per year (kWh/year) = Sum(64)m =		2479.9837	(64)
12Total per year (kWh/year)												2480	(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	114.4062	101.5371	108.5825	96.9490	95.0342	86.7628	86.3510	89.0808	89.3045	98.2502	102.8753	113.3320	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	141.8562	141.8562	141.8562	141.8562	141.8562	141.8562	141.8562	141.8562	141.8562	141.8562	141.8562	141.8562	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	142.0154	157.2313	142.0154	146.7492	142.0154	146.7492	142.0154	142.0154	146.7492	142.0154	146.7492	142.0154	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	277.2649	280.1421	272.8917	257.4567	237.9727	219.6606	207.4269	204.5497	211.8001	227.2351	246.7191	265.0312	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.1856	37.1856	37.1856	37.1856	37.1856	37.1856	37.1856	37.1856	37.1856	37.1856	37.1856	37.1856	(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)													
	-113.4849	-113.4849	-113.4849	-113.4849	-113.4849	-113.4849	-113.4849	-113.4849	-113.4849	-113.4849	-113.4849	-113.4849	(71)
Water heating gains (Table 5)													
	153.7718	151.0969	145.9443	134.6514	127.7341	120.5039	116.0632	119.7323	124.0341	132.0568	142.8823	152.3280	(72)
Total internal gains													
	641.6090	657.0271	629.4083	607.4142	576.2791	552.4705	531.0623	531.8543	548.1402	569.8641	604.9075	627.9315	(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	
North	7.0300	10.6334	0.6300	0.7000	0.5400	16.0215	(74)
East	12.3200	19.6403	0.6300	0.7000	0.5400	51.8600	(76)
South	7.0700	46.7521	0.6300	0.7000	0.5400	70.8427	(78)

Solar gains	138.7242	248.0892	366.8912	494.2707	585.2583	593.7179	567.2158	498.2035	411.2514	281.9653	168.4007	117.2181	(83)
Total gains	780.3332	905.1163	996.2994	1101.6849	1161.5374	1146.1884	1098.2781	1030.0578	959.3916	851.8294	773.3082	745.1495	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	76.0655	76.2103	76.3527	77.0289	77.1567	77.7574	77.7574	77.8697	77.5249	77.1567	76.8985	76.6305	
alpha	6.0710	6.0807	6.0902	6.1353	6.1438	6.1838	6.1838	6.1913	6.1683	6.1438	6.1266	6.1087	
util living area													
	0.9977	0.9938	0.9830	0.9392	0.8224	0.6226	0.4554	0.5052	0.7651	0.9608	0.9940	0.9982	(86)
MIT	19.9742	20.1445	20.3804	20.6841	20.8992	20.9850	20.9981	20.9965	20.9507	20.6678	20.2660	19.9449	(87)
Th 2	20.0641	20.0657	20.0673	20.0747	20.0761	20.0826	20.0826	20.0838	20.0801	20.0761	20.0733	20.0703	(88)
util rest of house													
	0.9968	0.9916	0.9767	0.9174	0.7687	0.5401	0.3616	0.4068	0.6857	0.9420	0.9915	0.9976	(89)
MIT 2	18.8699	19.0880	19.3872	19.7624	19.9963	20.0749	20.0821	20.0827	20.0498	19.7517	19.2498	18.8372	(90)
Living area fraction										fLA = Living area / (4) =		0.4477	(91)
MIT	19.3644	19.5611	19.8319	20.1751	20.4006	20.4824	20.4922	20.4919	20.4532	20.1619	19.7048	19.3332	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.3644	19.5611	19.8319	20.1751	20.4006	20.4824	20.4922	20.4919	20.4532	20.1619	19.7048	19.3332	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9960	0.9900	0.9747	0.9201	0.7888	0.5768	0.4037	0.4510	0.7197	0.9441	0.9901	0.9969	(94)
Useful gains	777.1904	896.0559	971.0812	1013.6883	916.2402	661.1270	443.3589	464.5638	690.4750	804.2343	765.6873	742.8419	(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													
	1758.0337	1707.7172	1550.0011	1299.3629	1001.0102	671.5467	444.3429	466.4618	727.4672	1100.1034	1455.0639	1753.0448	(97)
Space heating kWh													
	729.7474	545.4364	430.7164	205.6857	63.0689	0.0000	0.0000	0.0000	0.0000	220.1266	496.3511	751.5910	(98a)
Space heating requirement - total per year (kWh/year)												3442.7235	
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													
	729.7474	545.4364	430.7164	205.6857	63.0689	0.0000	0.0000	0.0000	0.0000	220.1266	496.3511	751.5910	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3442.7235	
Space heating per m2											(98c) / (4) =	30.1834	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												92.3000	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	729.7474	545.4364	430.7164	205.6857	63.0689	0.0000	0.0000	0.0000	0.0000	220.1266	496.3511	751.5910	(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)													
	790.6256	590.9387	466.6483	222.8448	68.3303	0.0000	0.0000	0.0000	0.0000	238.4903	537.7585	814.2915	(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													
	245.7469	217.1763	230.6572	203.0089	196.8491	177.4704	175.3763	182.3935	184.4195	205.4958	218.2661	243.1238	(64)
Efficiency of water heater												79.8000	(216)
(217)m	86.3467	86.0367	85.4394	84.0892	81.8120	79.8000	79.8000	79.8000	79.8000	84.2143	85.8430	86.4178	(217)
Fuel for water heating, kWh/month													
	284.6048	252.4229	269.9659	241.4210	240.6116	222.3940	219.7697	228.5633	231.1021	244.0153	254.2621	281.3353	(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	29.5080	23.6724	21.3144	15.6158	12.0621	9.8549	11.0035	14.3027	18.5778	24.3751	27.5316	30.3281	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-29.7148	-43.5750	-65.1088	-76.1689	-84.6767	-79.9196	-78.8998	-73.2078	-63.6345	-51.0957	-33.2462	-25.4945	(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	-12.0368	-25.7462	-51.9850	-79.2957	-106.0699	-107.0628	-105.8457	-89.0934	-64.5856	-37.2630	-16.2089	-9.4900	(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	3729.9279	(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	2970.4678	(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)	238.1464	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-1409.4253	(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	5615.1169	(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	3729.9279	0.2100	783.2849	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2970.4678	0.2100	623.7982	(264)
Space and water heating			1407.0831	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	238.1464	0.1443	34.3719	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-704.7423	0.1338	-94.2823	
PV Unit electricity exported	-704.6830	0.1254	-88.3913	
Total			-182.6737	(269)
Total CO2, kg/year			1270.7106	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			11.1400	(273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3729.9279	1.1300	4214.8185	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2970.4678	1.1300	3356.6286	(278)
Space and water heating			7571.4472	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	238.1464	1.5338	365.2769	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-704.7423	1.4944	-1053.1619	
PV Unit electricity exported	-704.6830	0.4604	-324.4408	
Total			-1377.6027	(283)
Total Primary energy kWh/year			6689.2222	(286)
Target Primary Energy Rate (TPER)			58.6500	(287)

