



Amethyst Lane

Energy and Overheating Assessment

April 2023

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1.0 Executive summary

HTA Design LLP has been appointed to prepare this Energy and Overheating Assessment Statement to support the submission of the planning application for the Amethyst Lane Site development, in the Reading Borough Council.

This report sets out how the development responds to all relevant planning and project requirements, including:

- Energy Statement
- Overheating Assessment

A Sustainability Statement is separately submitted, summarising the overall sustainability strategy and covering all aspects which lead to the development of the Amethyst Lane Development achieving and exceeding the national and regional targets, as outlined in the National Planning Policy Framework. This statement has also been prepared in line with the latest Reading Climate Change Strategy on preparing energy assessments.

The strategy for reducing energy use and associated carbon emissions through the design of the scheme follows the 'Be Lean', 'Be Clean', 'Be Green' Energy Hierarchy. The improvement in energy performance will be achieved through the use of high fabric efficiency, good air tightness levels, efficient building services, and the installation of PV panels on the roof.

The development achieves 45% reduction above 2021 Building Regulations at 'Be Lean' stage and 112% overall carbon reduction above 2021 Building Regulations, achieving a net zero regulated carbon. Tables 1-2 and Figure 1 demonstrate the overall reduction in the regulated carbon emissions of the development after each stage of the Energy Hierarchy.

Carbon emission factors

The proposed building has been modelled in Design web-based SAP 10.2 and IES VE 2022. The data produced by the software has been used to calculate the carbon dioxide emissions using the SAP 10.2 carbon factors, in line with the requirements set out in the new Approved Document L. The assessment has been undertaken by the energy modelling team who consists of accredited domestic energy and low carbon assessors.

Establishing CO₂ emissions

This document details the measures adopted to reduce the carbon emissions of the proposed buildings. The following tables report the regulated emissions as well as those emissions associated with uses not covered by Building Regulations, i.e. unregulated energy uses.

These tables demonstrate compliance with the energy hierarchy and the carbon targets. Savings are expressed in tonnes of CO₂ per annum as opposed to kgCO₂/m² per annum.

Based on the National Calculation Methodology, the total Carbon Emissions for the non-regulated end uses of the building have been calculated. The total carbon emissions of the development from equipment is circa 9.6 tonnes per year. No strategies are proposed to reduce the non-regulated energy demand of the development.

Be Lean

The first step addresses reduction in energy use, through the adoption of fabric, servicing improvements and the incorporation of flexibility measures.

The proposed development will incorporate a range of energy efficiency measures including levels of insulation exceeding current Building Regulation requirements, the installation of high performance glazing, energy efficient lighting and efficient MVHR system for general ventilation purposes in all habitable spaces.

The implementation of these measures at 'Be Lean' stage will reduce regulated CO₂ emissions by 13.4 tCO₂/year or 45% when compared to a notional building built to current Part L Building Regulations (2021).

Be Clean

The possibility of employing a decentralised energy network was investigated but no current or future decentralized energy schemes were identified within the vicinity of the site.

Be Green

The Air Source Heat Pump absorbs heat from outside air and then transfers it via the central heating system to provide both hot water heating and heating for an indoor space. The use of ASHP would allow the development to reduce its

carbon emissions and contribute to reducing poor air quality.

The majority of the dwellings will be provided with efficient compact Air Source Heat Pumps (ASHPs) with no outdoor units. Efficient Air Source Heat Pumps with outdoor units will be provided to the large end terrace houses.

Photovoltaic panels (PVs) will be installed on the roof. The full electric HVAC design solutions will be benefited from the future de-carbonisation of the grid. PVs provision has been maximised.

The implementation of the above measures at 'Be Green' stage will further reduce regulated CO₂ emissions by 19.9 tCO₂/year or 67% when compared to a notional building built to current Part L Building Regulations (2021), achieving net zero regulated carbon emissions.

Energy Costs

The energy hierarchy has been followed and the energy efficiency measures, and renewable energy generation has been maximised. This includes efficient building fabric, low

air tightness, efficient all electric building services solution, low distribution losses and efficient PV panels. These measures are anticipated to all play a significant role in reducing the occupants' energy costs and minimizing potential impacts from future electricity unit costs increases.

Using the predicted energy consumption taken from the Be Green Part L calculations, the expected space heating, hot water and lighting costs are expected to be zero as the building achieves net zero regulated target.

It should be noted that the actual costs will include additional charges for the heating system and maintenance, standing charges, the occupants' preferred internal temperatures and hot water usage patterns, the occupants' use of lights and appliances (unregulated loads) and the fit-out specification and usage of the communal spaces. Unit electricity costs may also be higher by the time the development is occupied.

Part L 2021 Performance		
	Carbon Dioxide Emissions (Tonnes CO ₂ per Annum)	
	Regulated	Unregulated
Baseline: Part L1A 2021 of the Building Regulations	29.7	9.6
Compliant Development		
After Energy Demand Reduction (Be Lean)	16.3	9.6
After CHP/DHN/Electric systems (Be Clean)	16.3	9.6
After Renewable Energy (Be Green)	-3.7	9.6

Table 1: Carbon Dioxide Emissions after each stage of the Energy Hierarchy.

	Regulated carbon dioxide savings	
	(Tonnes CO ₂ per Annum)	(%)
Savings from Energy Demand Reduction	13.4	45%
Savings from Heat Network / CHP/Electric syst.	0.0	0%
Savings from renewable energy	19.9	67%
Total Cumulative Savings	33.3	112%

Table 2: Regulated Carbon Dioxide savings from each stage of the Energy Hierarchy.

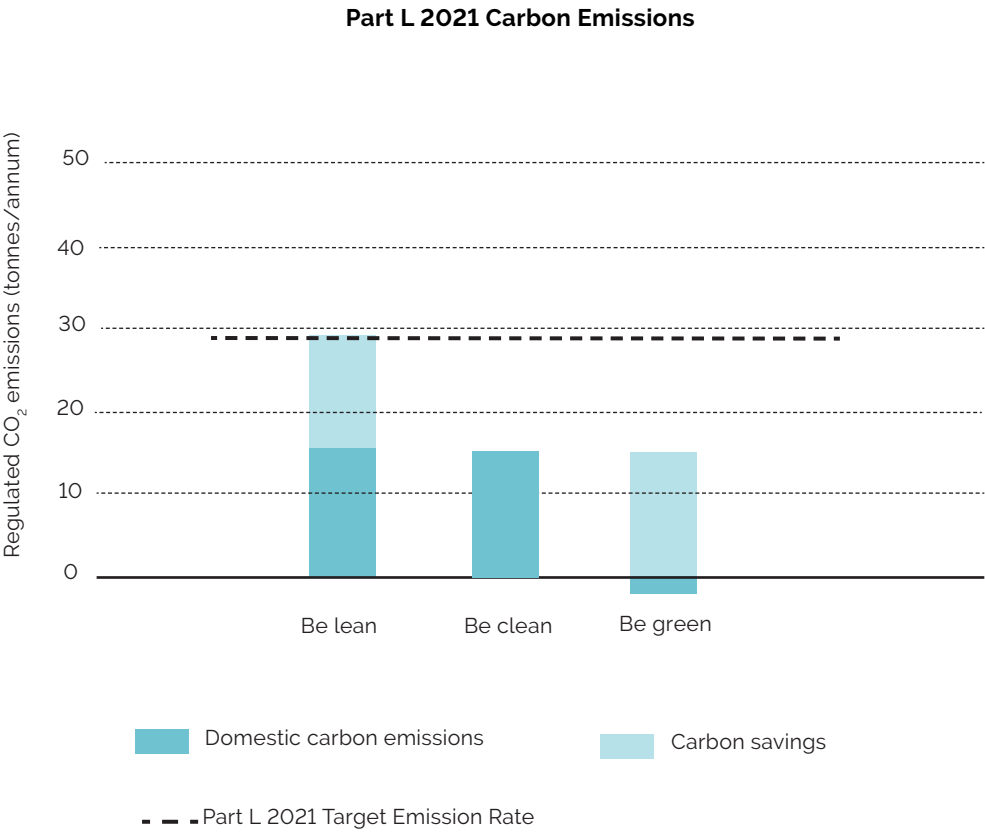


Figure 1: Domestic Part L 2021 Carbon Emissions

Overheating

Overheating analysis on eight representative domestic units have been conducted. These were selected based on design characteristics that establish them as representative of the overall proposed scheme. Among those there are dwellings which are more likely to present a high risk of overheating. Additionally, three typical communal corridors have been included in the modelling.

The representative domestic units have been assessed against CIBSE TM59 Guidance. Approved Part O requirements have been also taken into account when assessing the naturally ventilated homes. The assumptions regarding the building fabric as well as the occupant's behaviour have been summarised in this report.

As required by CIBSE TM59 Assessment Guidance the more extreme DSY2 and DSY3 weather data files for 2020s, describing a short intense warm spell and a less intense but longer warm spell respectively, have also been tested. Compliance with DSY2 and DSY3 is not mandatory but results have been presented.

Finally, a list of general guidelines that future occupants should be aware of, are proposed to help occupants' cope in the event of extreme weather conditions,

The results of the overheating assessment show that all domestic spaces and the communal corridors demonstrate compliance with the overheating criteria as defined by CIBSE TM59.

2.0 Introduction and context

2.1 Wider context

The Site is in the West of the Borough in the Southcote ward, southwest of Reading Town Centre. The site is located between Bath Road to the south and Tilehurst Road to the North. To the west is one of Reading's largest parks, Prospect Park. The area is predominantly residential, with a number of local primary schools and community centres throughout. There are shops and local facilities located on Bath Road.

Occupying a plot at the end of the cul-de-sac served by Amethyst Lane, the Site is currently not accessible. The previous Day Centre facility remains standing on the site, as a series of 1 storey courtyard style blocks, and a number of 1 storey outbuildings.

To the East of the site is a relatively recent residential housing development at Ashdene Gardens, consisting of a number of 2-3 storey houses, and 3 storey flatted point blocks, clad in brick, with a series of steeply sloping hipped roofs and 'mock-tudor' detailing. To the West is the primary access road to the site, Liebenrood Road, with Prospect Park just beyond. The site is located within a residential zone of Reading with houses and flatted development 2-3 storeys in height.

2.2 Local context

Existing configuration

The site currently contains a now vacated day centre providing services for older people and a family centre for children in care to meet with the birth parents in a safe environment. The services were relocated as part of previous review and the site has remained vacant for 3 years. Following initial internal site capacity studies the Council has requested a study for a full redevelopment of the site for both general needs housing, and a Respite centre.

2.3 Description of development

Proposed configuration

Following design development and pre-application feedback from Planning Officers across a number of disciplines, the adjacent plan represents the emerging scheme. The planning application proposal is described as follows:

- Site Area - 0.56 ha
- 21 new Houses (15 x 3 Bed, 6 x 4 Bed)
- 21 car spaces
- + 4 Respite centre staff car spaces
 - 3 General needs
 - 1 Disabled access space
- +1 Disabled access visitor's space
- +1 Larger minibs drop off space.
- +1 Dedicated deliveries space
- +1 Drop off point for minibs
- 6 Bedroom Respite Facility
- GIA = 529.7sqm
- Total Respite Amenity = 446.2sqm

Landscape vision

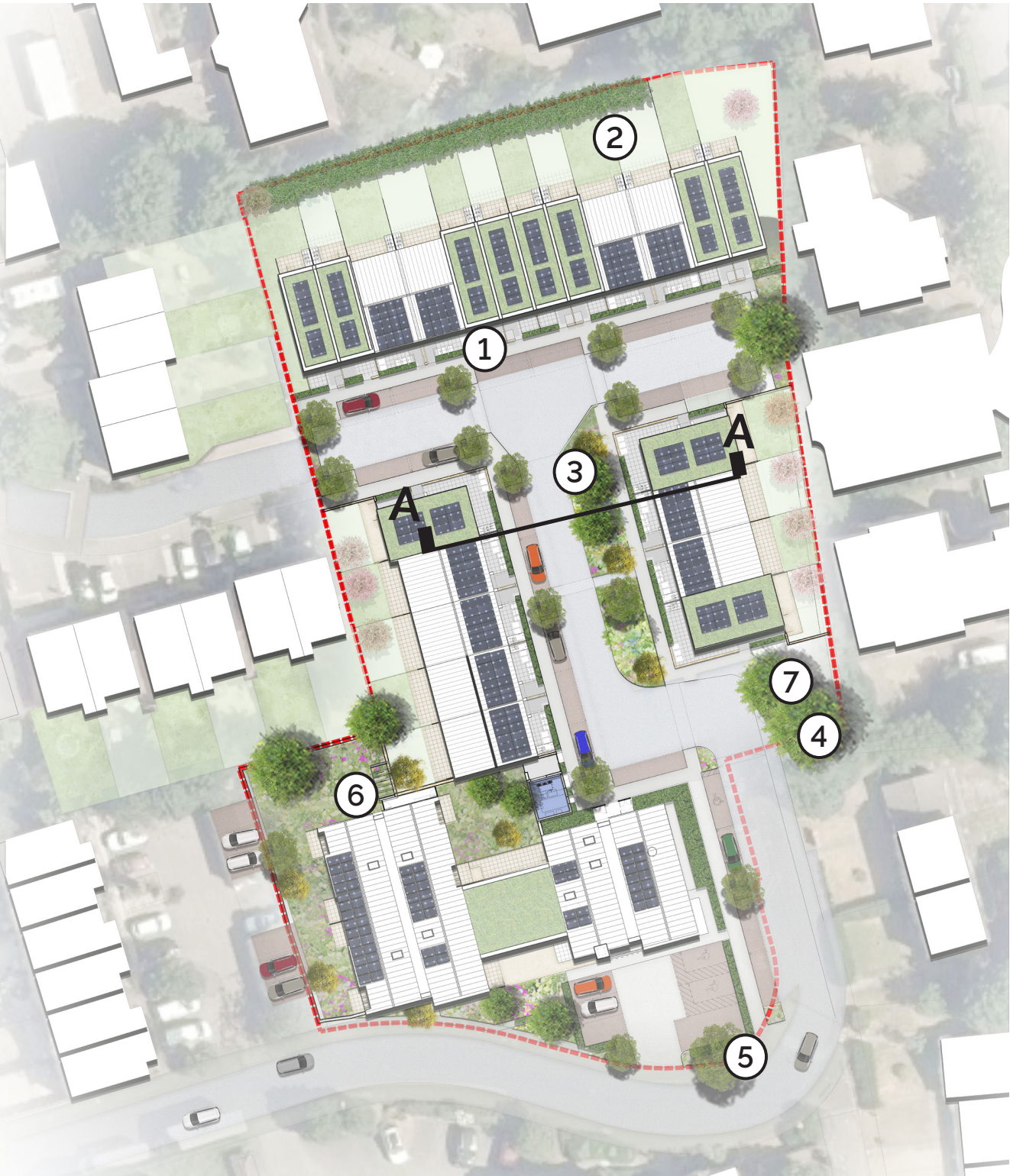
Reading Borough Council has clear policy guidance in relation to landscape and ecology. Amethyst Lane is fairly well located in terms of access to play, with the Kennet Valley play area a five minute walk to the west, and Prospect Park a fifteen minute walk to the east. The existing green spaces to the south of the site could potentially be enhanced and provide natural/ doorstep play as well as be enhanced with wildflower and other planting to increase biodiversity.

A dry swale along the north-south axis in the centre of the site offers a number of benefits including sustainable urban drainage, the opportunity for tree planting and informal play, and wildflower planting to attract pollinating insects.

An existing overgrown hedge to the north of the site is to be cut back and managed as a hedge to provide screening and a wildlife corridor. The group of two category C trees to the south east of the site are retained within communal open space which provides the opportunity for some wildflower planting and habitat features at the entrance to the proposed houses.