Full SAP Calculation Printout

Property Reference	03 Unit 36	**Issued on Date**	08/01/2025
Assessment Reference	Be Green MVHR	**Prop Type Ref**	
Property			

SAP Rating	82 B	**DER**	4.46	**TER**	14.53
Environmental	97 A	**% DER < TER**			69.30
CO_2 Emissions (t/year)	0.21	**DFEE**	30.18	**TFEE**	34.96
Compliance Check	See BREL	**% DFEE < TFEE**			13.69
% DPER < TPER	37.69	**DPER**	48.20	**TPER**	77.36

Assessor Details	Mr. Andreas Athanasi	**Assessor ID**	BD95-0001
Client			

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	52.6100	(1b)	x 2.5000	(2b) =	131.5250	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	52.6100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	131.5250	(5)

2. Ventilation rate

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

	Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		3.0000 (17)
Infiltration rate		0.1500 (18)
Number of sides sheltered		3 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1162 (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	0.1482	0.1453	0.1424	0.1279	0.1250	0.1104	0.1104	0.1075	0.1162	0.1250	0.1308	0.1366	(22b)
Balanced mechanical ventilation with heat recovery													
If mechanical ventilation												0.5000	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.5000	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												77.4000	(23c)
Effective ac	0.2612	0.2583	0.2554	0.2409	0.2380	0.2234	0.2234	0.2205	0.2292	0.2380	0.2438	0.2496	(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	
Windows (Uw = 1.10)			10.1700	1.0536	10.7155			(27)
Door			2.1000	1.4000	2.9400			(26)
External Wall 1	43.0500	10.1700	32.8800	0.1500	4.9320	140.0000	4603.1999	(29a)
Sheltered	34.0000	2.1000	31.9000	0.1500	4.7850	140.0000	4466.0000	(29a)
External Roof 1	6.3500		6.3500	0.1000	0.6350	9.0000	57.1500	(30)
Total net area of external elements Aum(A, m2)			83.4000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		24.0075			(33)
Party Floor 1			52.6100			40.0000	2104.4000	(32d)
Party Ceiling 1			46.2600			100.0000	4626.0000	(32b)
Internal Wall 1			99.6500			9.0000	896.8500	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		16753.5999	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							318.4490	(35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total

E9 Balcony between dwellings, wall insulation continuous	8.8200	0.0100	0.0882	
E17 Corner (inverted – internal area greater than external area)	2.5000	-0.0900	-0.2250	
E7 Party floor between dwellings (in blocks of flats)	42.1900	0.0350	1.4767	
E1 Steel lintel with perforated steel base plate	5.5000	0.0500	0.2750	
E3 Sill	4.5000	0.0500	0.2250	
E4 Jamb	13.2400	0.0500	0.6620	
E16 Corner (normal)	12.5000	0.0900	1.1250	
E24 Eaves (insulation at ceiling level - inverted)	8.3700	0.0800	0.6696	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 4.2965 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 28.3040 (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	11.3377	11.2116	11.0855	10.4548	10.3286	9.6979	9.6979	9.5718	9.9502	10.3286	10.5809	10.8332	(38)
Heat transfer coeff	39.6417	39.5156	39.3894	38.7587	38.6326	38.0019	38.0019	37.8757	38.2542	38.6326	38.8849	39.1371	(39)
Average = Sum(39)m / 12 =												38.7272	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7535	0.7511	0.7487	0.7367	0.7343	0.7223	0.7223	0.7199	0.7271	0.7343	0.7391	0.7439	(40)
HLP (average)												0.7361	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 1.7671 (42)
Hot water usage for mixer showers

53.8474	53.0381	51.8589	49.6028	47.9378	46.0810	45.0256	46.1958	47.4787	49.4723	51.7769	53.6410	(42a)

Hot water usage for baths

23.2794	22.9336	22.4468	21.5491	20.8769	20.1316	19.7290	20.2124	20.7388	21.5364	22.4525	23.2007	(42b)

Hot water usage for other uses

32.7265	31.5364	30.3464	29.1563	27.9663	26.7762	26.7762	27.9663	29.1563	30.3464	31.5364	32.7265	(42c)

Average daily hot water use (litres/day) 100.9805 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.8532	107.5082	104.6521	100.3082	96.7809	92.9888	91.5308	94.3745	97.3738	101.3551	105.7659	109.5682	(44)
Energy conte	173.9806	153.0902	160.8464	137.3169	130.2858	114.3405	110.6985	116.8554	120.0717	137.5378	150.6829	171.5573	(45)
Energy content (annual)										Total = Sum(45)m =		1677.2641	
Distribution loss (46)m = 0.15 x (45)m	26.0971	22.9635	24.1270	20.5975	19.5429	17.1511	16.6048	17.5283	18.0108	20.6307	22.6024	25.7336	(46)
Water storage loss:													
Store volume												110.0000	(47)
b) If manufacturer declared loss factor is not known :													
Hot water storage loss factor from Table 2 (kWh/litre/day)												0.0152	(51)
Volume factor from Table 2a												1.0294	(52)
Temperature factor from Table 2b												0.6000	(53)
Enter (49) or (54) in (55)												1.0327	(55)
Total storage loss	32.0144	28.9162	32.0144	30.9817	32.0144	30.9817	32.0144	32.0144	30.9817	32.0144	30.9817	32.0144	(56)
If cylinder contains dedicated solar storage	32.0144	28.9162	32.0144	30.9817	32.0144	30.9817	32.0144	32.0144	30.9817	32.0144	30.9817	32.0144	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	229.2574	203.0177	216.1232	190.8106	185.5626	167.8342	165.9753	172.1322	173.5653	192.8147	204.1766	226.8341	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	229.2574	203.0177	216.1232	190.8106	185.5626	167.8342	165.9753	172.1322	173.5653	192.8147	204.1766	226.8341	(64)
										Total per year (kWh/year) = Sum(64)m =		2328.1039	(64)
12Total per year (kWh/year)												2328	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000	(64a)
Heat gains from water heating, kWh/month	102.0700	90.8445	97.7029	88.4528	87.5415	80.8132	81.0287	83.0759	82.7188	89.9528	92.8970	101.2643	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	88.3532	88.3532	88.3532	88.3532	88.3532	88.3532	88.3532	88.3532	88.3532	88.3532	88.3532	88.3532	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	78.5324	86.9465	78.5324	81.1501	78.5324	81.1501	78.5324	78.5324	81.1501	78.5324	81.1501	78.5324	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	154.0075	155.6056	151.5784	143.0049	132.1825	122.0110	115.2158	113.6176	117.6448	126.2183	137.0407	147.2122	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.8353	31.8353	31.8353	31.8353	31.8353	31.8353	31.8353	31.8353	31.8353	31.8353	31.8353	31.8353	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-70.6825	-70.6825	-70.6825	-70.6825	-70.6825	-70.6825	-70.6825	-70.6825	-70.6825	-70.6825	-70.6825	-70.6825	(71)
Water heating gains (Table 5)	137.1909	135.1852	131.3210	122.8511	117.6632	112.2405	108.9095	111.6611	114.8872	120.9043	129.0236	136.1079	(72)
Total internal gains	419.2366	427.2433	410.9377	396.5121	377.8841	364.9075	352.1636	353.3171	363.1881	375.1609	396.7204	411.3584	(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	
West	10.1700	19.6403	0.4500	0.7000	0.7700	43.6026	(80)

Solar gains	43.6026	85.2959	140.4702	204.8673	251.0726	257.0175	244.6911	210.1861	163.3726	101.2107	54.3673	35.8566	(83)
Total gains	462.8392	512.5391	551.4079	601.3795	628.9567	621.9250	596.8548	563.5031	526.5607	476.3716	451.0877	447.2150	(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	117.3960	117.7707	118.1479	120.0705	120.4625	122.4618	122.4618	122.8696	121.6542	120.4625	119.6810	118.9095	
alpha	8.8264	8.8514	8.8765	9.0047	9.0308	9.1641	9.1641	9.1913	9.1103	9.0308	8.9787	8.9273	
util living area													
	0.9868	0.9674	0.9138	0.7599	0.5697	0.3910	0.2801	0.3092	0.5008	0.8088	0.9610	0.9895	(86)
MIT	20.6345	20.7500	20.8801	20.9786	20.9982	21.0000	21.0000	21.0000	20.9996	20.9705	20.8090	20.6166	(87)
Th 2	20.2938	20.2959	20.2980	20.3085	20.3106	20.3211	20.3211	20.3233	20.3169	20.3106	20.3064	20.3022	(88)
util rest of house													
	0.9824	0.9576	0.8921	0.7225	0.5281	0.3496	0.2369	0.2637	0.4515	0.7662	0.9477	0.9859	(89)
MIT 2	19.8841	20.0272	20.1801	20.2909	20.3095	20.3211	20.3211	20.3233	20.3167	20.2874	20.1094	19.8691	(90)
Living area fraction										fLA = Living area / (4) =		0.4210	(91)
MIT	20.2000	20.3315	20.4748	20.5804	20.5995	20.6069	20.6070	20.6082	20.6042	20.5750	20.4039	20.1838	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.2000	20.3315	20.4748	20.5804	20.5995	20.6069	20.6070	20.6082	20.6042	20.5750	20.4039	20.1838	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9817	0.9582	0.8980	0.7375	0.5456	0.3670	0.2551	0.2828	0.4723	0.7831	0.9498	0.9852	(94)
Useful gains	454.3783	491.1056	495.1505	443.5022	343.1409	228.2597	152.2716	159.3869	248.6712	373.0400	428.4358	440.6061	(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													
	630.3029	609.7842	550.4602	452.7180	343.8092	228.2745	152.2720	159.3879	248.8132	385.3597	517.3209	625.5602	(97)
Space heating kWh													
	130.8880	79.7520	41.1504	6.6354	0.4972	0.0000	0.0000	0.0000	0.0000	9.1658	63.9973	137.6059	(98a)
Space heating requirement - total per year (kWh/year)												469.6919	
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													
	130.8880	79.7520	41.1504	6.6354	0.4972	0.0000	0.0000	0.0000	0.0000	9.1658	63.9973	137.6059	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												469.6919	
Space heating per m2											(98c) / (4) =	8.9278	(99)