Hedges to front gardens and tree planting between parking bays create a greener and more pleasant pedestrian environment.

The respite centre garden would be designed to incorporate best practice, with circulation loops, smooth surfaces, colour contrast and careful placement of seating areas. The three courtyards would provide a range of functions including a sensory garden, a wildlife garden and a social garden for



- Key:**
- ① Boundary hedge
 - ② Rear garden
 - ③ Swale/ informal play
 - ④ Existing tree retained
 - ⑤ Proposed tree
 - ⑥ Respite amenity
 - ⑦ Communal amenity space

Figure 2. Illustrative landscape site plan (Source: DAS, HTA 2023).

3.0 Energy statement

The methodology employed to determine the potential CO₂ savings for this development is in accordance 'Be Lean, 'Be Clean', 'Be Green' Energy Hierarchy.

The energy assessment of the proposed scheme has been undertaken following the Approved Document L, Conservation of fuel and power, Volume 1: Dwellings, 2021 edition incorporating 2023 amendments and Volume 2: Buildings other than dwellings incorporating 2023 amendments.

The data from the approved software used for the analysis was combined in order to give energy consumption and CO₂ emissions of the development. This section outlines the energy strategy developed for the scheme and shows how significant carbon savings can be achieved by integrating energy efficiency measures and using renewable technologies on site.

All components of the development have been designed to exceed the requirements of the Building Regulations (Part L 2021).

- The requirements of Part L will be achieved through:
- Efficient Thermal Elements and Controlled fittings: the building fabric will be designed to improve on minimum Part L 2021 requirements;
 - Building Services and Lighting: the new building services will be designed and specified to perform better than the minimum standards detailed in the Part L 2021.

The following sections describe the performance of the proposed development based on the Be Lean, 'Be Clean', 'Be Green' Energy Hierarchy .

The web-based Elmhurst Design SAP 10.2 and IES-VE 2022 software have been used to carry out the calculations to demonstrate compliance with Part L 2021 and assess the energy and carbon performance of the development.

Baseline Part L 2021 regulated carbon emissions for the whole development have been calculated to be 29.7 tCO₂ (24.8 tCO₂ per year for residential spaces and 4.9 tCO₂ per year for Respite centre.

Be Lean: use less energy

At this first stage of the energy hierarchy the features that contribute to a reduction of CO₂ emissions compared to Building Regulations are passive and active design measures, i.e. fabric energy efficiency and efficient building services. Energy modelling results show that the scheme will exceed Building Regulations through demand reduction measures alone.

Passive Design Measures

In order to meet the more demanding standards set for this development, the new building will be built to a high specification prioritising a passive "fabric first" approach. Energy demand reductions will be achieved through:

Orientation

The orientation of the development is largely dictated by the site. The proposed layout maximises the number of rooms which receive direct sunlight throughout the day and balances the percentage of glazing.

Fabric performance

Lower U-values contribute to lower heat losses through different building elements, especially during winter. As a results the heating demand during the cooler months can be significantly reduced. The development will incorporate high levels of insulation and high performance glazing on all the facades to significantly reduce the demand of space heating. Table 3 shows the performance of the building fabric.

Air tightness

Heat loss may occur due to air infiltration. Although this cannot be eliminated altogether, good construction detailing and the use of best practice construction techniques can minimise the amount of air infiltration.

The maximum air permeability rate set by Part L 2021 Building Regulations is 8 m³/m² at 50Pa. The development will improve upon this to achieve 1 m³/m² at 50Pa.

Active Design Measures

After reducing the energy demand of the development, the next stage would be to use energy efficient building services, lighting and controls throughout the scheme to reduce energy consumption. The proposed energy strategy includes the following measures:

Mechanical Ventilation

Fresh air will be provided via efficient Mechanical Ventilation with Heat Recovery systems.

High efficacy lighting

The development intends to incorporate low energy lighting fittings throughout the building. 100% of all lighting fittings will be specified as low energy lighting.

	Proposed
Ground and Exposed Floor	0.10 W/m²K
External Walls	0.13 W/m²K
Corridor Walls	0.15 W/m²K
Roof	0.11 W/m²K
Windows	Triple glazing 0.80 W/m²K (clear window g-value: 0.54) (Frame factor: 0.8)
Entrance doors	1.00 W/m²K
Air permeability	Whole development: 1 m³/hm² (@50 Pa)
MVHR Unit	Heat Recovery (HR) 90% SFP: 1 Wet Room: 0.54 W per l/s 2 Wet Rooms: 0.55 W per l/s 3 Wet Rooms: 0.62 W per l/s 4 West Rooms: 0.76 W per l/s
Lighting	Low Energy LED Lighting

Table 3: Building fabric performance - Part L 2021

Savings from 'BE LEAN' measures

Domestic spaces and Respite Centre

After implementing all the measures listed above, the estimated regulated carbon dioxide emissions of the development at be lean stage have been calculated to be 16.3 tCO₂ (14.7 tCO₂ per year for residential spaces and 1.6 tCO₂ per year for Respite centre). These result in 45% carbon emissions reduction over Baseline.

BE LEAN STAGE - Carbon dioxide emissions reduction

	Development Total
Baseline Emissions	29.7 Tonnes CO ₂ / year
Be Lean: After energy demand reduction	16.3 Tonnes CO ₂ / year
Carbon Savings over Baseline	13.4 Tonnes CO ₂ / year
Carbon reduction over Baseline	45%

Table 4: Carbon dioxide emissions reduction - 'Be Lean' stage

Fabric Efficiency

	Target Fabric Energy Efficiency (MWh/year)	Design Fabric Energy Efficiency (MWh/year)	Improvement (%)
Domestic Total	37.59	31.41	16%

Table 5: DFEE-TFEE values

Unregulated loads

Approved Document L takes into account only carbon emissions from regulated loads, i.e. energy consumption for heating, cooling, lighting and auxiliary. However, during the lifespan of a building, carbon emissions due to unregulated loads, e.g. energy consumption for appliances, lifts operation, external lighting, should be also considered.

The carbon emissions due to the unregulated energy consumption have been calculated to be 9.6 tCO₂ per year based on SAP 10.2 electricity carbon factor (8.3. tCO₂ per year for residential spaces and 1.3 tCO₂ per year for Respite centre).

Be Clean: supply low carbon energy

After minimising energy demand in the first "Be Lean" stage, the second stage of the hierarchy assesses the potential and tests the performance of Decentralised Energy (DE) in order to reduce further the energy of the systems and the associated carbon emissions.

Decentralized energy projects using technologies such as Combined Heat and Power (CHP) and district heating networks can provide electricity and heat at very low carbon intensities, therefore they are encouraged by local councils.

Connecting to a Heat Network

The opportunity to link with a district heating network was investigated but no existing or proposed networks within the vicinity of the site that would be feasible to connect) were identified.

BE CLEAN STAGE - Carbon dioxide emissions reduction

	Development Total
Baseline Emissions	29.7 Tonnes CO ₂ / year
Be Lean: After energy demand reduction	16.3 Tonnes CO ₂ / year
Be Clean: After heat network/CHP/electric system	16.3 Tonnes CO ₂ / year
Carbon Savings over 'Be Clean' stage	0 Tonnes CO ₂ / year
Carbon reduction over 'Be Clean' stage	0%

Table 6: Carbon dioxide emissions reduction - 'Be Clean' stage

Savings from 'BE CLEAN' measures

Domestic spaces and Respite Centre

No measures were implemented at Be Clean stage. Regulated carbon dioxide emissions at Be Clean stage are shown below.

Be Green: renewable energy technologies

In order to further reduce emissions from the development in accordance with the local authority policies and Energy Hierarchy, it is necessary to consider the introduction of renewable energy systems on site.

This section explores the available renewable energy options that have been assessed for the proposed development.

Heat pumps

The Air Source Heat Pump absorbs heat from outside air and then transfers it via the central heating system to provide both hot water heating and heating for an indoor space. The use of ASHPs would allow the development to reduce its carbon emissions and contribute to reducing poor air quality.

It should be noted that the efficiency of the heat pumps is dependent on the temperature difference between the heat source and the space required to be heated. The lower the difference between internal and external temperature, the more efficient the system.

The majority of the dwellings will be provided with efficient compact Air Source Heat Pumps (ASHPs) with no outdoor units. Efficient Air Source Heat Pumps with outdoor units will be provided to the large end terrace houses. The full electric HVAC design solutions will be benefited from the future de-carbonisation of the grid. Table 7 shows ASHPs panels specifications.

	Small/Mid Dwellings	Large Dwellings
Heating ASHPs CoP	3.16	3
DHW ASHPs CoP	3.16	3
Respite Centre		
Heating SCoP		3.57
Heating Delivery Efficiency		90%
DHW ASHPs CoP		3.57
Space Heating Delivery Efficiency		90%

Table 7: Heating specification

PVs

Assuming the current weather conditions in the area, particularly solar irradiation and favourable solar orientation, a payback period of around six years is estimated for the PV panels. Photovoltaic panels are a relatively discreet technology and are not considered to be a planning issue from the perspective of visual impact. There are no available grants for the procurement of the PV panels.

Initial calculations were carried out to maximise the use of PVs on the roof. In total the proposed system can provide a total of 112.5 kWp.

As required by the client, the following information is reported:

- Drawings showing the amount of roof that is available within the development and that could be used to install photovoltaic modules with suitable orientation and lack of shading. - An indicative PV layout has been provided.
- An estimate of the total PV system output (kWp) - The system will provide 112.5 kWp.
- Quantification of the amount of roof area that could be used to install photovoltaic modules - A total gross area of 793 m² will be used for the installation of the PVpanels.
- A calculation of the CO₂ savings that may be realized through the use of this technology. - It is estimated that 12.6 Tonnes CO₂/yr savings may be realized through the use of this technology based on 20.1% PV panels efficiency and 30 °C south facing inclination .

Savings from 'BE GREEN' measures

Domestic spaces and Respite Centre

After implementing the renewable energy measures listed above, the estimated carbon dioxide emissions have been calculated to be -3.7 tCO₂/year (-2.2 tCO₂ per year for residential spaces and -1.4 tCO₂ per year for Respite centre).

BE GREEN STAGE - Carbon dioxide emissions reduction

	Development Total
Baseline Emissions	29.7 Tonnes CO ₂ / year
Be Lean: After energy demand reduction	16.3 Tonnes CO ₂ / year
Be Clean: After heat network / CHP	16.3 Tonnes CO ₂ / year
Be Green: After renewable energy technologies	-3.7 Tonnes CO ₂ / year
Carbon savings over 'Be Green' stage	19.9 Tonnes Co ₂ / year
Carbon reduction over 'Be Green' stage	67%

Table 8: Carbon dioxide emissions reduction - 'Be Green' stage

Energy Strategy Summary

The overall energy strategy has been defined by the 'Be Lean, 'Be Clean', 'Be Green' Energy Hierarchy, which focuses on minimising energy use, before using efficient systems and finally making use of renewable energy technology to minimise the energy required from the prime energy sources.

The strategy for reducing energy use and associated carbon emissions through the design of the scheme follows a three-step approach:

- Reducing the energy demand through passive design strategies and provision of high-quality building envelope
- Reducing the energy consumption through best practice design of building services, lighting and control. Connecting the scheme to a District Heating Network was not feasible at this time.
- Installation of on-site renewable energy technologies.

Energy efficiency features incorporated in the development are:

- Building fabric will exceed Part L minimum requirements in terms of u-values and airtightness
- Mechanical Ventilation and Heat Recovery system will be installed in all homes to make use of wasted heat of exhaust air by preheating incoming air. An integrated peak lopping cooling unit will be additionally integrated into the MVHR of specific homes.
- Low energy LED light fitting will be installed throughout the scheme

The scheme will be provided with efficient ASHPs which will provide space heating and domestic hot water.

The majority of the dwellings will be provided with efficient compact Air Source Heat Pumps (ASHPs) with no outdoor units. Efficient Air Source Heat Pumps with outdoor units will be provided to the large end terrace houses.

Tables 9-10 summarise the carbon dioxide emissions and the carbon dioxide savings for each stage of the energy hierarchy.

Energy Costs

The energy hierarchy has been followed and the energy efficiency measures, and renewable energy generation has been maximised. This includes efficient building fabric, low air tightness, efficient all electric building services solution, low distribution losses and efficient PV panels. These measures are anticipated to all play a significant role in reducing the occupants' energy costs and minimizing potential impacts from future electricity unit costs increases.

Using the predicted energy consumption taken from the Be Green Part L calculations, the expected space heating, hot water and lighting costs are expected to be zero as the building achieves net zero regulated target.

It should be noted that the actual costs will include additional charges for the heating system and maintenance, standing charges, the occupants' preferred internal temperatures and hot water usage patterns, the occupants' use of lights and appliances (unregulated loads) and the fit-out specification and usage of the communal spaces. Unit electricity costs may also be higher by the time the development is occupied.

	Part L 2021 Performance	
	Carbon Dioxide Emissions (Tonnes CO ₂ per Annum)	
	Regulated	Unregulated
Baseline: Part L1A 2021 of the Building Regulations Compliant Development	29.7	9.6
6After Energy Demand Reduction (Be Lean)	16.3	9.6
After CHP/DHN/Electric systems (Be Clean)	16.3	9.6
After Renewable Energy (Be Green)	-3.7	9.6

Table 9: Carbon Dioxide Emissions after each stage of the Energy Hierarchy

	Regulated carbon dioxide savings	
	(Tonnes CO ₂ per Annum)	(%)
Savings from Energy Demand Reduction	13.4	45%
Savings from Heat Network / CHP/Electric syst.	0.0	0%
Savings from renewable energy	19.9	67%
Total Cumulative Savings	33.3	112%

Table 10: Regulated Carbon Dioxide savings from each stage of the Energy Hierarchy.

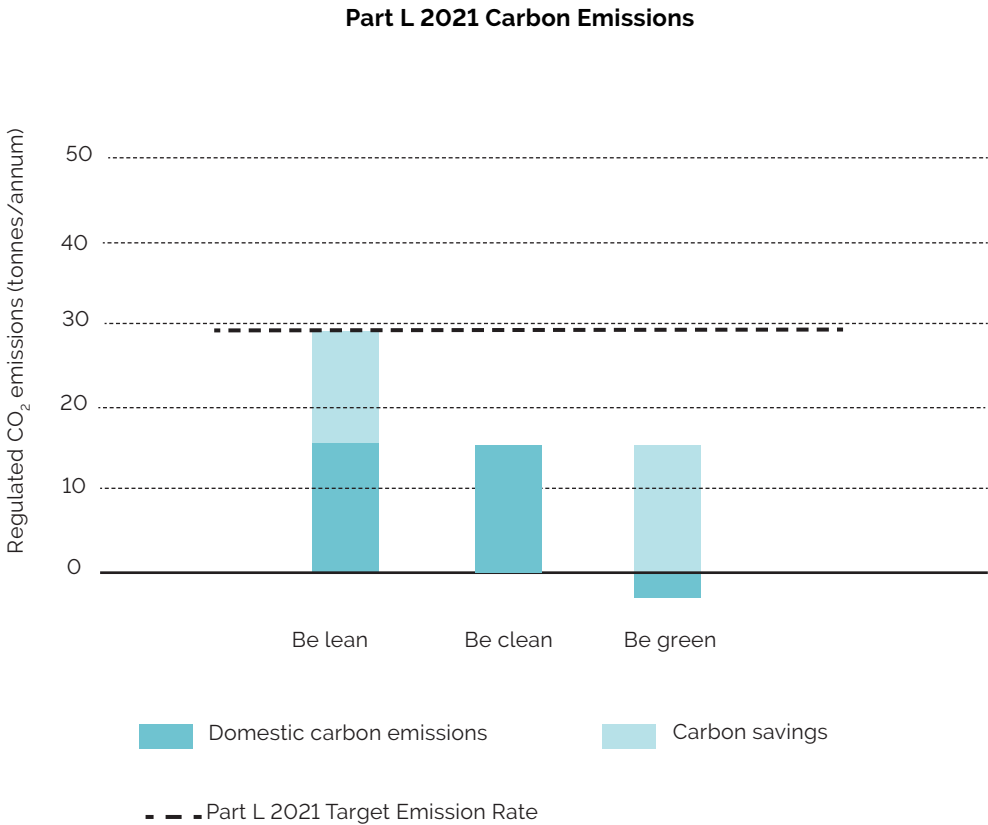


Figure 3: Domestic Part L 2021 Carbon Emissions

4.0 Overheating Assessment

Approved Document O, Requirement O1: Overheating mitigation

The aim of requirement O1 of Approved Document O is to protect the health and welfare of occupants of the building by reducing the occurrence of high indoor temperatures.