9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(301)
Fraction of space heat from community system												1.0000	(302)
Fraction of heat from community Heat pump-Space and Water												1.0000	(303a)
Factor for control and charging method (Table 4c(3)) for space heating												1.0000	(305)
Factor for charging method (Table 4c(3)) for water heating												1.0000	(305a)
Distribution loss factor (Table 12c) for community heating system												1.5000	(306)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating:													
Space heating requirement													
	130.8880	79.7520	41.1504	6.6354	0.4972	0.0000	0.0000	0.0000	0.0000	9.1658	63.9973	137.6059	(98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.50													
307a	196.3319	119.6281	61.7256	9.9530	0.7458	0.0000	0.0000	0.0000	0.0000	13.7487	95.9959	206.4088	
Space heating requirement													
	196.3319	119.6281	61.7256	9.9530	0.7458	0.0000	0.0000	0.0000	0.0000	13.7487	95.9959	206.4088	(307)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)												0.0000	(308)
Space heating fuel for secondary/supplementary system													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(309)
Water heating													
Annual water heating requirement													
	229.2574	203.0177	216.1232	190.8106	185.5626	167.8342	165.9753	172.1322	173.5653	192.8147	204.1766	226.8341	(64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.50													
310a	343.8861	304.5265	324.1848	286.2158	278.3438	251.7513	248.9630	258.1983	260.3480	289.2220	306.2649	340.2512	
Water heating fuel													
	343.8861	304.5265	324.1848	286.2158	278.3438	251.7513	248.9630	258.1983	260.3480	289.2220	306.2649	340.2512	(310)
Cooling System Energy Efficiency Ratio												0.0000	(314)
Space coolin	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(315)
Pumps and Fa	11.9246	10.7706	11.9246	11.5400	11.9246	11.5400	11.9246	11.9246	11.5400	11.9246	11.5400	11.9246	(331)
Lighting	17.1792	13.7818	12.4090	9.0914	7.0224	5.7374	6.4061	8.3269	10.8158	14.1909	16.0286	17.6567	(332)
Electricity generated by PVs (Appendix M) (negative quantity)													
(333a)m	-4.3107	-6.8060	-10.9698	-13.8862	-16.4139	-15.8759	-15.6765	-14.0480	-11.4873	-8.3955	-4.9886	-3.6462	(333a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(334a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(334a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(335a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(335a)
Electricity generated by PVs (Appendix M) (negative quantity)													
(333b)m	-0.6979	-1.5520	-3.2649	-5.1910	-7.1544	-7.2954	-7.1886	-5.9294	-4.1590	-2.2891	-0.9524	-0.5452	(333b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(334b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(334b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(335b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(335b)
Annual totals kWh/year													
Space heating fuel - community heating												704.5379	(307)
Space heating fuel - secondary												0.0000	(309)
Water heating fuel - community heating												3492.1558	(310)
Efficiency of water heater												0.0000	(311)
Electricity used for heat distribution												7.0454	(313)
Space cooling fuel												0.0000	(321)
Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.8750)													
mechanical ventilation fans (SFP = 0.8750)												140.4029	(330a)
Total electricity for the above, kWh/year												140.4029	(331)
Electricity for lighting (calculated in Appendix L)												138.6461	(332)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-172.7239	(333)
Wind generation												0.0000	(334)
Hydro-electric generation (Appendix N)												0.0000	(335a)
Electricity generated - Micro CHP (Appendix N)												0.0000	(335)

Appendix Q - special features

Energy saved or generated	-0.0000	(336)
Energy used	0.0000	(337)
Total delivered energy for all uses	4303.0188	(338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of heat source Heat pump			285.0000	(367)
Space and Water heating from Heat pump	1472.5241	0.1591	39.3397	(367)
Electrical energy for heat distribution (space & water)	7.0454	0.0000	6.0373	(372)
Overall CO2 factor for heat network			0.0519	(386)
Total CO2 associated with community systems			217.8736	(373)
Space and water heating			217.8736	(376)
Pumps, fans and electric keep-hot	140.4029	0.1387	19.4756	(378)
Energy for lighting	138.6461	0.1443	20.0109	(379)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-126.5046	0.1323	-16.7318	
PV Unit electricity exported	-46.2193	0.1244	-5.7480	
Total			-22.4798	(380)
Total CO2, kg/year			234.8803	(383)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			4.4600	(384)

13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Efficiency of heat source Heat pump			285.0000	(467a)
Space and Water heating from Heat pump	1472.5241	1.5890	392.8188	(467)
Electrical energy for heat distribution (space & water)	7.0454	0.0000	64.2948	(472)
Overall CO2 factor for heat network			0.5529	(486)
Total CO2 associated with community systems			2320.2536	(473)
Space and water heating			2320.2536	(476)
Pumps, fans and electric keep-hot	140.4029	1.5128	212.4016	(478)
Energy for lighting	138.6461	1.5338	212.6601	(479)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-126.5046	1.4887	-188.3252	
PV Unit electricity exported	-46.2193	0.4564	-21.0956	
Total			-209.4209	(480)
Total Primary energy kWh/year			2535.8944	(483)
Dwelling Primary energy Rate (DPER)			48.2000	(484)

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)	
Ground floor		52.6100 (1b)	x	2.5000 (2b)	=	131.5250	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	52.6100						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	131.5250	(5)

2. Ventilation rate

	m3 per hour	
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	2 * 10 =	20.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)

	Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1521 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.4021 (18)
Number of sides sheltered		3 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3116 (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	0.3973	0.3895	0.3817	0.3428	0.3350	0.2960	0.2960	0.2882	0.3116	0.3350	0.3505	0.3661	(22b)
Effective ac	0.5789	0.5759	0.5729	0.5587	0.5561	0.5438	0.5438	0.5415	0.5485	0.5561	0.5614	0.5670	(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	
TER Opaque door			2.1000	1.0000	2.1000			(26)
TER Opening Type (Uw = 1.20)			10.1700	1.1450	11.6450			(27)
External Wall 1	43.0500	10.1700	32.8800	0.1800	5.9184			(29a)
Sheltered	34.0000	2.1000	31.9000	0.1800	5.7420			(29a)
External Roof 1	6.3500		6.3500	0.1100	0.6985			(30)
Total net area of external elements Aum(A, m2)			83.4000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		26.1039			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 300.8629 (35)

List of Thermal Bridges

	K1 Element	Length	Psi-value	Total
E9	Balcony between dwellings, wall insulation continuous	8.8200	0.0200	0.1764
E17	Corner (inverted - internal area greater than external area)	2.5000	-0.0900	-0.2250
E7	Party floor between dwellings (in blocks of flats)	42.1900	0.0700	2.9533
E1	Steel lintel with perforated steel base plate	5.5000	0.0500	0.2750
E3	Sill	4.5000	0.0500	0.2250
E4	Jamb	13.2400	0.0500	0.6620
E16	Corner (normal)	12.5000	0.0900	1.1250
E24	Eaves (insulation at ceiling level - inverted)	8.3700	0.2400	2.0088

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 7.2005 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 33.3044 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	25.1270	24.9939	24.8636	24.2512	24.1366	23.6033	23.6033	23.5045	23.8087	24.1366	24.3684	24.6107	(38)
Heat transfer coeff	58.4314	58.2984	58.1680	57.5556	57.4411	56.9077	56.9077	56.8089	57.1132	57.4411	57.6728	57.9152	(39)

Average = Sum(39)m / 12 = 57.5551

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1107	1.1081	1.1056	1.0940	1.0918	1.0817	1.0817	1.0798	1.0856	1.0918	1.0962	1.1008	(40)
HLP (average)												1.0940	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 1.7671 (42)