Approved Document O, Requirement O1: Overheating mitigation

Dynamic thermal modelling method

2.3 To demonstrate compliance using the dynamic thermal modelling method, all of the following guidance should be followed.

- a. CIBSE's TM59 methodology for predicting overheating risk.
- b. The limits on the use of CIBSE's TM59 methodology set out in paragraphs 2.5 and 2.6 of this document.
- c. The acceptable strategies for reducing overheating risk in paragraphs.

Limits on CIBSE's TM59 modelling

2.5 CIBSE's TM59 method requires the modeller to make choices. The dynamic thermal modelling method in this section applies limits to these choices, which are detailed in paragraph 2.6. These limits should be applied when following the guidance in CIBSE's TM59.

2.6 All of the following limits on CIBSE's TM59, section 3.3, apply.

- a. When a room is occupied during the day (8am to 11pm), openings should be modelled to do all of the following.
 - i. Start to open when the internal temperature exceeds 22°C.
 - ii. Be fully open when the internal temperature exceeds 26°C.
 - iii. Start to close when the internal temperature falls below 26°C.
 - iv. Be fully closed when the internal temperature falls below 22°C.
- b. At night (11pm to 8am), openings should be modelled as fully open if both of the following apply.
 - i. The opening is on the first floor or above and not easily accessible.
 - ii. The internal temperature exceeds 23°C at 11pm.
- c. When a ground floor or easily accessible room is unoccupied, both of the following apply.
 - i. In the day, windows, patio doors and balcony doors should be modelled as open, if this can be done securely, following the guidance in paragraph 3.7 of this document.
 - ii. At night, windows, patio doors and balcony doors should be modelled as closed.
- d. An entrance door should be included, which should be shut all the time.

Table 11: Approved document O, Requirement O1: Overheating mitigation

CIBSE TM59 Overheating Criteria for dwellings

CIBSE has published TM59 'Design methodology for the assessment of overheating risk in homes' in May 2017. The guidance replaces the TM52 to be used in residential buildings. TM59 provides designers with a standardised approach to predicting overheating risk for residential building designs using dynamic thermal analysis.

Both of the criteria presented in detail in Table 12 must be met in order to demonstrate compliance. In order to allow

the occupants to 'adapt', each habitable room needs openable windows with a minimum free area that satisfies the purge ventilation criteria set in Part F of the Building Regulations for England (NBS, 2010), and equivalent regulations in other countries, i.e. the window opening area should be at least 1/20th of the floor area of the room (different conditions exist for windows with restricted openings, and the same requirement applies for external doors).

cIBSE TM59 Overheating criteria (2017): predominantly naturally ventilated dwellings

Criterion 1 (for living rooms, bedrooms and kitchens)	The number of hours in which the difference between the actual operative temperature in a room and the maximum acceptable temperature is greater than or equal to one degree during the period May to September inclusive shall not be more than 3% of occupied hours (CIBSE TM52 -Criterion 1).
Criterion 2 (for bedrooms only)	To guarantee comfort during the sleeping hours, the operative temperature in the bedrooms from 10pm to 7am shall not exceed 26°C for more than 1% of annual hours.

Table 12: CIBSE TM59 Overheating Criteria for dwellings

The inclusion of corridors in the overheating analysis is mandatory where community heating pipework runs through them. At least one corridor should be modelled as part of the assessment and the ventilation of it should be included in the analysis as designed.

Communal corridor heat gains should be modelled based on calculated losses from pipework (see CIBSE Guide C (2007) and/or the Domestic Heating Design Guide (DBSP, 2015)), or based on the simplified method provided in Table 5 of the Domestic Building Services Compliance Guide (HMG, 2013).

CIBSE TM59 Overheating criteria (2017): corridors

Criterion for corridors	Whilst there is no mandatory target, if an operative temperature of 28 °C is exceeded for more than 3% of total annual hours, this should be flagged as a significant risk.
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Table 13: CIBSE TM59 Overheating Criteria for corridors

Since some homes will be only predominantly mechanically ventilated due to noise issues and consequently restrictions in opening windows, CIBSE Guide A has been implemented in these cases (for the purposes of the assessment methodology).

CIBSE GUIDE A: predominantly mechanically ventilated dwellings

The CIBSE fixed temperature test must be followed, i.e. all occupied rooms should not exceed an operative temperature of 26 °C for more than 3% of the annual occupied annual hours.

Table 14: CIBSE Guide A Overheating Criteria for dwellings with restricted window openings or mechanically cooled

4.3 Passive design measures

Detailed dynamic modelling were carried out to assess the design against Part O and TM59 criteria . It should be noted that these have been explored as far as practicable, in order to avoid the use of active cooling, as detailed below.

1. Reduce the amount of heat entering the building through orientation, shading, high albedo materials, fenestration, insulation and the provision of green infrastructure. It is also expected that external shading will form part of major proposals

Orientation	The orientation is dictated by the site limiting the design. The site's axis is located close to the south/north direction.
Shading	External shading in the form of balconies as well as the deep recessions in windows are specified and will contribute significantly to the mitigation of the overheating risk. The use of internal blinds has not been considered in the assessment as per the Part O recommendations but could potentially further contribute to the mitigation of the overheating risk.
High albedo materials, fenestration and insulation	Highly efficient building fabric has been specified with all elements achieving low u-values. The air tightness has also been optimised, aiming balance heat losses and overheating risk. Windows of high performance will be provided to all spaces. These will have a low u-value to reduce heat losses during winter and prevent heat transfer from outside during summer. Solar control glass of a low g-value (0.54) is specified to reduce solar gains being transmitted through the windows.
Provision of green infrastructure	Planting at ground floor level will contribute to the reduction of the heat island effect and will provide an improved quality of life to the occupants and users of the building.

2. Minimise internal heat generation through energy efficient design: For example, heat distribution infrastructure within buildings should be designed to minimise pipe lengths, particularly lateral pipework in corridors of apartment blocks, and adopting pipe configurations which minimise heat loss e.g., twin pipes.

Low energy LED lighting and lighting controls will be provided. These will minimise lights in use when not required (therefore reducing heat gains).
Pipe insulation has been maximised as much as practicable.

3. Manage the heat within the building through exposed internal thermal mass and high ceilings: Increasing the amount of exposed thermal mass can help to absorb excess heat within the building. Efficient thermal mass should be coupled with night time purge ventilation.

The current design includes concrete slab between floors, the thermal mass of which will help reduce the overheating risk.

4. Provide passive ventilation: For example, through the use of openable windows, shallow floorplates, dual aspect units or designing in the 'stack effect' where possible.

The majority of the dwellings have been designed to be dual aspect offering opportunity for cross-ventilation.

Windows will be openable on restrictors (15 degrees) during daytime and nighttime to provide fresh air and assist in mitigating the overheating risk, where possible.

5. Provide mechanical ventilation: Mechanical ventilation can be used to make use of 'free cooling' where the outside air temperature is below that in the building during summer months. This will require a by-pass on the heat recovery system for summer mode operation.

All homes will have mechanical supply and extract with heat recovery (MVHR).
MVHR will be specified with summer by-pass to prevent recovery of unwanted heat and hence allow heat to escape the building.
MVHR will run at design boost ventilation during warm periods to supplement natural ventilation.

6. Provide active cooling systems: The increased use of air conditioning systems is generally not supported, as these have significant energy requirements and, under conventional operation, expel hot air, thereby adding to the urban heat island effect. However, once passive measures have been prioritised if there is still a need for active cooling systems, such as air conditioning systems, these should be designed in a very efficient way and should aim to reuse the waste heat they produce

No active cooling is suggested at this stage.

4.4 Noise Assessment

The results of the noise assessment carried out by 24 Acoustics (March 2023) have identified that windows can be open for rapid or purge ventilation or for residents' choice during daytime and nighttime.

Night time internal noise level requirements set by Approved document O can be achieved by partially open windows on restrictors to mitigate overheating risks when required.

4.5 Security

Dwellings and Respite Centre overheating analysis has been conducted in accordance with CIBSE TM59 Guidance and Approved document O requirements. This is to ensure that comfortable spaces will be provided and overeating will be avoided.

At night, windows, patio doors and balcony doors on the ground floor were modelled as closed following Approved document O guidance. This includes Respite Centre bedrooms.

Building category	Category II: Normal expectation for new building.
Sample size	In total, 2 domestic units and 5 bedrooms/studios from Respite centre were analysed. The Approved Document O requirements have been taken into account in cases of homes being naturally ventilated.
Weather file used	Based on CIBSE TM59 Guidance, CIBSE Design Summer Year (DSY1) for 2020s, high emissions, 50% percentile scenario has been implemented. The London Gatwick airport data, representing lower density urban and suburban areas, was used. Although not required for compliance, the following additional extreme weather files have been also tested: DSY2 (2020s): featuring short intense warm spell DSY3 (2020s): featuring long, less intense warm spell
Air speed	The modelled air speeds inside the rooms have been set at 0.1 m/s in line with the TM59 methodology.
Exposure type	Depending on the location of each window, various exposure types have been applied in the thermal model.
Air infiltration	0.08 ach domestic spaces

Table 15: Model input data

Data input		Discussion
Natural ventilation	Operation	Windows openable on restrictors during daytime on all levels and during nighttime on the first floor or above.
	Openable area	All openable windows have 80% openable area on restrictors (by 15 degrees) to account for security limitations.
Internal doors	Operation	As per TM 59 guidelines.
Mechanical ventilation	Operation	A mechanical ventilation with heat recovery system able to provide 1.1 ach of fresh air at external air temperature to living rooms, kitchens and bedrooms in all domestic units. A mechanical ventilation with heat recovery system able to provide 1.4 ach of fresh air at external air temperature to bedrooms in the Respite Centre.
Shading devices	Internal blinds	No internal blinds are specified.
	External shading	External shading is mainly provided by deep recessions on all windows and by balconies. At specific domestic spaces external shading will be installed at specific domestic spaces.

Table 16: Ventilation strategy and shading devices

Minimising corridor internal gains by limiting horizontal pipework in the corridor ceiling void where possible, and maximising pipe insulation ensures that internal heat generation is minimal and the ventilation requirements of the communal corridors for overheating mitigation are relatively low.

Corridors	Insulation thickness of pipework	50mm
	Flow & Return Temperatures	65°C Flow, 45°C Return
	Thickness of pipework	40mm
	Ventilation strategy	Mechanically ventilated using environmental ventilation shaft systems. Each shaft will have a closed base and duty/standby environmental fans (with associated dampers/attenuation) on the roof which bypasses any smoke shaft fans. - up to 1.1 ach extract rate to be achieved.

Table 18: Communal corridor assumptions.

4.6 Summary of results

Dynamic thermal modelling has been carried out on the basis of the assumptions presented in the previous paragraphs. The risk of overheating in all the main areas has been assessed against the CIBSE DSY1 weather file.

Table 19 provides a summary of the number of rooms complying with Criteria "a" and "b" of the CIBSE TM59 Guide for the naturally ventilated homes.

Results show that all the assessed rooms comply with the TM59 overheating criteria as a result of the passive design features and the ventilation strategy described in the previous sections being integrated in the proposed design.

All rooms have also been assessed against the more extreme weather conditions, described by weather files DSY2 and DSY3.

Table 20 provides a summary of the corridors spaces compliance against CIBSE TM59 Guide criteria. Results show that the assessed corridors comply with the TM59 overheating criteria as a result of the passive design features and the ventilation strategy described in the previous sections being integrated in the proposed design.

Part O - TM59 Assessment			
	DSY1-2020	DSY2-2020	DSY3-2020
Percentage of units passing	100%	37%	0%

Table 19: Summary results for the domestic spaces of the TM59 overheating assessment for the 2020 DSY weather files.

Part O - TM59 Assessment			
	DSY1-2020	DSY2-2020	DSY3-2020
Percentage of corridors passing	100%	100%	100%

Table 20: Summary results for the communal corridors of the TM59 overheating assessment for the 2020 DSY weather files.

4.7 Conclusions

HTA Design LLP has been appointed to prepare an Overheating Assessment to support the submission of a planning application for the development of Amethyst Lane Site.

Overheating analysis on 2 domestic units and 5 bedrooms/studios from Respite centre have been conducted. These were selected based on design characteristics that establish them as representative of the overall proposed scheme. Among those there are dwellings which are more likely to present a high risk of overheating. Additionally, typical communal corridors have been included in the modelling.

The representative domestic units have been assessed against CIBSE TM59 Guidance. Approved Part O requirements have been also taken into account when assessing the naturally ventilated homes. The assumptions regarding the building fabric as well as the occupant's

behaviour have been summarised in this report.

As required by CIBSE TM59 Assessment Guidance the more extreme DSY2 and DSY3 weather data files for 2020s, describing a short intense warm spell and a less intense but longer warm spell respectively, have also been tested. Compliance with DSY2 and DSY3 is not mandatory but results have been presented.

Finally, a list of general guidelines that future occupants should be aware of, are proposed to help occupants cope in the event of extreme weather conditions,

The results of the overheating assessment show that all domestic spaces and the communal corridors demonstrate compliance with the overheating criteria as defined by CIBSE TM59.

5.0 Appendix A - Sample SAPs and BRUKLs

SAP10.2 Be Lean

Full SAP Calculation Printout



Property Reference	3B5PA House-Flat roof-Unit 5				Issued on Date	14/04/2023
Assessment Reference	BE LEAN-3B5PA-Unit 5	Prop Type Ref	House			
Property						
SAP Rating	87 B	DER	8.87	TER	10.88	
Environmental	92 A	% DER < TER				18.47
CO ₂ Emissions (t/year)	0.91	DFEE	31.88	TFEE	36.39	
Compliance Check	See BREL	% DFEE < TFEE				12.41
% DPER < TPER	0.07	DPER	51.81	TPER	56.98	
Assessor Details	Mr. Rory Bergin				Assessor ID	N427-0001
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	38.0000 (1b)	x	2.5000 (2b)	=	95.0000 (1b)	-
First floor	38.0000 (1c)	x	2.5000 (2c)	=	95.0000 (1c)	-
Second floor	38.0000 (1d)	x	2.5000 (2d)	=	95.0000 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	114.0000				(4)	
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	285.0000 (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											1.0000	(17)
Infiltration rate											0.0500	(18)
Number of sides sheltered											2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =										0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =										0.0425	(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	0.0542	0.0531	0.0521	0.0468	0.0457	0.0404	0.0404	0.0393	0.0425	0.0457	0.0478	0.0499 (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) =												79.2000 (23c)
Effective ac	0.1582	0.1571	0.1561	0.1507	0.1497	0.1444	0.1444	0.1433	0.1465	0.1497	0.1518	0.1539 (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
Window (Uw = 0.80)			18.8000	0.7752	14.5736		(27)

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GF							3.3600	1.0000	3.3600				(26)
EW							38.0000	0.1000	3.8000				(28a)
ER	62.1600	22.1600					40.0000	0.1300	5.2000				(29a)
	38.0000						38.0000	0.1000	3.8000				(30)
Total net area of external elements Aum(A, m2)							138.1600						(31)
Fabric heat loss, W/K = Sum (A x U)							(26)...(30) + (32) =		30.7336				(33)
PW							172.7000	0.0000	0.0000				(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K													250.0000 (35)
List of Thermal Bridges													
K1 Element									Length	Psi-value		Total	
E5 Ground floor (normal)									7.4000	0.2680		1.9832	
E6 Intermediate floor within a dwelling									7.4000	0.1400		1.0360	
E18 Party wall between dwellings									30.0000	0.1200		3.6000	
P2 Party wall - Intermediate floor within a dwelling									20.4000	0.0000		0.0000	
P4 Party wall - Roof (insulation at ceiling level)									20.4000	0.2400		4.8960	
E15 Flat roof with parapet									27.9000	0.5600		15.6240	
P1 Party wall - Ground floor									20.4000	0.1600		3.2640	
E2 Other lintels (including other steel lintels)									11.3700	0.0300		0.3411	
E3 Sill									10.0100	0.0200		0.2002	
E4 Jamb									26.8500	0.0200		0.5370	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)												31.4815 (36)	
Point Thermal bridges												(36a) = 0.0000	
Total fabric heat loss												(33) + (36) + (36a) = 62.2151 (37)	
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat transfer coeff	14.8775	14.7776	14.6777	14.1780	14.0781	13.5785	13.5785	13.4785	13.7783	14.0781	14.2780	14.4778	(38)
Average = Sum(39)m / 12 =	77.0927	76.9927	76.8928	76.3932	76.2933	75.7936	75.7936	75.6937	75.9935	76.2933	76.4931	76.6930	(39)
												76.3682	
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP (average)	0.6763	0.6754	0.6745	0.6701	0.6692	0.6649	0.6649	0.6640	0.6666	0.6692	0.6710	0.6727	(40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	
													31

4. Water heating energy requirements (kWh/year)													

Assumed occupancy													2.8368 (42)
Hot water usage for mixer showers													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)
Hot water usage for baths													
	82.8019	81.5722	79.8404	76.6475	74.2566	71.6056	70.1736	71.8932	73.7655	76.6022	79.8610	82.5220	(42b)
Hot water usage for other uses													
	43.6819	42.0935	40.5050	38.9166	37.3282	35.7397	35.7397	37.3282	38.9166	40.5050	42.0935	43.6819	(42c)
Average daily hot water use (litres/day)													116.4812 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	126.4838	123.6656	120.3455	115.5641	111.5848	107.3453	105.9133	109.2213	112.6821	117.1073	121.9544	126.2038	(44)
Energy conte	200.3194	176.0982	184.9665	158.2015	150.2146	131.9936	128.0930	135.2388	138.9483	158.9135	173.7464	197.6047	(45)
Energy content (annual)													Total = Sum(45)m = 1934.3384
Distribution loss (46)m = 0.15 x (45)m													
	30.0479	26.4147	27.7450	23.7302	22.5322	19.7990	19.2139	20.2858	20.8422	23.8370	26.0620	29.6407	(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													
	255.5962	226.0256	240.2433	211.6951	205.4914	185.4872	183.3698	190.5156	192.4420	214.1903	227.2401	252.8815	(62)
WMHRS													
	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													
	255.5962	226.0256	240.2433	211.6951	205.4914	185.4872	183.3698	190.5156	192.4420	214.1903	227.2401	252.8815	(64)
Total per year (kWh/year)													2585.1782 (64)
Electric shower(s)													2585 (64)
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =													0.0000 (64a)
Heat gains from water heating, kWh/month													
	110.8276	98.4946	105.7228	95.3969	94.1678	86.6828	86.8124	89.1884	88.9953	97.0602	100.5656	109.9250	(65)

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

Metabolic gains (Table 5), Watts													

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(66)m	141.8411	141.8411	141.8411	141.8411	141.8411	141.8411	141.8411	141.8411	141.8411	141.8411	141.8411	141.8411	141.8411	(66)	
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	145.0060	160.5424	145.0060	149.8395	145.0060	149.8395	145.0060	145.0060	149.8395	145.0060	149.8395	145.0060	149.8395	(67)	
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	277.1823	280.0586	272.8104	257.3800	237.9018	219.5951	207.3651	204.4888	211.7369	227.1674	246.6455	264.9523	264.9523	(68)	
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.1841	37.1841	37.1841	37.1841	37.1841	37.1841	37.1841	37.1841	37.1841	37.1841	37.1841	37.1841	37.1841	(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	0.0000	(70)	
Losses e.g. evaporation (negative values) (Table 5)	-113.4729	-113.4729	-113.4729	-113.4729	-113.4729	-113.4729	-113.4729	-113.4729	-113.4729	-113.4729	-113.4729	-113.4729	-113.4729	(71)	
Water heating gains (Table 5)	148.9619	146.5693	142.1006	132.4957	126.5696	120.3928	116.6833	119.8768	123.6045	130.4572	139.6745	147.7487		(72)	
Total internal gains	636.7025	652.7226	625.4693	605.2676	575.0298	555.3798	534.6067	534.9240	550.7333	568.1829	601.7119	623.2593		(73)	
6. Solar gains															
[Jan]			Area		Solar flux		g		FF		Access		Gains		
			m2		Table 6a		Specific data		Specific data		factor		W		
					W/m2		or Table 6b		or Table 6c		Table 6d				
North			10.8900		10.6334		0.5400		0.8000		0.7700		34.6670	(74)	
South			7.9100		46.7521		0.5400		0.8000		0.7700		110.7119	(78)	
Solar gains	145.3789	247.5680	343.5421	441.8677	515.6106	522.5530	499.2401	441.5522	376.6242	274.4305	173.9976	124.5654		(83)	
Total gains	782.0814	900.2906	969.0115	1047.1353	1090.6404	1077.9327	1033.8468	976.4761	927.3575	842.6135	775.7095	747.8247		(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	102.6903	102.8235	102.9572	103.6305	103.7663	104.4503	104.4503	104.5882	104.1756	103.7663	103.4952	103.2255			
alpha	7.8460	7.8549	7.8638	7.9087	7.9178	7.9634	7.9634	7.9725	7.9450	7.9178	7.8997	7.8817			
util living area	0.9920	0.9764	0.9390	0.8252	0.6428	0.4496	0.3225	0.3565	0.5628	0.8594	0.9762	0.9942		(86)	
MIT	20.4735	20.6289	20.7889	20.9379	20.9913	20.9995	21.0000	20.9999	20.9975	20.9286	20.6847	20.4388		(87)	
Th 2	20.3619	20.3626	20.3634	20.3673	20.3681	20.3720	20.3720	20.3728	20.3704	20.3681	20.3665	20.3650		(88)	
util rest of house	0.9898	0.9704	0.9247	0.7947	0.6018	0.4057	0.2765	0.3079	0.5126	0.8264	0.9689	0.9925		(89)	
MIT 2	19.7489	19.9441	20.1389	20.3093	20.3615	20.3717	20.3720	20.3727	20.3689	20.3034	20.0186	19.7075		(90)	
living area fraction									fLA =	Living area / (4) =		0.1465		(91)	
MIT	19.8551	20.0444	20.2341	20.4014	20.4537	20.4637	20.4640	20.4646	20.4610	20.3950	20.1162	19.8147		(92)	
Temperature adjustment												0.0000			
adjusted MIT	19.8551	20.0444	20.2341	20.4014	20.4537	20.4637	20.4640	20.4646	20.4610	20.3950	20.1162	19.8147		(93)	
8. Space heating requirement															
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec			
Utilisation	0.9876	0.9667	0.9214	0.7964	0.6074	0.4121	0.2833	0.3151	0.5198	0.8279	0.9655	0.9907		(94)	
Useful gains	772.3508	870.3533	892.8937	833.9710	662.4533	444.2046	292.8549	307.6446	482.0798	697.5687	748.9569	740.8518		(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	1199.1827	1166.0078	1056.0551	878.6284	667.8500	444.4299	292.8640	307.6658	483.3909	747.2886	995.6493	1197.5340		(97)	
Space heating kWh	317.5629	198.6798	121.3921	32.1533	4.0151	0.0000	0.0000	0.0000	0.0000	36.9916	177.6186	339.7716		(98a)	
Space heating requirement - total per year (kWh/year)												1228.1850			
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	317.5629	198.6798	121.3921	32.1533	4.0151	0.0000	0.0000	0.0000	0.0000	36.9916	177.6186	339.7716		(98c)	
Space heating requirement after solar contribution - total per year (kWh/year)												1228.1850			
Space heating per m2										(98c) / (4) =		10.7736		(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 Boilers-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													1.0500	(306)	
Efficiency of secondary/supplementary heating system, %													0.0000	(208)	
Space heating:															
Space heating requirement															
	317.5629	198.6798	121.3921	32.1533	4.0151	0.0000	0.0000	0.0000	0.0000	36.9916	177.6186	339.7716		(98)	
Space heat from Boilers =	(98) x 1.00 x 1.00 x 1.05														
307a	333.4411	208.6138	127.4617	33.7610	4.2159	0.0000	0.0000	0.0000	0.0000	38.8412	186.4995	356.7601			

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Space heating requirement	333.4411	208.6138	127.4617	33.7610	4.2159	0.0000	0.0000	0.0000	0.0000	38.8412	186.4995	356.7601	(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	255.5962	226.0256	240.2433	211.6951	205.4914	185.4872	183.3698	190.5156	192.4420	214.1903	227.2401	252.8815	(64)
Water heat from Boilers = (64) x 1.00 x 1.00 x 1.05													
310a	268.3760	237.3269	252.2555	222.2799	215.7660	194.7616	192.5383	200.0414	202.0641	224.8998	238.6021	265.5256	
Water heating fuel	268.3760	237.3269	252.2555	222.2799	215.7660	194.7616	192.5383	200.0414	202.0641	224.8998	238.6021	265.5256	(310)
Cooling System Energy Efficiency Ratio	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	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	28.0542	25.3392	28.0542	27.1492	28.0542	27.1492	28.0542	28.0542	27.1492	28.0542	28.0542	28.0542	(331)
Lighting	30.1294	24.1709	21.7632	15.9447	12.3161	10.0624	11.2352	14.6039	18.9690	24.8884	28.1114	30.9668	(332)
Electricity generated by PVs (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(333a)
Electricity generated by wind turbines (Appendix M) (negative quantity)	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)	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)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(333b)
Electricity generated by wind turbines (Appendix M) (negative quantity)	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)	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												1289.5943	(307)
Space heating fuel - secondary												0.0000	(309)
Water heating fuel - community heating												2714.4371	(310)
Efficiency of water heater												0.0000	(311)
Electricity used for heat distribution												12.8959	(313)
Space cooling fuel												0.0000	(321)
Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.9500)													
mechanical ventilation fans (SFP = 0.9500)												330.3150	(330a)
Total electricity for the above, kWh/year												330.3150	(331)
Electricity for lighting (calculated in Appendix L)												243.1614	(332)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												0.0000	(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												4577.5078	(338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Efficiency of heat source Boilers			91.0000 (367)
Space and Water heating from Boilers	4400.0345	0.2100	297.5987 (367)
Electrical energy for heat distribution (space & water)	12.8959	0.0000	5.8649 (372)
Overall CO2 factor for heat network			0.2322 (386)
Total CO2 associated with community systems			929.8721 (373)
Space and water heating			929.8721 (376)
Pumps, fans and electric keep-hot	330.3150	0.1387	45.8188 (378)
Energy for lighting	243.1614	0.1443	35.0957 (379)
Total CO2, kg/year			1010.7866 (383)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			8.8700 (384)

13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Efficiency of heat source Boilers			91.0000 (467a)
Space and Water heating from Boilers	4400.0345	1.1300	1601.3643 (467)
Electrical energy for heat distribution (space & water)	12.8959	0.0000	61.7345 (472)
Overall CO2 factor for heat network			1.2572 (486)
Total CO2 associated with community systems			5033.7734 (473)
Space and water heating			5033.7734 (476)
Pumps, fans and electric keep-hot	330.3150	1.5128	499.7005 (478)
Energy for lighting	243.1614	1.5338	372.9691 (479)
Total Primary energy kWh/year			5906.4430 (483)
Dwelling Primary energy Rate (DPER)			51.8100 (484)

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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	38.0000 (1b)	x 2.5000 (2b)	= 95.0000 (1b) -
First floor	38.0000 (1c)	x 2.5000 (2c)	= 95.0000 (1c) -
Second floor	38.0000 (1d)	x 2.5000 (2d)	= 95.0000 (1d) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	114.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	285.0000 (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) = 0.1404 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.3904 (18)
Number of sides sheltered	2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.3318 (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	0.4230	0.4147	0.4065	0.3650	0.3567	0.3152	0.3152	0.3069	0.3318	0.3567	0.3733	0.3899 (22b)
Effective ac	0.5895	0.5860	0.5826	0.5666	0.5636	0.5497	0.5497	0.5471	0.5550	0.5636	0.5697	0.5760 (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			3.3600	1.0000	3.3600		(26)
TER Opening Type (Uw = 1.20)			18.8000	1.1450	21.5267		(27)
GF			38.0000	0.1300	4.9400		(28a)
EW	62.1600	22.1600	40.0000	0.1800	7.2000		(29a)
ER	38.0000		38.0000	0.1100	4.1800		(30)
Total net area of external elements Aum(A, m2)			138.1600				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		41.2067		(33)
PW			172.7000	0.0000	0.0000		(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 250.0000 (35)

List of Thermal Bridges							
K1 Element		Length	Psi-value	Total			
E5 Ground floor (normal)		7.4000	0.1600	1.1840			
E6 Intermediate floor within a dwelling		7.4000	0.0000	0.0000			
E18 Party wall between dwellings		30.0000	0.0600	1.8000			
P2 Party wall - Intermediate floor within a dwelling		20.4000	0.0000	0.0000			
P4 Party wall - Roof (insulation at ceiling level)		20.4000	0.1200	2.4480			
E15 Flat roof with parapet		27.9000	0.5600	15.6240			
P1 Party wall - Ground floor		20.4000	0.0800	1.6320			
E2 Other lintels (including other steel lintels)		11.3700	0.0500	0.5685			
E3 Sill		10.0100	0.0500	0.5005			
E4 Jamb		26.8500	0.0500	1.3425			
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							25.0995 (36)
Point Thermal bridges						(36a) =	0.0000
Total fabric heat loss						(33) + (36) + (36a) =	66.3062 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	55.4408	55.1140	54.7937	53.2892	53.0077	51.6972	51.6972	51.4546	52.2020	53.0077	53.5771	54.1725 (38)
	121.7471	121.4203	121.0999	119.5954	119.3139	118.0034	118.0034	117.7608	118.5082	119.3139	119.8833	120.4787 (39)

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12a. Carbon dioxide emissions - Individual heating systems including micro-CHP			
	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	3859.7582	0.2100	810.5492 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2983.3062	0.2100	626.4943 (264)
Space and water heating			1437.0435 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	243.1614	0.1443	35.0957 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-844.1312	0.1342	-113.2732
PV Unit electricity exported	-1034.1140	0.1257	-129.9428
Total			-243.2161 (269)
Total CO2, kg/year			1240.8524 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			10.8800 (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	3859.7582	1.1300	4361.5268 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2983.3062	1.1300	3371.1360 (278)
Space and water heating			7732.6627 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	243.1614	1.5338	372.9691 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-844.1312	1.4959	-1262.7512
PV Unit electricity exported	-1034.1140	0.4612	-476.9672
Total			-1739.7184 (283)
Total Primary energy kWh/year			6496.0142 (286)
Target Primary Energy Rate (TPER)			56.9800 (287)