Hot water usage for mixer showers

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
53.8474	53.0381	51.8589	49.6028	47.9378	46.0810	45.0256	46.1958	47.4787	49.4723	51.7769	53.6410	(42a)

Hot water usage for baths

23.2794	22.9336	22.4468	21.5491	20.8769	20.1316	19.7290	20.2124	20.7388	21.5364	22.4525	23.2007	(42b)

Hot water usage for other uses

32.7265	31.5364	30.3464	29.1563	27.9663	26.7762	26.7762	27.9663	29.1563	30.3464	31.5364	32.7265	(42c)

Average daily hot water use (litres/day) 100.9805 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.8532	107.5082	104.6521	100.3082	96.7809	92.9888	91.5308	94.3745	97.3738	101.3551	105.7659	109.5682	(44)
Energy conte	173.9806	153.0902	160.8464	137.3169	130.2858	114.3405	110.6985	116.8554	120.0717	137.5378	150.6829	171.5573	(45)
Energy content (annual)										Total = Sum(45)m =		1677.2641	
Distribution loss (46)m = 0.15 x (45)m	26.0971	22.9635	24.1270	20.5975	19.5429	17.1511	16.6048	17.5283	18.0108	20.6307	22.6024	25.7336	(46)

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

Total storage loss

23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(56)

If cylinder contains dedicated solar storage

23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(57)

Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)

Total heat required for water heating calculated for each month

	220.5755	195.1760	207.4413	182.4087	176.8807	159.4324	157.2934	163.4503	165.1635	184.1328	195.7748	218.1522	(62)
WWHRS	-24.6168	-21.7713	-22.7976	-18.8773	-17.5930	-15.0544	-14.1111	-15.0058	-15.5759	-18.3623	-20.8022	-24.1609	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	195.9588	173.4047	184.6437	163.5314	159.2877	144.3779	143.1823	148.4445	149.5876	165.7705	174.9725	193.9913	(64)
										Total per year (kWh/year) = Sum(64)m =		1997.1529	(64)
12Total per year (kWh/year)												1997	(64)

Electric shower(s)

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)

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

Heat gains from water heating, kWh/month

95.1245	84.5711	90.7573	81.7313	80.5959	74.0917	74.0832	76.1303	75.9973	83.0073	86.1755	94.3187	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	88.3532	88.3532	88.3532	88.3532	88.3532	88.3532	88.3532	88.3532	88.3532	88.3532	88.3532	88.3532	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	78.5324	86.9465	78.5324	81.1501	78.5324	81.1501	78.5324	78.5324	81.1501	78.5324	81.1501	78.5324	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	154.0075	155.6056	151.5784	143.0049	132.1825	122.0110	115.2158	113.6176	117.6448	126.2183	137.0407	147.2122	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.8353	31.8353	31.8353	31.8353	31.8353	31.8353	31.8353	31.8353	31.8353	31.8353	31.8353	31.8353	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-70.6825	-70.6825	-70.6825	-70.6825	-70.6825	-70.6825	-70.6825	-70.6825	-70.6825	-70.6825	-70.6825	-70.6825	(71)
Water heating gains (Table 5)	127.8555	125.8498	121.9857	113.5157	108.3279	102.9051	99.5742	102.3257	105.5518	111.5689	119.6883	126.7725	(72)
Total internal gains	412.9013	420.9079	404.6024	390.1767	371.5487	355.5722	342.8282	343.9817	353.8527	368.8255	390.3850	405.0230	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
West	10.1700	19.6403	0.6300	0.7000	0.7700	61.0436	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	61.0436	119.4142	196.6582	286.8143	351.5017	359.8245	342.5676	294.2605	228.7216	141.6950	76.1142	50.1993	(83)
Total gains	473.9448	540.3221	601.2606	676.9910	723.0504	715.3967	685.3958	638.2422	582.5743	510.5205	466.4992	455.2223	(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	75.2468	75.4185	75.5876	76.3918	76.5442	77.2615	77.2615	77.3959	76.9836	76.5442	76.2365	75.9176	
alpha	6.0165	6.0279	6.0392	6.0928	6.1029	6.1508	6.1508	6.1597	6.1322	6.1029	6.0824	6.0612	
util living area	0.9933	0.9845	0.9590	0.8709	0.7044	0.5051	0.3649	0.4084	0.6552	0.9171	0.9841	0.9946	(86)
MIT	20.1080	20.2815	20.5284	20.8108	20.9559	20.9950	20.9994	20.9989	20.9781	20.7712	20.3936	20.0798	(87)
Th 2	19.9921	19.9942	19.9962	20.0057	20.0075	20.0158	20.0158	20.0174	20.0126	20.0075	20.0039	20.0001	(88)
util rest of house	0.9908	0.9789	0.9448	0.8332	0.6412	0.4294	0.2835	0.3218	0.5709	0.8824	0.9774	0.9926	(89)
MIT 2	18.9783	19.1983	19.5041	19.8350	19.9767	20.0136	20.0157	20.0171	20.0010	19.8032	19.3491	18.9488	(90)
Living area fraction									fLA = Living area / (4) =			0.4210	(91)
MIT	19.4540	19.6543	19.9353	20.2458	20.3890	20.4268	20.4299	20.4304	20.4124	20.2107	19.7889	19.4250	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.4540	19.6543	19.9353	20.2458	20.3890	20.4268	20.4299	20.4304	20.4124	20.2107	19.7889	19.4250	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9890	0.9766	0.9438	0.8431	0.6663	0.4613	0.3178	0.3583	0.6060	0.8905	0.9756	0.9911	(94)
Useful gains	468.7538	527.6546	567.4569	570.7455	481.7606	330.0101	217.8191	228.6984	353.0313	454.6130	455.0941	451.1802	(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	885.4670	860.1543	781.5073	653.0159	499.1035	331.5874	217.9484	228.9643	360.5188	552.0507	731.8041	881.7568	(97)
Space heating kWh	310.0346	223.4398	159.2534	59.2347	12.9031	0.0000	0.0000	0.0000	0.0000	72.4936	199.2312	320.3490	(98a)
Space heating requirement - total per year (kWh/year)												1356.9396	
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	310.0346	223.4398	159.2534	59.2347	12.9031	0.0000	0.0000	0.0000	0.0000	72.4936	199.2312	320.3490	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1356.9396	
Space heating per m2										(98c) / (4) =		25.7924	(99)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	310.0346	223.4398	159.2534	59.2347	12.9031	0.0000	0.0000	0.0000	0.0000	72.4936	199.2312	320.3490	(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)	335.8989	242.0800	172.5389	64.1763	13.9795	0.0000	0.0000	0.0000	0.0000	78.5413	215.8518	347.0737	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	195.9588	173.4047	184.6437	163.5314	159.2877	144.3779	143.1823	148.4445	149.5876	165.7705	174.9725	193.9913	(64)
Efficiency of water heater												79.8000	(216)
(217)m	85.0837	84.6294	83.7298	82.0102	80.4107	79.8000	79.8000	79.8000	79.8000	82.3391	84.3517	85.1768	(217)
Fuel for water heating, kWh/month	230.3128	204.8989	220.5232	199.4038	198.0926	180.9247	179.4264	186.0207	187.4531	201.3266	207.4322	227.7514	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	16.3175	13.0905	11.7865	8.6353	6.6702	5.4496	6.0847	7.9092	10.2733	13.4791	15.2246	16.7710	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-14.2298	-21.1553	-32.0542	-38.0673	-42.8544	-40.6850	-40.2092	-37.0692	-31.8359	-25.0883	-16.0344	-12.1797	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-5.0280	-10.8190	-21.9551	-33.6405	-45.1272	-45.5603	-45.0043	-37.7919	-27.3055	-15.6671	-6.7767	-3.9569	(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	1470.1404	(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	2423.5666	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
Total electricity for the above, kWh/year	86.0000	(231)
Electricity for lighting (calculated in Appendix L)	131.6913	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-650.0953	(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	3461.3030	(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	1470.1404	0.2100	308.7295	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2423.5666	0.2100	508.9490	(264)
Space and water heating			817.6785	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	131.6913	0.1443	19.0071	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-351.4627	0.1335	-46.9087	
PV Unit electricity exported	-298.6325	0.1253	-37.4265	
Total			-84.3352	(269)
Total CO2, kg/year			764.2797	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			14.5300	(273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	1470.1404	1.1300	1661.2586	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2423.5666	1.1300	2738.6302	(278)
Space and water heating			4399.8889	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	131.6913	1.5338	201.9926	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-351.4627	1.4932	-524.8067	
PV Unit electricity exported	-298.6325	0.4600	-137.3732	
Total			-662.1800	(283)
Total Primary energy kWh/year			4069.8023	(286)
Target Primary Energy Rate (TPER)			77.3600	(287)