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

1. Overall dwelling characteristics

	Area (m ²)	Storey	height (m)	Volume (m ³)
Ground floor	38.0000 (1b)	x	2.5000 (2b)	= 95.0000 (1b)
First floor	38.0000 (1c)	x	2.5000 (2c)	= 95.0000 (1c)
Second floor	38.0000 (1d)	x	2.5000 (2d)	= 95.0000 (1d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	114.0000			(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	285.0000 (5)

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2. Ventilation rate

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

Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	Air changes per hour 0.1404 (8)
Pressure test			Yes
Pressure Test Method			Blower Door
Measured/design AP50			1.0000 (17)
Infiltration rate			0.1904 (18)
Number of sides sheltered			2 (19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor		(21) = (18) x (20) =	0.1618 (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 infiltr rate												
	0.2063	0.2022	0.1982	0.1780	0.1739	0.1537	0.1537	0.1497	0.1618	0.1739	0.1820	0.1901 (22b)
If exhaust air heat pump using Appendix N, 23(b) = (23a) x Fmv (equation (N5)), otherwise 23(b) = (23a)												
												0.0000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												
												0.0000 (23c)
Effective ac	0.5213	0.5205	0.5196	0.5158	0.5151	0.5118	0.5118	0.5112	0.5131	0.5151	0.5166	0.5181 (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
Window (Uw = 0.80)			18.8000	0.7752	14.5736		(26)
Door			3.3600	1.0000	3.3600		(27)
GF			38.0000	0.1000	3.8000		(28a)
EW	62.1600	22.1600	40.0000	0.1300	5.2000		(29a)
ER	38.0000		38.0000	0.1000	3.8000		(30)
Total net area of external elements Aum(A, m2)			138.1600				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		30.7336		(33)
PW			172.7000	0.0000	0.0000		(32)

Thermal mass parameter (TMP = C_m / TFA) in kJ/m²K 250.0000 (35)

K1 Element	Length	Psi-value	Total
E5 Ground floor (normal)	7.4000	0.2680	1.9832
E6 Intermediate floor within a dwelling	7.4000	0.1400	1.0360
E18 Party wall between dwellings	30.0000	0.1200	3.6000
P2 Party wall - Intermediate floor within a dwelling	20.4000	0.0000	0.0000
P4 Party wall - Roof (insulation at ceiling level)	20.4000	0.2400	4.8960
E15 Flat roof with parapet	27.9000	0.5600	15.6240
P1 Party wall - Ground floor	20.4000	0.1600	3.2640
E2 Other lintels (including other steel lintels)	11.3700	0.0300	0.3411
E3 Sill	10.0100	0.0200	0.2002
E4 Jamb	26.8500	0.0200	0.5370

Thermal bridges (Sum(L x Psi) calculated using Appendix K)	26.6366	0.0266	0.5576	31.4815 (36)
Point Thermal bridges			(36a) =	0.0000
Total fabric heat loss		(33) + (36) + (36a) =		62.2151 (37)

Ventilation heat loss calculated monthly $(38)_m = 0.33 \times (25)_m \times (5)$

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	0.9758	0.9751	0.9745	0.9713	0.9707	0.9680	0.9680	0.9675	0.9690	0.9707	0.9719	0.9732 (40)
HLP (average)												0.9713
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8368 (42)
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (42a)
Hot water usage for baths	30.9927	30.5324	29.8842	28.6891	27.7942	26.8019	26.2659	26.9096	27.6104	28.6722	29.8919	30.8879 (42b)
Hot water usage for other uses	43.6819	42.0935	40.5050	38.9166	37.3282	35.7397	35.7397	37.3282	38.9166	40.5050	42.0935	43.6819 (42c)

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Average daily hot water use (litres/day)												68.4459 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	74.6746	72.6259	70.3893	67.6057	65.1224	62.5416	62.0057	64.2377	66.5270	69.1772	71.9854	74.5698 (44)
Energy conte	118.2663	103.4183	108.1857	92.5488	87.6672	76.9022	74.9905	79.5397	82.0344	93.8728	102.5564	116.7583 (45)
Energy content (annual)	Total = Sum(45)m = 1136.7406											
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)
Total heat required for water heating calculated for each month	100.5263	87.9055	91.9578	78.6665	74.5171	65.3669	63.7419	67.6088	69.7293	79.7919	87.1729	99.2446 (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	100.5263	87.9055	91.9578	78.6665	74.5171	65.3669	63.7419	67.6088	69.7293	79.7919	87.1729	99.2446 (64)
12Total per year (kWh/year)	Total Energy used by instantaneous electric shower(s) = Sum(64a)m = 966.2295 (64)											
Electric shower(s)	57.4870	51.2214	55.9318	53.3750	54.3766	51.8700	53.5990	54.3766	53.3750	55.9318	54.8801	57.4870 (64a)
Heat gains from water heating, kWh/month	39.5033	34.7817	36.9724	33.0104	32.2234	29.3092	29.3352	30.4963	30.7761	33.9309	35.5132	39.1829 (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	141.8411	141.8411	141.8411	141.8411	141.8411	141.8411	141.8411	141.8411	141.8411	141.8411	141.8411	141.8411 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	145.0060	160.5424	145.0060	149.8395	145.0060	149.8395	145.0060	145.0060	149.8395	145.0060	149.8395	145.0060 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	277.1823	280.0586	272.8104	257.3800	237.9018	219.5951	207.3651	204.4888	211.7369	227.1674	246.6455	264.9523 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.1841	37.1841	37.1841	37.1841	37.1841	37.1841	37.1841	37.1841	37.1841	37.1841	37.1841	37.1841 (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)	-113.4729	-113.4729	-113.4729	-113.4729	-113.4729	-113.4729	-113.4729	-113.4729	-113.4729	-113.4729	-113.4729	-113.4729 (71)
Water heating gains (Table 5)	53.0959	51.7585	49.6941	45.8478	43.3111	40.7073	39.4291	40.9897	42.7445	45.6061	49.3239	52.6652 (72)
Total internal gains	540.8365	557.9118	533.0629	518.6196	491.7712	475.6942	457.3525	456.0368	469.8734	483.3318	511.3614	528.1758 (73)

6. Solar gains

[Jan]	Area m2		Solar flux Table 6a W/m2		Specific data or Table 6b		Specific data or Table 6c		Access factor Table 6d		Gains W	
North	10.8900		10.6334		0.5400		0.8000		0.7700		34.6670 (74)	
South	7.9100		46.7521		0.5400		0.8000		0.7700		110.7119 (78)	
Solar gains	145.3789	247.5680	343.5421	441.8677	515.6106	522.5530	499.2401	441.5522	376.6242	274.4305	173.9976	124.5654 (83)
Total gains	686.2154	805.4798	876.6050	960.4873	1007.3819	998.2472	956.5926	897.5890	846.4976	757.7623	685.3590	652.7412 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	71.1666	71.2163	71.2651	71.4954	71.5387	71.7407	71.7407	71.7782	71.6627	71.5387	71.4512	71.3600
alpha	5.7444	5.7478	5.7510	5.7664	5.7692	5.7827	5.7827	5.7852	5.7775	5.7692	5.7634	5.7573
util living area	0.9979	0.9944	0.9860	0.9536	0.8612	0.6765	0.5026	0.5560	0.8043	0.9674	0.9948	0.9985 (86)
MIT	19.8609	20.0396	20.2749	20.5880	20.8429	20.9700	20.9953	20.9919	20.9209	20.5939	20.1658	19.8223 (87)
Th 2	20.1035	20.1041	20.1047	20.1073	20.1078	20.1101	20.1101	20.1105	20.1092	20.1078	20.1068	20.1068 (88)
util rest of house	0.9973	0.9926	0.9812	0.9373	0.8164	0.5951	0.4036	0.4533	0.7328	0.9528	0.9927	0.9979 (89)
MIT 2	19.0609	19.2391	19.4721	19.7762	20.0028	20.0965	20.1089	20.1082	20.0669	19.7868	19.3675	19.0242 (90)
Living area fraction	fLA = Living area / (4) = 0.1465 (91)											
MIT	19.1781	19.3563	19.5897	19.8951	20.1259	20.2244	20.2387	20.2377	20.1920	19.9051	19.4844	19.1411 (92)
Temperature adjustment	0.0000											
adjusted MIT	19.1781	19.3563	19.5897	19.8951	20.1259	20.2244	20.2387	20.2377	20.1920	19.9051	19.4844	19.1411 (93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9963	0.9905	0.9776	0.9327	0.8174	0.6061	0.4181	0.4683	0.7401	0.9485	0.9908	0.9972 (94)
Useful gains	683.6530	797.8247	857.0063	895.8250	823.4422	605.0010	399.9964	420.3606	626.5103	718.7559	679.0243	650.8877 (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	1655.0558	1607.0187	1454.1059	1217.4852	932.4307	620.6624	401.5397	423.2687	672.9856	1029.7231	1372.1707	1657.5616 (97)
Space heating kWh	722.7237	543.7784	444.2421	231.5954	81.0874	0.0000	0.0000	0.0000	0.0000	231.3596	499.0654	748.9654 (98a)
Space heating requirement - total per year (kWh/year)	3502.8174											
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	722.7237	543.7784	444.2421	231.5954	81.0874	0.0000	0.0000	0.0000	0.0000	231.3596	499.0654	748.9654 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)	3502.8174											
Space heating per m2	(98c) / (4) = 30.7265 (99)											

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	1037.3010	816.5986	838.2303	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8776	0.9383	0.9140	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	910.3365	766.1890	766.1551	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1103.5190	1057.7600	991.7108	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	139.0914	216.9288	167.8135	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction	fC = cooled area / (4) = 1.0000 (105)											
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500 (106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	34.7729	54.2322	41.9534	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement	130.9584 (107)											
Energy for space heating	30.7265 (99)											
Energy for space cooling	1.1488 (108)											
Total	31.8752 (109)											
Fabric Energy Efficiency (DFEE)	31.9 (109)											

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	38.0000 (1b)	x	2.5000 (2b)	=	95.0000 (1b)	-
First floor	38.0000 (1c)	x	2.5000 (2c)	=	95.0000 (1c)	-
Second floor	38.0000 (1d)	x	2.5000 (2d)	=	95.0000 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	114.0000				(4)	
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		285.0000 (5)	

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Measured/design AP50												5.0000 (17)
Infiltration rate												0.3904 (18)
Number of sides sheltered												2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =											0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =											0.3318 (21)
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind factor	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)
Adj infilt rate	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)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.4230	0.4147	0.4065	0.3650	0.3567	0.3152	0.3152	0.3069	0.3318	0.3567	0.3733	0.3899 (22b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												0.0000 (23b)
Effective ac	0.5895	0.5860	0.5826	0.5666	0.5636	0.5497	0.5497	0.5471	0.5550	0.5636	0.5697	0.0000 (23c)
												0.5760 (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			3.3600	1.0000	3.3600		(26)
TER Opening Type (Uw = 1.20)			18.8000	1.1450	21.5267		(27)
GF			38.0000	0.1300	4.9400		(28a)
EW	62.1600	22.1600	40.0000	0.1800	7.2000		(29a)
ER	38.0000		38.0000	0.1100	4.1800		(30)
Total net area of external elements Aum(A, m2)			138.1600				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	41.2067	(33)
PW			172.7000	0.0000	0.0000		(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 250.0000 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E5 Ground floor (normal)	7.4000	0.1600	1.1840
E6 Intermediate floor within a dwelling	7.4000	0.0000	0.0000
E18 Party wall between dwellings	30.0000	0.0600	1.8000
P2 Party wall - Intermediate floor within a dwelling	20.4000	0.0000	0.0000
P4 Party wall - Roof (insulation at ceiling level)	20.4000	0.1200	2.4480
E15 Flat roof with parapet	27.9000	0.5600	15.6240
P1 Party wall - Ground floor	20.4000	0.0800	1.6320
E2 Other lintels (including other steel lintels)	11.3700	0.0500	0.5685
E3 Sill	10.0100	0.0500	0.5005
E4 Jamb	26.8500	0.0500	1.3425

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 25.0995 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 66.3062 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	55.4408	55.1140	54.7937	53.2892	53.0077	51.6972	51.6972	51.4546	52.2020	53.0077	53.5771	54.1725 (38)
Heat transfer coeff	121.7471	121.4203	121.0999	119.5954	119.3139	118.0034	118.0034	117.7608	118.5082	119.3139	119.8833	120.4787 (39)
Average = Sum(39)m / 12 =												119.5940

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.0680	1.0651	1.0623	1.0491	1.0466	1.0351	1.0351	1.0330	1.0395	1.0466	1.0516	1.0568 (40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8368 (42)
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (42a)
Hot water usage for baths	30.9927	30.5324	29.8842	28.6891	27.7942	26.8019	26.2659	26.9096	27.6104	28.6722	29.8919	30.8879 (42b)
Hot water usage for other uses	43.6819	42.0935	40.5050	38.9166	37.3282	35.7397	35.7397	37.3282	38.9166	40.5050	42.0935	43.6819 (42c)
Average daily hot water use (litres/day)												68.4459 (43)

Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	74.6746	72.6259	70.3893	67.6057	65.1224	62.5416	62.0057	64.2377	66.5270	69.1772	71.9854	74.5698 (44)
Energy content (annual)	118.2663	103.4183	108.1857	92.5488	87.6672	76.9022	74.9905	79.5397	82.0344	93.8728	102.5564	116.7583 (45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)
Total heat required for water heating calculated for each month												
WHRS	100.5263	87.9055	91.9578	78.6665	74.5171	65.3669	63.7419	67.6088	69.7293	79.7919	87.1729	99.2446 (62)
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63a)

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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	100.5263	87.9055	91.9578	78.6665	74.5171	65.3669	63.7419	67.6088	69.7293	79.7919	87.1729	99.2446 (64)