Appendix C – Be Lean SBEM

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

J3092_Otterfield Road_Be Lean

As designed

Date: Thu Mar 27 14:01:04 2025

Administrative information

Building Details

Address: Yiewsley Housing, Hillingdon, London, UB7

Certifier details

Name: MWL

Telephone number: 020 8446 9696

Address: Lymehouse Studios, 30/31 Lyme Street, London, NW1 0EE

Certification tool

Calculation engine: SBEM

Calculation engine version: v6.1.e.1

Interface to calculation engine: Virtual Environment

Interface to calculation engine version: v7.0.26

BRUKL compliance module version: v6.1.e.1

Foundation area [m^2]: 407.15

The CO_2 emission and primary energy rates of the building must not exceed the targets

Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	5.35	
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	4.57	
Target primary energy rate (TPER), kWh_{PE}/m^2.annum	57.63	
Building primary energy rate (BPER), kWh_{PE}/m^2.annum	49.7	
Do the building's emission and primary energy rates exceed the targets?	BER =< TER	BPER =< TPER

The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Fabric element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	First surface with maximum value
Walls*	0.26	0.19	1.1	00000000_W8_O0
Floors	0.18	0.1	0.1	00000000_F
Pitched roofs	0.16	-	-	No heat loss pitched roofs
Flat roofs	0.18	0.1	0.1	00000000_C
Windows** and roof windows	1.6	1.1	1.1	00000000_W1_O0
Rooflights***	2.2	-	-	No external rooflights
Personnel doors^	1.6	-	-	No external personnel doors
Vehicle access & similar large doors	1.3	-	-	No external vehicle access doors
High usage entrance doors	3	-	-	No external high usage entrance doors

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [$W/(m^2K)$] $U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [$W/(m^2K)$]

$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [$W/(m^2K)$]

* Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.

** Display windows and similar glazing are excluded from the U-value check. *** Values for rooflights refer to the horizontal position.

^ For fire doors, limiting U-value is 1.8 W/m^2K

NB: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air permeability	Limiting standard	This building
$m^3/(h.m^2)$ at 50 Pa	8	3

Building services

For details on the standard values listed below, system-specific guidance, and additional regulatory requirements, refer to the Approved Documents.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	0.9 to 0.95

1- VRF system w Condensors and FC amenity Be Lean

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	2.64	7.2	-	1	0.83
Standard value	2.5*	5	N/A	2^	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps.

^ Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.

1- SYST0000-DHW

	Water heating efficiency	**Storage loss factor [kWh/litre per day]**
This building	1	-
Standard value	1	N/A

Zone-level mechanical ventilation, exhaust, and terminal units

ID	**System type in the Approved Documents**
A	Local supply or extract ventilation units
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal balanced supply and extract ventilation system
E	Local balanced supply and extract ventilation units
F	Other local ventilation units
G	Fan assisted terminal variable air volume units
H	Fan coil units
I	Kitchen extract with the fan remote from the zone and a grease filter

NB: Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.

Zone name	**SFP [W/(l/s)]**									**HR efficiency**	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	**Zone**	**Standard**
00_09 - Changing Places	-	-	0.3	-	-	-	-	-	-	-	N/A
00_17 - WC	-	-	0.3	-	-	-	-	-	-	-	N/A
00_18 - WC	-	-	0.3	-	-	-	-	-	-	-	N/A
00_19 - Disabled WC	-	-	0.3	-	-	-	-	-	-	-	N/A

General lighting and display lighting	**General luminaire**	**Display light source**	
Zone name	**Efficacy [lm/W]**	**Efficacy [lm/W]**	**Power density [W/m²]**
Standard value	95	80	0.3
00_ Cupboard	110	-	-
00_ Cupboard	110	-	-
00_ Cupboard	110	-	-
00_13 - Draft Lobby	110	-	-
00_15 - Store	110	-	-

General lighting and display lighting	General luminaire	Display light source	
Zone name	**Efficacy [lm/W]**	**Efficacy [lm/W]**	**Power density [W/m²]**
Standard value	95	80	0.3
00_20 - Lobby	110	-	-
00_ Flexible Event Space	110	90	2.2
00_06 - Community Space	110	90	2.2
00_07 - Meeting/Study Room	110	-	-
00_08 - Multi-function Room	110	90	2.2
00_09 - Changing Places	110	-	-
00_12 - Reception	110	90	1.5
00_14 - M O	110	-	-
00_15 - Staff room	110	-	-
00_17 - WC	110	-	-
00_18 - WC	110	-	-
00_19 - Disabled WC	110	-	-

The spaces in the building should have appropriate passive control measures to limit solar gains in summer

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
00_ Flexible Event Space	NO (-39%)	NO
00_06 - Community Space	NO (-34.5%)	NO
00_07 - Meeting/Study Room	NO (-51.9%)	NO
00_08 - Multi-function Room	NO (-23.4%)	NO
00_09 - Changing Places	N/A	N/A
00_12 - Reception	N/A	N/A
00_14 - M O	N/A	N/A
00_15 - Staff room	N/A	N/A
00_17 - WC	N/A	N/A
00_18 - WC	N/A	N/A
00_19 - Disabled WC	N/A	N/A

Regulation 25A: Consideration of high efficiency alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	YES
Is evidence of such assessment available as a separate submission?	YES
Are any such measures included in the proposed design?	YES

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Floor area [m^2]	402.6	402.6
External area [m^2]	960.4	960.4
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	3	3
Average conductance [W/K]	217.02	272.43
Average U-value [W/m^2K]	0.23	0.28
Alpha value* [%]	30.07	19.4

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
	Retail/Financial and Professional Services
	Restaurants and Cafes/Drinking Establishments/Takeaways
	Offices and Workshop Businesses
	General Industrial and Special Industrial Groups
	Storage or Distribution
	Hotels
	Residential Institutions: Hospitals and Care Homes
	Residential Institutions: Residential Schools
	Residential Institutions: Universities and Colleges
	Secure Residential Institutions
	Residential Spaces
	Non-residential Institutions: Community/Day Centre
100	**Non-residential Institutions: Libraries, Museums, and Galleries**
	Non-residential Institutions: Education
	Non-residential Institutions: Primary Health Care Building
	Non-residential Institutions: Crown and County Courts
	General Assembly and Leisure, Night Clubs, and Theatres
	Others: Passenger Terminals
	Others: Emergency Services
	Others: Miscellaneous 24hr Activities
	Others: Car Parks 24 hrs
	Others: Stand Alone Utility Block

Energy Consumption by End Use [kWh/m^2]

	Actual	Notional
Heating	4.32	5.41
Cooling	6.34	6.45
Auxiliary	6.82	14.26
Lighting	14.52	17.88
Hot water	1.15	1.15
Equipment*	16.89	16.89
TOTAL**	**33.15**	**45.14**

* Energy used by equipment does not count towards the total for consumption or calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m^2]

	Actual	Notional
Photovoltaic systems	0	6.17
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	*0*	*6.17*

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	172.94	167.25
Primary energy [kWh_{PE}/m^2]	49.7	57.63
Total emissions [kg/m^2]	4.57	5.35

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] No Heating or Cooling										
	Actual	144.6	93.9	0	0	0	0	0	0	0
	Notional	140.3	73.7	0	0	0	0	0	----	----
[ST] Variable refrigerant flow, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	44.1	124.4	4.6	6.8	7.3	2.65	5.1	2.64	7.2
	Notional	54.9	109.2	5.8	6.9	15.2	2.64	4.4	----	----

Key to terms

Heat dem [MJ/m2] = Heating energy demand
Cool dem [MJ/m2] = Cooling energy demand
Heat con [kWh/m2] = Heating energy consumption
Cool con [kWh/m2] = Cooling energy consumption
Aux con [kWh/m2] = Auxiliary energy consumption
Heat SSEFF = Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
Cool SSEER = Cooling system seasonal energy efficiency ratio
Heat gen SSEFF = Heating generator seasonal efficiency
Cool gen SSEER = Cooling generator seasonal energy efficiency ratio
ST = System type
HS = Heat source
HFT = Heating fuel type
CFT = Cooling fuel type

Appendix D – Be Green SBEM

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

J3092_Otterfield Road_Be Green

As designed

Date: Thu Mar 13 17:11:32 2025

Administrative information

Building Details

Address: Yiewsley Housing, Hillingdon, London, UB7

Certifier details

Name: MWL

Telephone number: 020 8446 9696

Address: Lymehouse Studios, 30/31 Lyme Street, London, NW1 0EE

Certification tool

Calculation engine: SBEM

Calculation engine version: v6.1.e.1

Interface to calculation engine: Virtual Environment

Interface to calculation engine version: v7.0.26

BRUKL compliance module version: v6.1.e.1

Foundation area [m^2]: 407.15

The CO_2 emission and primary energy rates of the building must not exceed the targets

Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	5.35	
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	3.4	
Target primary energy rate (TPER), kWh_{PE}/m^2.annum	57.63	
Building primary energy rate (BPER), kWh_{PE}/m^2.annum	36.61	
Do the building's emission and primary energy rates exceed the targets?	BER =< TER	BPER =< TPER

The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Fabric element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	First surface with maximum value
Walls*	0.26	0.19	1.1	00000000_W8_O0
Floors	0.18	0.1	0.1	00000000_F
Pitched roofs	0.16	-	-	No heat loss pitched roofs
Flat roofs	0.18	0.1	0.1	00000000_C
Windows** and roof windows	1.6	1.1	1.1	00000000_W1_O0
Rooflights***	2.2	-	-	No external rooflights
Personnel doors^	1.6	-	-	No external personnel doors
Vehicle access & similar large doors	1.3	-	-	No external vehicle access doors
High usage entrance doors	3	-	-	No external high usage entrance doors

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [$W/(m^2K)$] $U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [$W/(m^2K)$]

$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [$W/(m^2K)$]

* Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.

** Display windows and similar glazing are excluded from the U-value check. *** Values for rooflights refer to the horizontal position.