12Total per year (kWh/year)	Total per year (kWh/year) = Sum(64)m =											966.2295 (64)
Electric shower(s)	57.4870	51.2214	55.9318	53.3750	54.3766	51.8700	53.5990	54.3766	53.3750	55.9318	54.8801	57.4870 (64a)
Heat gains from water heating, kWh/month	39.5033	34.7817	36.9724	33.0104	32.2234	29.3092	29.3352	30.4963	30.7761	33.9309	35.5132	39.1829 (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	141.8411	141.8411	141.8411	141.8411	141.8411	141.8411	141.8411	141.8411	141.8411	141.8411	141.8411	141.8411 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	145.0060	160.5424	145.0060	149.8395	145.0060	149.8395	145.0060	145.0060	149.8395	145.0060	149.8395	145.0060 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	277.1823	280.0586	272.8104	257.3800	237.9018	219.5951	207.3651	204.4888	211.7369	227.1674	246.6455	264.9523 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.1841	37.1841	37.1841	37.1841	37.1841	37.1841	37.1841	37.1841	37.1841	37.1841	37.1841	37.1841 (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)	-113.4729	-113.4729	-113.4729	-113.4729	-113.4729	-113.4729	-113.4729	-113.4729	-113.4729	-113.4729	-113.4729	-113.4729 (71)
Water heating gains (Table 5)	53.0959	51.7585	49.6941	45.8478	43.3111	40.7073	39.4291	40.9897	42.7445	45.6061	49.3239	52.6652 (72)
Total internal gains	540.8365	557.9118	533.0629	518.6196	491.7712	475.6942	457.3525	456.0368	469.8734	483.3318	511.3614	528.1758 (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					10.8900	10.6334	0.6300	0.7000	0.7700		35.3893 (74)	
South					7.9100	46.7521	0.6300	0.7000	0.7700		113.0184 (78)	
Solar gains	148.4077	252.7257	350.6993	451.0733	526.3525	533.4395	509.6409	450.7512	384.4705	280.1478	177.6225	127.1605 (83)
Total gains	689.2442	810.6375	883.7621	969.6929	1018.1237	1009.1337	966.9934	906.7880	854.3439	763.4796	688.9839	655.3363 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	65.0255	65.2005	65.3730	66.1954	66.3516	67.0884	67.0884	67.2267	66.8027	66.3516	66.0364	65.7101
alpha	5.3350	5.3467	5.3582	5.4130	5.4234	5.4726	5.4726	5.4818	5.4535	5.4234	5.4024	5.3807
util living area	0.9979	0.9947	0.9873	0.9591	0.8782	0.7029	0.5285	0.5826	0.8259	0.9711	0.9950	0.9984 (86)
MIT	19.7157	19.9030	20.1558	20.5047	20.7935	20.9559	20.9922	20.9871	20.8925	20.5213	20.0609	19.6898 (87)
Th 2	20.0271	20.0294	20.0318	20.0426	20.0447	20.0542	20.0542	20.0559	20.0505	20.0447	20.0405	20.0362 (88)
util rest of house	0.9972	0.9929	0.9828	0.9440	0.8347	0.6169	0.4194	0.4705	0.7541	0.9575	0.9930	0.9979 (89)
MIT 2	18.8554	19.0437	19.2958	19.6430	19.9050	20.0340	20.0522	20.0522	19.9921	19.6653	19.2102	18.8368 (90)
Living area fraction	18.9815	19.1696	19.4218	19.7692	20.0351	20.1690	20.1899	20.1892	20.1240	19.7907	19.3349	18.9617 (92)
Temperature adjustment												0.0000
adjusted MIT	18.9815	19.1696	19.4218	19.7692	20.0351	20.1690	20.1899	20.1892	20.1240	19.7907	19.3349	18.9617 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9962	0.9908	0.9791	0.9386	0.8342	0.6281	0.4354	0.4869	0.7604	0.9528	0.9910	0.9971 (94)
Ext temp.	686.6143	803.1452	865.2628	910.1938	849.3585	633.7885	421.0037	441.5238	649.6683	727.4054	682.7701	653.4104 (95)
Heat loss rate W	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.0000	16.4000	14.1000	10.6000	7.1000	4.2000 (96)
Space heating	1787.4257	1732.6135	1564.8307	1299.9042	994.4969	657.1635	423.6164	446.2182	713.8903	1096.5763	1466.7552	1778.4720 (97)
Solar heating	819.0037	624.6027	520.4786	280.5914	107.9830	0.0000	0.0000	0.0000	0.0000	274.6631	564.4693	837.0458 (98a)
Space heating requirement - total per year (kWh/year)												4028.8376
Solar heating contribution - total per year (kWh/year)	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)
Space heating	819.0037	624.6027	520.4786	280.5914	107.9830	0.0000	0.0000	0.0000	0.0000	274.6631	564.4693	837.0458 (98c)

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

Space heating per m2

(98c) / (4) = 4028.837635.3407 (99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1109.2324	873.2255	894.9819	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8482	0.9173	0.8894	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	940.7986	801.0240	795.9858	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1116.2435	1069.9168	1002.4629	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	126.3204	200.0563	153.6189	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction													
Intermittency factor (Table 10b)													
	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	(105)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	31.5801	50.0141	38.4047	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement													
Energy for space heating													119.9989 (107)
Energy for space cooling													35.3407 (99)
Total													1.0526 (108)
Fabric Energy Efficiency (TFEE)													36.3933 (109)
													36.4 (109)

BRUKL Output Document

Compliance with England Building Regulations Part L 2021

Project name

Shell and Core

Amethyst Lane

As designed

Date: Wed Apr 05 14:13:32 2023

Administrative information

Building Details

Address: Address 1, Reading, RG30

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.18

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.18

BRUKL compliance module version: v6.1.d.0

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Foundation area [m²]: 458.36

The CO₂ emission and primary energy rates of the building must not exceed the targets

The building does not comply with England Building Regulations Part L 2021

Target CO ₂ emission rate (TER), kgCO ₂ /m²annum	10.68
Building CO ₂ emission rate (BER), kgCO ₂ /m²annum	7.77
Target primary energy rate (TPER), kWh/m²annum	40.77
Building primary energy rate (BPER), kWh/m²annum	48.49
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 -Limit	U _a -Calc	U _i -Calc	First surface with maximum value
Walls*	0.26	0.13	0.13	DJ000004:Surf[3]
Floors	0.18	0.1	0.1	DJ000004:Surf[0]
Pitched roofs	0.16	-	-	No pitched roofs in building
Flat roofs	0.18	0.11	0.11	DJ000004:Surf[1]
Windows** and roof windows	1.6	0.8	0.8	DJ000004:Surf[2]
Rooflights***	2.2	-	-	No roof lights in building
Personnel doors^	1.6	1	1	DJ00000C:Surf[2]
Vehicle access & similar large doors	1.3	-	-	No vehicle access doors in building
High usage entrance doors	3	-	-	No high usage entrance doors in building
U _a -Limit = Limiting area-weighted average U-values [W/(m²K)] U _a -Calc = Calculated area-weighted average U-values [W/(m²K)] U _i -Calc = Calculated maximum individual element U-values [W/(m²K)] * 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/m²K 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	
m³/(h.m²) at 50 Pa	8		1	

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	>0.95

1- Space Heating

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1.01	-	0.2	-	0.85
Standard value	0.93*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* Standard shown is for gas single boiler systems <=2 MW output and overall for multi-boiler systems. For single boiler systems >2 MW or any individual boiler in a multi-boiler system, limiting efficiency is 0.88.					

"No HWS in project, or hot water is provided by HVAC system"

"No zones in project where local mechanical ventilation, exhaust, or terminal unit is applicable"

Shell and core configuration

Zone	Assumed shell?
GF_Sensory Room	NO
GF_Medical Room	NO
GF_WC	NO
GF_Lobby	NO
GF_Office	NO
GF_Office / Meeting Room	NO
GF_Plant Room	NO
GF_Circulation	NO
GF_Kitchen	NO
GF_Acc. WC	NO
GF_Lounge	NO
GF_Lobby	NO
GF_Quiet Lounge	NO
GF_Circulation	NO
GF_Ensuite Shower Room	NO
GF_Ensuite Shower Room	NO
GF_Ensuite Bathroom	NO
GF_WC	NO
GF_Bedroom	NO
GF_Bedroom	NO
GF_Ensuite Shower Room	NO
GF_Ensuite Shower Room	NO
GF_Bedroom	NO
GF_GF_Ensuite Bathroom	NO
GF_Flatlet	NO
GF_Staff Sleeping Office	NO
GF_WC	NO
GF_Bathing Suite	NO
GF_Bedroom	NO
GF_Bedroom	NO
GF_Circulation	NO

Shell and core configuration

Zone	Assumed shell?
GF_Dining	NO

General lighting and display lighting		General luminaire	Display light source	
Zone name	Standard value	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
GF_Sensory Room	153	-	-	-
GF_Medical Room	153	-	-	-
GF_WC	170	-	-	-
GF_Lobby	170	-	-	-
GF_Office	153	-	-	-
GF_Office / Meeting Room	153	-	-	-
GF_Plant Room	153	-	-	-
GF_Circulation	170	-	-	-
GF_Kitchen	170	-	-	-
GF_Acc. WC	170	-	-	-
GF_Lounge	170	-	-	-
GF_Lobby	170	-	-	-
GF_Quiet Lounge	170	-	-	-
GF_Circulation	170	-	-	-
GF_Ensuite Shower Room	170	-	-	-
GF_Ensuite Shower Room	170	-	-	-
GF_Ensuite Bathroom	170	-	-	-
GF_WC	170	-	-	-
GF_Bedroom	170	-	-	-
GF_Bedroom	170	-	-	-
GF_Ensuite Shower Room	170	-	-	-
GF_Ensuite Shower Room	170	-	-	-
GF_Bedroom	170	-	-	-
GF_GF_Ensuite Bathroom	170	-	-	-
GF_Flatlet	170	-	-	-
GF_Staff Sleeping Office	153	-	-	-
GF_WC	170	-	-	-
GF_Bathing Suite	170	-	-	-
GF_Bedroom	170	-	-	-
GF_Bedroom	170	-	-	-
GF_Circulation	170	-	-	-
GF_Dining	170	-	-	-

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?
GF_Sensory Room	NO (-63.8%)	NO
GF_Medical Room	N/A	N/A
GF_Lobby	YES (+35.9%)	NO
GF_Office	NO (-59%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
GF_Office / Meeting Room	NO (-67.1%)	NO
GF_Lounge	NO (-20.2%)	NO
GF_Lobby	YES (+30.4%)	NO
GF_Quiet Lounge	NO (-42.8%)	NO
GF_Bedroom	YES (+20.7%)	NO
GF_Bedroom	YES (+18.9%)	NO
GF_Bedroom	NO (-26%)	NO
GF_Flatlet	NO (-41%)	NO
GF_Staff Sleeping Office	N/A	N/A
GF_Bedroom	NO (-36.7%)	NO
GF_Bedroom	YES (+6.7%)	NO

Regulation 25A: Consideration of high efficiency alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	NO
Is evidence of such assessment available as a separate submission?	NO
Are any such measures included in the proposed design?	NO

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters			Building Use	
	Actual	Notional	% Area	Building Type
Floor area [m²]	458.4	458.4		Retail/Financial and Professional Services
External area [m²]	1441.1	1441.1		Restaurants and Cafes/Drinking Establishments/Takeaways
Weather	LON	LON		Offices and Workshop Businesses
Infiltration [m³/hm²@ 50Pa]	1	3		General Industrial and Special Industrial Groups
Average conductance [W/K]	221.11	416.15		Storage or Distribution
Average U-value [W/m²K]	0.15	0.29		Hotels
Alpha value* [%]	25.44	10		Residential Institutions: Hospitals and Care Homes
* Percentage of the building's average heat transfer coefficient which is due to thermal bridging				
			58	Residential Spaces
			42	Non-residential Institutions: Community/Day Centre
				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/m²]

	Actual	Notional
Heating	23.55	45.71
Cooling	0	0
Auxiliary	1.52	3.08
Lighting	4.42	6.07
Hot water	10.75	20.6
Equipment*	20.54	20.54
TOTAL**	40.24	75.46

* 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/m²]

	Actual	Notional
Photovoltaic systems	0	32.9
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	0	32.9

Energy & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	76.74	148.97
Primary energy [kWh/m²]	48.49	40.77
Total emissions [kg/m²]	7.77	10.68

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 SSEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity									
Actual	76.7	0	23.5	0	1.5	0.91	0	1.01	0
Notional	149	0	45.7	0	1.1	0.91	0	----	----
[ST] No Heating or Cooling									
Actual	0	0	0	0	0	0	0	0	0
Notional	0	0	0	0	0	0	0	----	----

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

SAP10.2 Be Green

Full SAP Calculation Printout



Property Reference	3B5PA House-Flat roof-Unit 5		Issued on Date	14/04/2023	
Assessment Reference	BE GREEN-3B5PA-Unit 5		Prop Type Ref	House	
Property					
SAP Rating	102 A	DER	-1.50	TER	10.88
Environmental	101 A	% DER < TER	113.79		
CO ₂ Emissions (t/year)	-0.19	DFEE	31.88	TFEE	36.39
Compliance Check	See BREL	% DFEE < TFEE	12.41		
% DPER < TPER	104.86	DPER	-2.77	TPER	56.98
Assessor Details	Mr. Rory Bergin		Assessor ID	N427-0001	
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	38.0000 (1b)	x 2.5000 (2b)	= 95.0000 (1b)	-
First floor	38.0000 (1c)	x 2.5000 (2c)	= 95.0000 (1c)	-
Second floor	38.0000 (1d)	x 2.5000 (2d)	= 95.0000 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	114.0000		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	285.0000 (5)
Dwelling volume				

2. Ventilation rate

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)
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	1.0000 (17)	
Infiltration rate	0.0500 (18)	
Number of sides sheltered	2 (19)	
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.0425 (21)
Wind speed	Jan 5.1000 Feb 5.0000 Mar 4.9000 Apr 4.4000 May 4.3000 Jun 3.8000 Jul 3.8000 Aug 3.7000 Sep 4.0000 Oct 4.3000 Nov 4.5000 Dec 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	0.0542 0.0531 0.0521 0.0468 0.0457 0.0404 0.0404 0.0393 0.0425 0.0457 0.0478 0.0499 (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) =		79.2000 (23c)
Effective ac	0.1582 0.1571 0.1561 0.1507 0.1497 0.1444 0.1444 0.1433 0.1465 0.1497 0.1518 0.1539 (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
Window (Uw = 0.80)			18.8000	0.7752	14.5736		(27)

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Door							3.3600	1.0000		3.3600			(26)
GF							38.0000	0.1000		3.8000			(28a)
EW		62.1600	22.1600				40.0000	0.1300		5.2000			(29a)
ER		38.0000					38.0000	0.1000		3.8000			(30)
Total net area of external elements Aum(A, m2)							138.1600						(31)
Fabric heat loss, W/K = Sum (A x U)							(26)...(30) + (32) =		30.7336				(33)
PW							172.7000	0.0000		0.0000			(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K												250.0000 (35)	
List of Thermal Bridges													
K1 Element							Length		Psi-value		Total		
E5 Ground floor (normal)							7.4000		0.2680		1.9832		
E6 Intermediate floor within a dwelling							7.4000		0.1400		1.0360		
E18 Party wall between dwellings							30.0000		0.1200		3.6000		
P2 Party wall - Intermediate floor within a dwelling							20.4000		0.0000		0.0000		
P4 Party wall - Roof (insulation at ceiling level)							20.4000		0.2400		4.8960		
E15 Flat roof with parapet							27.9000		0.5600		15.6240		
P1 Party wall - Ground floor							20.4000		0.1600		3.2640		
E2 Other lintels (including other steel lintels)							11.3700		0.0300		0.3411		
E3 Sill							10.0100		0.0200		0.2002		
E4 Jamb							26.8500		0.0200		0.5370		
Thermal bridges (Sum(L x Psi) calculated using Appendix K)												31.4815 (36)	
Point Thermal bridges												(36a) = 0.0000	
Total fabric heat loss												(33) + (36) + (36a) = 62.2151 (37)	
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(38)
Heat transfer coeff	14.8775	14.7776	14.6777	14.1780	14.0781	13.5785	13.5785	13.4785	13.7783	14.0781	14.2780	14.4778	(38)
	77.0927	76.9927	76.8928	76.3932	76.2933	75.7936	75.7936	75.6937	75.9935	76.2933	76.4931	76.6930	(39)
Average = Sum(39)m / 12 =													76.3682
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(40)
HLP (average)	0.6763	0.6754	0.6745	0.6701	0.6692	0.6649	0.6649	0.6640	0.6666	0.6692	0.6710	0.6727	(40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	
													0.6699
													31

4. Water heating energy requirements (kWh/year)													

Assumed occupancy												2.8368 (42)	
Hot water usage for mixer showers													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)
Hot water usage for baths													
	82.8019	81.5722	79.8404	76.6475	74.2566	71.6056	70.1736	71.8932	73.7655	76.6022	79.8610	82.5220	(42b)
Hot water usage for other uses													
	43.6819	42.0935	40.5050	38.9166	37.3282	35.7397	35.7397	37.3282	38.9166	40.5050	42.0935	43.6819	(42c)
Average daily hot water use (litres/day)													116.4812 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(44)
Daily hot water use	126.4838	123.6656	120.3455	115.5641	111.5848	107.3453	105.9133	109.2213	112.6821	117.1073	121.9544	126.2038	(44)
Energy conte	200.3194	176.0982	184.9665	158.2015	150.2146	131.9936	128.0930	135.2388	138.9483	158.9135	173.7464	197.6047	(45)
Energy content (annual)										Total = Sum(45)m =		1934.3384	(45)
Distribution loss (46)m = 0.15 x (45)m	30.0479	26.4147	27.7450	23.7302	22.5322	19.7990	19.2139	20.2858	20.8422	23.8370	26.0620	29.6407	(46)
Water storage loss:													
Store volume													160.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):													1.1500 (48)
Temperature factor from Table 2b													0.6000 (49)
Enter (49) or (54) in (55)													0.6900 (55)
Total storage loss													
	21.3900	19.3200	21.3900	20.7000	21.3900	20.7000	21.3900	21.3900	20.7000	21.3900	20.7000	21.3900	(56)
If cylinder contains dedicated solar storage													
	21.3900	19.3200	21.3900	20.7000	21.3900	20.7000	21.3900	21.3900	20.7000	21.3900	20.7000	21.3900	(57)
Primary loss	31.1612	28.1456	31.1612	30.1560	31.1612	22.5120	23.2624	23.2624	22.5120	31.1612	30.1560	31.1612	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month													
	252.8706	223.5638	237.5177	209.0575	202.7658	175.2056	172.7454	179.8912	182.1603	211.4647	224.6024	250.1559	(62)
MWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	252.8706	223.5638	237.5177	209.0575	202.7658	175.2056	172.7454	179.8912	182.1603	211.4647	224.6024	250.1559	(64)
12Total per year (kWh/year)												2522.0008 (64)	
Electric shower(s)													2522 (64)
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												0.0000 (64a)	
Heat gains from water heating, kWh/month													
	108.6472	96.5251	103.5423	93.2868	91.9873	78.4575	78.3128	80.6888	80.7699	94.8797	98.4555	107.7445	(65)

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

Metabolic gains (Table 5), Watts													
(66)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(66)
	141.8411	141.8411	141.8411	141.8411	141.8411	141.8411	141.8411	141.8411	141.8411	141.8411	141.8411	141.8411	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													

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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	145.0060	160.5424	145.0060	149.8395	145.0060	149.8395	145.0060	145.0060	149.8395	145.0060	149.8395	145.0060 (67)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	277.1823	280.0586	272.8104	257.3800	237.9018	219.5951	207.3651	204.4888	211.7369	227.1674	246.6455	264.9523 (68)
Pumps, fans	37.1841	37.1841	37.1841	37.1841	37.1841	37.1841	37.1841	37.1841	37.1841	37.1841	37.1841	37.1841 (69)
Losses e.g. evaporation (negative values) (Table 5)	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)
Water heating gains (Table 5)	-113.4729	-113.4729	-113.4729	-113.4729	-113.4729	-113.4729	-113.4729	-113.4729	-113.4729	-113.4729	-113.4729	-113.4729 (71)
Total internal gains	146.0311	143.6386	139.1698	129.5650	123.6389	108.9687	105.2592	108.4527	112.1804	127.5265	136.7437	144.8179 (72)
	633.7717	649.7919	622.5386	602.3368	572.0990	543.9557	523.1826	523.4999	539.3092	565.2522	598.7812	620.3285 (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				10.8900	10.6334		0.5400		0.8000		0.7700	34.6670 (74)
South				7.9100	46.7521		0.5400		0.8000		0.7700	110.7119 (78)
Solar gains	145.3789	247.5680	343.5421	441.8677	515.6106	522.5530	499.2401	441.5522	376.6242	274.4305	173.9976	124.5654 (83)
Total gains	779.1507	897.3599	966.0807	1044.2045	1087.7096	1066.5087	1022.4227	965.0520	915.9334	839.6827	772.7787	744.8939 (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, nli,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	102.6903	102.8235	102.9572	103.6305	103.7663	104.4503	104.4503	104.5882	104.1756	103.7663	103.4952	103.2255
alpha	7.8460	7.8549	7.8638	7.9087	7.9178	7.9634	7.9634	7.9725	7.9450	7.9178	7.8997	7.8817
util living area	0.9922	0.9769	0.9399	0.8267	0.6444	0.4544	0.3261	0.3607	0.5695	0.8611	0.9767	0.9943 (86)
MIT	20.4707	20.6264	20.7869	20.9371	20.9912	20.9995	21.0000	20.9999	20.9972	20.9275	20.6822	20.4359 (87)
Th 2	20.3619	20.3626	20.3634	20.3673	20.3681	20.3720	20.3720	20.3728	20.3704	20.3681	20.3665	20.3650 (88)
util rest of house	0.9900	0.9709	0.9257	0.7963	0.6033	0.4100	0.2796	0.3116	0.5189	0.8283	0.9696	0.9927 (89)
MIT 2	19.7453	19.9409	20.1366	20.3085	20.3613	20.3717	20.3720	20.3727	20.3687	20.3023	20.0155	19.7039 (90)
Living area fraction									fLA =	Living area / (4) =		0.1465 (91)
MIT	19.8516	20.0413	20.2319	20.4006	20.4536	20.4637	20.4640	20.4646	20.4608	20.3939	20.1132	19.8111 (92)
Temperature adjustment												0.0000
adjusted MIT	19.8516	20.0413	20.2319	20.4006	20.4536	20.4637	20.4640	20.4646	20.4608	20.3939	20.1132	19.8111 (93)
8. Space heating requirement												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9878	0.9673	0.9225	0.7980	0.6089	0.4165	0.2864	0.3188	0.5262	0.8297	0.9662	0.9909 (94)
Useful gains	769.6659	868.0155	891.1642	833.2912	662.3501	444.1847	292.8540	307.6425	481.9521	696.6940	746.6398	738.1100 (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	1198.9146	1165.7739	1055.8845	878.5650	667.8407	444.4282	292.8639	307.6656	483.3795	747.2063	995.4190	1197.2620 (97)
Space heating kWh	319.3611	200.0936	122.5519	32.5972	4.0850	0.0000	0.0000	0.0000	0.0000	37.5812	179.1210	341.6091 (98a)
Space heating requirement - total per year (kWh/year)												1237.0001
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	319.3611	200.0936	122.5519	32.5972	4.0850	0.0000	0.0000	0.0000	0.0000	37.5812	179.1210	341.6091 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1237.0001
Space heating per m2										(98c) / (4) =		10.8509 (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)
Fraction of main heating from main system 2												0.9999 (203)
Fraction of total heating from main system 1												0.0001 (204)
Fraction of total heating from main system 2												0.9999 (205)
Efficiency of main space heating system 1 (in %)												100.0000 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	319.3611	200.0936	122.5519	32.5972	4.0850	0.0000	0.0000	0.0000	0.0000	37.5812	179.1210	341.6091 (98)
Space heating efficiency (main heating system 1)	100.0000	100.0000	100.0000	100.0000	100.0000	0.0000	0.0000	0.0000	0.0000	100.0000	100.0000	100.0000 (210)

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Space heating fuel (main heating system)	0.0319	0.0200	0.0123	0.0033	0.0004	0.0000	0.0000	0.0000	0.0000	0.0038	0.0179	0.0342	(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)
Space heating fuel used, main system 2												0.0000	(213)
Water heating													
Water heating requirement	252.8706	223.5638	237.5177	209.0575	202.7658	175.2056	172.7454	179.8912	182.1603	211.4647	224.6024	250.1559	(64)
Efficiency of water heater (217)m	254.4600	254.4600	254.4600	254.4600	254.4600	254.4600	254.4600	254.4600	254.4600	254.4600	254.4600	254.4600	(216)
Fuel for water heating, kWh/month	99.3754	87.8581	93.3419	82.1573	79.6847	68.8539	67.8870	70.6953	71.5870	83.1033	88.2663	98.3085	(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	28.0542	25.3392	28.0542	27.1492	28.0542	27.1492	28.0542	28.0542	27.1492	28.0542	27.1492	28.0542	(231)
Lighting	30.1294	24.1709	21.7632	15.9447	12.3161	10.0624	11.2352	14.6039	18.9690	24.8884	28.1114	30.9668	(232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-57.2248	-81.3905	-118.2703	-134.1166	-146.0418	-136.3073	-134.6642	-127.0957	-112.7412	-93.9468	-63.2609	-49.4222	(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	-30.7271	-65.3760	-131.6898	-200.8791	-267.8172	-270.5820	-266.8479	-223.7075	-162.0080	-93.6746	-41.0627	-24.1785	(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												0.1237	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												254.4600	
Water heating fuel used												991.1188	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.9500)													
mechanical ventilation fans (SFP = 0.9500)												330.3150	(230a)
Total electricity for the above, kWh/year												330.3150	(231)
Electricity for lighting (calculated in Appendix L)												243.1614	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-3033.0324	(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												-1468.3135	(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	0.1237	0.1583	0.0196 (261)
Space heating - main system 2	0.0000	0.0000	0.0000 (262)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	991.1188	0.1412	139.9076 (264)
Space and water heating			139.9272 (265)
Pumps, fans and electric keep-hot	330.3150	0.1387	45.8188 (267)
Energy for lighting	243.1614	0.1443	35.0957 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1254.4821	0.1344	-168.5804
PV Unit electricity exported	-1778.5503	0.1255	-223.2598
Total			-391.8402 (269)
Total CO2, kg/year			-170.9985 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			-1.5000 (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	0.1237	1.5861	0.1962 (275)
Space heating - main system 2	0.0000	0.0000	0.0000 (276)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	991.1188	1.5220	1508.4636 (278)
Space and water heating			1508.6598 (279)

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Pumps, fans and electric keep-hot	330.3150	1.5128	499.7005 (281)
Energy for lighting	243.1614	1.5338	372.9691 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1254.4821	1.4966	-1877.5125
PV Unit electricity exported	-1778.5503	0.4608	-819.4843
Total			-2696.9969 (283)
Total Primary energy kWh/year			-315.6674 (286)
Dwelling Primary energy Rate (DPER)			-2.7700 (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	38.0000 (1b)	x 2.5000 (2b)	= 95.0000 (1b) -
First floor	38.0000 (1c)	x 2.5000 (2c)	= 95.0000 (1c) -
Second floor	38.0000 (1d)	x 2.5000 (2d)	= 95.0000 (1d) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	114.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	285.0000 (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)
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) = 0.1404 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.3904 (18)
Number of sides sheltered		2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3318 (21)
Wind speed	Jan 5.1000 Feb 5.0000 Mar 4.9000 Apr 4.4000 May 4.3000 Jun 3.8000 Jul 3.8000 Aug 3.7000 Sep 4.0000 Oct 4.3000 Nov 4.5000 Dec 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	0.4230 0.4147 0.4065 0.3650 0.3567 0.3152 0.3152 0.3069 0.3318 0.3567 0.3733 0.3899	(22b)
Effective ac	0.5895 0.5860 0.5826 0.5666 0.5636 0.5497 0.5497 0.5471 0.5550 0.5636 0.5697 0.5760	(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			3.3600	1.0000	3.3600		(26)
TER Opening Type (Uw = 1.20)			18.8000	1.1450	21.5267		(27)
GF			38.0000	0.1300	4.9400		(28a)
EW	62.1600	22.1600	40.0000	0.1800	7.2000		(29a)
ER	38.0000		38.0000	0.1100	4.1800		(30)
Total net area of external elements Aum(A, m2)			138.1600				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		41.2067		(33)
PW			172.7000	0.0000	0.0000		(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value		Total
E5 Ground floor (normal)				7.4000	0.1600		1.1840
E6 Intermediate floor within a dwelling				7.4000	0.0000		0.0000
E18 Party wall between dwellings				30.0000	0.0600		1.8000

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P2 Party wall - Intermediate floor within a dwelling	20.4000	0.0000	0.0000
P4 Party wall - Roof (insulation at ceiling level)	20.4000	0.1200	2.4480
E15 Flat roof with parapet	27.9000	0.5600	15.6240
P1 Party wall - Ground floor	20.4000	0.0800	1.6320
E2 Other lintels (including other steel lintels)	11.3700	0.0500	0.5685
E3 Sill	10.0100	0.0500	0.5005
E4 Jamb	26.8500	0.0500	1.3425
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			25.0995 (36)
Point Thermal bridges		(36a) =	0.0000
Total fabric heat loss		(33) + (36) + (36a) =	66.3062 (37)
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)			
(38)m	Jan	Feb	Mar
Heat transfer coeff	55.4408	55.1140	54.7937
	Apr	May	Jun
	53.2892	53.0077	51.6972
	Jul	Aug	Sep
	51.6972	51.4546	52.2020
	Oct	Nov	Dec
	53.0077	53.5771	54.1725 (38)
Average = Sum(39)m / 12 =	121.7471	121.4203	121.0999
	119.5954	119.3139	118.0034
	118.0034	117.7608	118.5082
	119.3139	119.8833	120.4787 (39)
	119.5940		
HLP	Jan	Feb	Mar
HLP (average)	1.0680	1.0651	1.0623
Days in mont	31	28	31
	Apr	May	Jun
	1.0491	1.0466	1.0351
	Jul	Aug	Sep
	1.0351	1.0330	1.0395
	Oct	Nov	Dec
	1.0466	1.0516	1.0568 (40)
	1.0491	1.0491	1.0491
4. Water heating energy requirements (kWh/year)			
Assumed occupancy			2.8368 (42)
Hot water usage for mixer showers	0.0000	0.0000	0.0000
Hot water usage for baths	82.8019	81.5722	79.8404
Hot water usage for other uses	43.6819	42.0935	40.5050
Average daily hot water use (litres/day)	43.6819	42.0935	40.5050
	Jan	Feb	Mar
Daily hot water use	126.4838	123.6656	120.3455
Energy conte	200.3194	176.0982	184.9665
Energy content (annual)	200.3194	176.0982	184.9665
Distribution loss (46)m = 0.15 x (45)m	30.0479	26.4147	27.7450
Water storage loss:			
Store volume			160.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):			1.4476 (48)
Temperature factor from Table 2b			0.5400 (49)
Enter (49) or (54) in (55)			0.7817 (55)
Total storage loss	24.2332	21.8880	24.2332
If cylinder contains dedicated solar storage	24.2332	21.8880	24.2332
Primary loss	23.2624	21.0112	23.2624
Combi loss	0.0000	0.0000	0.0000
Total heat required for water heating calculated for each month	247.8150	218.9974	232.4621
WWHRS	0.0000	0.0000	0.0000
PV diverter	-0.0000	-0.0000	-0.0000
Solar input	0.0000	0.0000	0.0000
FGHRS	0.0000	0.0000	0.0000
Output from w/h	247.8150	218.9974	232.4621
12Total per year (kWh/year)	247.8150	218.9974	232.4621
Electric shower(s)	0.0000	0.0000	0.0000
Heat gains from water heating, kWh/month	104.6027	92.8720	99.4978
	89.3728	87.9428	80.6586
	80.5874	82.9634	82.9711
	90.8352	94.5415	103.7000 (65)
5. Internal gains (see Table 5 and 5a)			
Metabolic gains (Table 5), Watts	Jan	Feb	Mar
(66)m	141.8411	141.8411	141.8411
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	145.0060	160.5424	145.0060
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	277.1823	280.0586	272.8104
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.1841	37.1841	37.1841
Pumps, fans	3.0000	3.0000	3.0000
Losses e.g. evaporation (negative values) (Table 5)	-113.4729	-113.4729	-113.4729
Water heating gains (Table 5)	140.5950	138.2024	133.7337
Total internal gains	631.3356	647.3557	620.1024
	599.9007	569.6629	547.0129
	526.2398	526.5571	542.3664
	562.8160	596.3450	617.8924 (73)