^ For fire doors, limiting U-value is 1.8 W/m^2K

NB: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air permeability	Limiting standard	This building
$m^3/(h.m^2)$ at 50 Pa	8	3

Building services

For details on the standard values listed below, system-specific guidance, and additional regulatory requirements, refer to the Approved Documents.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	0.9 to 0.95

1- VRF system w Condensors and FC amenity

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	4.5	7.2	-	1	0.83
Standard value	2.5*	5	N/A	2^	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps.

^ Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.

1- SYST0000-DHW

	Water heating efficiency	**Storage loss factor [kWh/litre per day]**
This building	1	-
Standard value	1	N/A

Zone-level mechanical ventilation, exhaust, and terminal units

ID	**System type in the Approved Documents**
A	Local supply or extract ventilation units
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal balanced supply and extract ventilation system
E	Local balanced supply and extract ventilation units
F	Other local ventilation units
G	Fan assisted terminal variable air volume units
H	Fan coil units
I	Kitchen extract with the fan remote from the zone and a grease filter

NB: Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.

Zone name	**SFP [W/(l/s)]**									**HR efficiency**	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	**Zone**	**Standard**
00_09 - Changing Places	-	-	0.3	-	-	-	-	-	-	-	N/A
00_17 - WC	-	-	0.3	-	-	-	-	-	-	-	N/A
00_18 - WC	-	-	0.3	-	-	-	-	-	-	-	N/A
00_19 - Disabled WC	-	-	0.3	-	-	-	-	-	-	-	N/A

General lighting and display lighting	**General luminaire**	**Display light source**	
Zone name	**Efficacy [lm/W]**	**Efficacy [lm/W]**	**Power density [W/m²]**
Standard value	95	80	0.3
00_ Cupboard	110	-	-
00_ Cupboard	110	-	-
00_ Cupboard	110	-	-
00_13 - Draft Lobby	110	-	-
00_15 - Store	110	-	-

General lighting and display lighting	General luminaire	Display light source	
Zone name	**Efficacy [lm/W]**	**Efficacy [lm/W]**	**Power density [W/m²]**
Standard value	95	80	0.3
00_20 - Lobby	110	-	-
00_ Flexible Event Space	110	90	2.2
00_06 - Community Space	110	90	2.2
00_07 - Meeting/Study Room	110	-	-
00_08 - Multi-function Room	110	90	2.2
00_09 - Changing Places	110	-	-
00_12 - Reception	110	90	1.5
00_14 - M O	110	-	-
00_15 - Staff room	110	-	-
00_17 - WC	110	-	-
00_18 - WC	110	-	-
00_19 - Disabled WC	110	-	-

The spaces in the building should have appropriate passive control measures to limit solar gains in summer

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
00_ Flexible Event Space	NO (-39%)	NO
00_06 - Community Space	NO (-34.5%)	NO
00_07 - Meeting/Study Room	NO (-51.9%)	NO
00_08 - Multi-function Room	NO (-23.4%)	NO
00_09 - Changing Places	N/A	N/A
00_12 - Reception	N/A	N/A
00_14 - M O	N/A	N/A
00_15 - Staff room	N/A	N/A
00_17 - WC	N/A	N/A
00_18 - WC	N/A	N/A
00_19 - Disabled WC	N/A	N/A

Regulation 25A: Consideration of high efficiency alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	YES
Is evidence of such assessment available as a separate submission?	YES
Are any such measures included in the proposed design?	YES

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Floor area [m^2]	402.6	402.6
External area [m^2]	960.4	960.4
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	3	3
Average conductance [W/K]	217.02	272.43
Average U-value [W/m^2K]	0.23	0.28
Alpha value* [%]	30.07	19.4

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
	Retail/Financial and Professional Services
	Restaurants and Cafes/Drinking Establishments/Takeaways
	Offices and Workshop Businesses
	General Industrial and Special Industrial Groups
	Storage or Distribution
	Hotels
	Residential Institutions: Hospitals and Care Homes
	Residential Institutions: Residential Schools
	Residential Institutions: Universities and Colleges
	Secure Residential Institutions
	Residential Spaces
	Non-residential Institutions: Community/Day Centre
100	**Non-residential Institutions: Libraries, Museums, and Galleries**
	Non-residential Institutions: Education
	Non-residential Institutions: Primary Health Care Building
	Non-residential Institutions: Crown and County Courts
	General Assembly and Leisure, Night Clubs, and Theatres
	Others: Passenger Terminals
	Others: Emergency Services
	Others: Miscellaneous 24hr Activities
	Others: Car Parks 24 hrs
	Others: Stand Alone Utility Block

Energy Consumption by End Use [kWh/m^2]

	Actual	Notional
Heating	2.54	5.41
Cooling	6.34	6.45
Auxiliary	6.82	14.26
Lighting	14.52	17.88
Hot water	1.15	1.15
Equipment*	16.89	16.89
TOTAL**	**31.36**	**45.14**

* Energy used by equipment does not count towards the total for consumption or calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m^2]

	Actual	Notional
Photovoltaic systems	7.01	6.17
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	*7.01*	*6.17*

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	172.94	167.25
Primary energy [kWh_{PE}/m^2]	36.61	57.63
Total emissions [kg/m^2]	3.4	5.35

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] No Heating or Cooling										
	Actual	144.6	93.9	0	0	0	0	0	0	0
	Notional	140.3	73.7	0	0	0	0	0	----	----
[ST] Variable refrigerant flow, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	44.1	124.4	2.7	6.8	7.3	4.52	5.1	4.5	7.2
	Notional	54.9	109.2	5.8	6.9	15.2	2.64	4.4	----	----

Key to terms

Heat dem [MJ/m2] = Heating energy demand
Cool dem [MJ/m2] = Cooling energy demand
Heat con [kWh/m2] = Heating energy consumption
Cool con [kWh/m2] = Cooling energy consumption
Aux con [kWh/m2] = Auxiliary energy consumption
Heat SSEFF = Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
Cool SSEER = Cooling system seasonal energy efficiency ratio
Heat gen SSEFF = Heating generator seasonal efficiency
Cool gen SSEER = Cooling generator seasonal energy efficiency ratio
ST = System type
HS = Heat source
HFT = Heating fuel type
CFT = Cooling fuel type