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6. Solar gains													
[Jan]													
	Area	Solar flux											
	m2	Table 6a											
		W/m2											
North	10.8900	10.6334											
South	7.9100	46.7521											
Solar gains	148.4077	252.7257	350.6993	451.0733	526.3525	533.4395	509.6409	450.7512	384.4705	280.1478	177.6225	127.1605 (83)	
Total gains	779.7433	900.0814	970.8017	1050.9740	1096.0154	1080.4524	1035.8807	977.3083	926.8370	842.9639	773.9676	745.0529 (84)	
7. Mean internal temperature (heating season)													
Temperature during heating periods in the living area from Table 9, Th1 (C)													
Utilisation factor for gains for living area, nil,m (see Table 9a)													
tau	65.0255	65.2005	65.3730	66.1954	66.3516	67.0884	67.0884	67.2267	66.8027	66.3516	66.0364	65.7101	
alpha	5.3350	5.3467	5.3582	5.4130	5.4234	5.4726	5.4726	5.4818	5.4535	5.4234	5.4024	5.3807	
util living area	0.9963	0.9914	0.9809	0.9444	0.8495	0.6661	0.4955	0.5443	0.7876	0.9570	0.9914	0.9971 (86)	
MIT	19.8007	19.9852	20.2320	20.5645	20.8289	20.9659	20.9943	20.9907	20.9158	20.5839	20.1392	19.7745 (87)	
Th 2	20.0271	20.0294	20.0318	20.0426	20.0447	20.0542	20.0542	20.0559	20.0505	20.0447	20.0405	20.0362 (88)	
util rest of house	0.9951	0.9886	0.9744	0.9252	0.8011	0.5810	0.3920	0.4378	0.7114	0.9382	0.9882	0.9961 (89)	
MIT 2	18.6321	18.8686	19.1823	19.5999	19.9000	20.0347	20.0523	20.0526	19.9941	19.6315	19.0742	18.6053 (90)	
Living area fraction	18.8033	19.0322	19.3361	19.7412	20.0361	20.1711	20.1903	20.1900	20.1291	19.7710	19.2302	18.7766 (92)	
MIT	18.8033	19.0322	19.3361	19.7412	20.0361	20.1711	20.1903	20.1900	20.1291	19.7710	19.2302	18.7766 (93)	
Temperature adjustment													
adjusted MIT	18.8033	19.0322	19.3361	19.7412	20.0361	20.1711	20.1903	20.1900	20.1291	19.7710	19.2302	18.7766 (93)	
8. Space heating requirement													
Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	774.1514	886.2636	940.0000	964.6443	877.4704	639.7222	421.7843	442.9927	665.8090	785.1065	761.7568	740.7812 (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	1765.7351	1715.9341	1554.4514	1296.5542	994.6103	657.4059	423.6681	446.3152	714.4968	1094.2300	1454.2062	1756.1702 (97)	
Space heating kWh	737.7383	557.5386	457.1519	238.9752	87.1521	0.0000	0.0000	0.0000	0.0000	229.9879	498.5636	755.4494 (98a)	
Space heating requirement - total per year (kWh/year)												3562.5568	
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	737.7383	557.5386	457.1519	238.9752	87.1521	0.0000	0.0000	0.0000	0.0000	229.9879	498.5636	755.4494 (98c)	
Space heating requirement after solar contribution - total per year (kWh/year)												3562.5568	
Space heating per m2												31.2505 (99)	
9a. Energy requirements - Individual heating systems, including micro-CHP													
Fraction of space heat from secondary/supplementary system (Table 11)													
Fraction of space heat from main system(s)													
Efficiency of main space heating system 1 (in %)													
Efficiency of main space heating system 2 (in %)													
Efficiency of secondary/supplementary heating system, %													
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement	737.7383	557.5386	457.1519	238.9752	87.1521	0.0000	0.0000	0.0000	0.0000	229.9879	498.5636	755.4494 (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)	799.2831	604.0505	495.2891	258.9114	94.4226	0.0000	0.0000	0.0000	0.0000	249.1743	540.1556	818.4717 (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	247.8150	218.9974	232.4621	204.1649	197.7102	177.9570	175.5886	182.7344	184.9118	206.4091	219.7099	245.1003 (64)	
Efficiency of water heater	86.3512	86.0626	85.5477	84.4138	82.3536	79.8000	79.8000	79.8000	79.8000	84.3029	85.8387	79.8000 (216)	
Fuel for water heating, kWh/month	286.9850	254.4628	271.7340	241.8622	240.0747	223.0038	220.0358	228.9905	231.7190	244.8421	255.9567	283.6395 (219)	
Space cooling fuel requirement													

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[illegible]

Electricity for pumps and fans:	
Total electricity for the above, kWh/year	86.0000 (231)
Electricity for lighting (calculated in Appendix L)	243.1614 (232)

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

PV generation	-1878.2452	(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	5293.9806	(238)

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

	Energy kWh/year	Emission factor kg CO ₂ /kWh	Emissions kg CO ₂ /year
Space heating - main system 1	3859.7582	0.2100	810.5492 (261)
Total CO ₂ associated with community systems			0.0000 (373)
Water heating (other fuel)	2983.3062	0.2100	626.4943 (264)
Space and water heating			1437.0435 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	243.1614	0.1443	35.0957 (268)

Energy saving/generation technologies			
PV Unit electricity used in dwelling	-844.1312	0.1342	-113.2732
PV Unit electricity exported	-1034.1140	0.1257	-129.9428
Total			-243.2161 (269)
Total CO2, kg/year			1240.8524 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			10.8800 (273)

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

	Energy Primary energy factor	Primary energy	
	kwh/year	kg CO2/kwh	kwh/year
Space heating - main system 1	3859.7582	1.1300	4361.5268 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2983.3062	1.1300	3371.1360 (278)
Space and water heating			7732.6627 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	243.1614	1.5338	372.9691 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-844.1312	1.4959	-1262.7512
PV Unit electricity exported	-1034.1140	0.4612	-476.9672
Total			-1739.7184 (283)
Total Primary energy kwh/year			6496.0142 (286)
Target Primary Energy Rate (TPER)			56.9800 (287)

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

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1. Overall dwelling characteristics

	Area (m ²)		Storey height (m)		Volume (m ³)
Ground floor	38.0000 (1b)	x	2.5000 (2b)	=	95.0000 (1b)
First floor	38.0000 (1c)	x	2.5000 (2c)	=	95.0000 (1c)
Second floor	38.0000 (1d)	x	2.5000 (2d)	=	95.0000 (1d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	114.0000				(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	285.0000 (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)

Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	Air changes per hour 0.1404 (8)
Pressure test			
Pressure Test Method			Blower Door
Measured/design AP50			1.0000 (17)
Infiltration rate			0.1904 (18)
Number of sides sheltered			2 (19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor		(21) = (18) x (20) =	0.1618 (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 infiltr rate												
	0.2063	0.2022	0.1982	0.1780	0.1739	0.1537	0.1537	0.1497	0.1618	0.1739	0.1820	0.1901 (22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.0000 (22b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												0.0000 (23c)
Effective ac	0.5213	0.5205	0.5196	0.5158	0.5151	0.5118	0.5118	0.5112	0.5131	0.5151	0.5166	0.5181 (25c)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Window (Uw = 0.80)			18.8000	0.7752	14.5736		(27)
Door			3.3600	1.0000	3.3600		(26)
GF			38.0000	0.1000	3.8000		(28a)
EW	62.1600	22.1600	40.0000	0.1300	5.2000		(29a)
ER	38.0000		38.0000	0.1000	3.8000		(30)
Total net area of external elements Aum(A, m ²)			138.1600				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	30.7336		(33)
PW			172.7000	0.0000	0.0000		(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K			250.0000 (35)
List of Thermal Bridges			
K1 Element	Length	Psi-value	Total
E5 Ground floor (normal)	7.4000	0.2680	1.9832
E6 Intermediate floor within a dwelling	7.4000	0.1400	1.0360
E18 Party wall between dwellings	30.0000	0.1200	3.6000
P2 Party wall - Intermediate floor within a dwelling	20.4000	0.0000	0.0000
P4 Party wall - Roof (insulation at ceiling level)	20.4000	0.2400	4.8960
E15 Flat roof with parapet	27.9000	0.5600	15.6240
P1 Party wall - Ground floor	20.4000	0.1600	3.2640
E2 Other lintels (including other steel lintels)	11.3700	0.0300	0.3411
E3 Sill	10.0100	0.0200	0.2002
E4 Jamb	26.8500	0.0200	0.5370

Thermal bridges (Sum(L x Psi) calculated using Appendix K)	241558	36259	31537	31.4815 (36)
Point Thermal bridges			(36a) =	0.0000
Total fabric heat loss		(33) + (36) + (36a) =		62.2151 (37)

Ventilation heat loss calculated monthly (38)m = $0.33 \times (25)m \times (5)$

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	0.9758	0.9751	0.9745	0.9713	0.9707	0.9680	0.9680	0.9675	0.9690	0.9707	0.9719	0.9732 (40)

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LPLP (average) Days in mont	31	28	31	30	31	30	31	31	30	31	30	0.9713 31
4. Water heating energy requirements (kWh/year)												
Assumed occupancy												2.8368 (42)
Hot water usage for mixer showers												
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (42a)
Hot water usage for baths												
30.9927	30.5324	29.8842	28.6891	27.7942	26.8019	26.2659	26.9096	27.6104	28.6722	29.8919	30.8879	30.8879 (42b)
Hot water usage for other uses												
43.6819	42.0935	40.5050	38.9166	37.3282	35.7397	35.7397	37.3282	38.9166	40.5050	42.0935	43.6819	43.6819 (42c)
Average daily hot water use (litres/day)												68.4459 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
74.6746	72.6259	70.3893	67.6057	65.1224	62.5416	62.0057	64.2377	66.5270	69.1772	71.9854	74.5698	74.5698 (44)
Energy conte	118.2663	103.4183	108.1857	92.5488	87.6672	76.9022	74.9905	79.5397	82.0344	93.8728	102.5564	116.7583 (45)
Energy content (annual)												Total = Sum(45)m = 1136.7406
Distribution loss (46)m = 0.15 x (45)m												
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Water storage loss:												
Total storage loss												
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	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	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 (58)
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												
100.5263	87.9055	91.9578	78.6665	74.5171	65.3669	63.7419	67.6088	69.7293	79.7919	87.1729	99.2446	99.2446 (62)
WHHRS	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	100.5263	87.9055	91.9578	78.6665	74.5171	65.3669	63.7419	67.6088	69.7293	79.7919	87.1729	99.2446 (64)
											Total per year (kWh/year) = Sum(64)m = 966.2295 (64)	
12Total per year (kWh/year)												966 (64)
Electric shower(s)												
57.4870	51.2214	55.9318	53.3750	54.3766	51.8700	53.5990	54.3766	53.3750	55.9318	54.8801	57.4870	57.4870 (64a)
											Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 653.9114 (64a)	
Heat gains from water heating, kWh/month	39.5033	34.7817	36.9724	33.0104	32.2234	29.3092	29.3352	30.4963	30.7761	33.9309	35.5132	39.1829 (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	141.8411	141.8411	141.8411	141.8411	141.8411	141.8411	141.8411	141.8411	141.8411	141.8411	141.8411	141.8411 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	145.0060	160.5424	145.0060	149.8395	145.0060	149.8395	145.0060	145.0060	149.8395	145.0060	149.8395	145.0060 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	277.1823	280.0586	272.8104	257.3800	237.9018	219.5951	207.3651	204.4888	211.7369	227.1674	246.6455	264.9523 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.1841	37.1841	37.1841	37.1841	37.1841	37.1841	37.1841	37.1841	37.1841	37.1841	37.1841	37.1841 (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)	-113.4729	-113.4729	-113.4729	-113.4729	-113.4729	-113.4729	-113.4729	-113.4729	-113.4729	-113.4729	-113.4729	-113.4729 (71)
Water heating gains (Table 5)	53.0959	51.7585	49.6941	45.8478	43.3111	40.7073	39.4291	40.9897	42.7445	45.6061	49.3239	52.6652 (72)
Total internal gains	540.8365	557.9118	533.0629	518.6196	491.7712	475.6942	457.3525	456.0368	469.8734	483.3318	511.3614	528.1758 (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					10.8900	10.6334	0.5400		0.8000	0.7700	34.6670 (78)	
South					7.9100	46.7521	0.5400		0.8000	0.7700	110.7119 (74)	
Solar gains	145.3789	247.5680	343.5421	441.8677	515.6106	522.5530	499.2401	441.5522	376.6242	274.4305	173.9976	124.5654 (83)
Total gains	686.2154	805.4798	876.6050	960.4873	1007.3819	998.2472	956.5926	897.5890	846.4976	757.7623	685.3590	652.7412 (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, nll,m (see Table 9a)												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

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tau	71.1666	71.2163	71.2651	71.4954	71.5387	71.7407	71.7407	71.7782	71.6627	71.5387	71.4512	71.3600
alpha	5.7444	5.7478	5.7510	5.7664	5.7692	5.7827	5.7827	5.7852	5.7775	5.7692	5.7634	5.7573
util living area	0.9979	0.9944	0.9860	0.9536	0.8612	0.6765	0.5026	0.5560	0.8043	0.9674	0.9948	0.9985 (86)
MIT	19.8609	20.0396	20.2749	20.5880	20.8429	20.9700	20.9953	20.9919	20.9209	20.5939	20.1658	19.8223 (87)
Th 2	20.1035	20.1041	20.1047	20.1073	20.1078	20.1101	20.1101	20.1105	20.1092	20.1078	20.1068	20.1058 (88)
util rest of house	0.9973	0.9926	0.9812	0.9373	0.8164	0.5951	0.4036	0.4533	0.7328	0.9528	0.9927	0.9979 (89)
MIT 2	19.0609	19.2391	19.4721	19.7762	20.0028	20.0965	20.1089	20.1082	20.0669	19.7868	19.3675	19.0242 (90)
Living area fraction									FLA =	Living area / (4) =		0.1465 (91)
MIT	19.1781	19.3563	19.5897	19.8951	20.1259	20.2244	20.2387	20.2377	20.1920	19.9051	19.4844	19.1411 (92)
Temperature adjustment												0.0000
adjusted MIT	19.1781	19.3563	19.5897	19.8951	20.1259	20.2244	20.2387	20.2377	20.1920	19.9051	19.4844	19.1411 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9963	0.9905	0.9776	0.9327	0.8174	0.6061	0.4181	0.4683	0.7401	0.9485	0.9908	0.9972 (94)
Useful gains	683.6530	797.8247	857.0063	895.8250	823.4422	605.0010	399.9964	420.3606	626.5103	718.7559	679.0243	650.8877 (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	1655.0558	1607.0187	1454.1059	1217.4852	932.4307	620.6624	401.5397	423.2687	672.9856	1029.7231	1372.1707	1657.5616 (97)
Space heating kwh	722.7237	543.7784	444.2421	231.5954	81.0874	0.0000	0.0000	0.0000	0.0000	231.3596	499.0654	748.9654 (98a)
Space heating requirement - total per year (kwh/year)												3502.8174
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	722.7237	543.7784	444.2421	231.5954	81.0874	0.0000	0.0000	0.0000	0.0000	231.3596	499.0654	748.9654 (98c)
Space heating requirement after solar contribution - total per year (kwh/year)												3502.8174
Space heating per m2												(98c) / (4) = 30.7265 (99)

8c. Space cooling requirement

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

[illegible]

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

1. Overall dwelling characteristics

					Area (m2)	Storey height (m)		Volume (m3)
Ground floor					38.0000 (1b)	x	2.5000 (2b)	= 95.0000 (1b)
First floor					38.0000 (1c)	x	2.5000 (2c)	= 95.0000 (1c)
Second floor					38.0000 (1d)	x	2.5000 (2d)	= 95.0000 (1d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)				114.0000				(4)
Dwelling volume							(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	285.0000 (5)

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	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) = 0.1404 (8)													
Pressure test	Yes													
Pressure Test Method	Blower Door													
Measured/design AP50	5.0000 (17)													
Infiltration rate	0.3904 (18)													
Number of sides sheltered	2 (19)													
Shelter factor	(20) = 1 - [0.075 x (19)] = 0.8500 (20)													
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.3318 (21)													
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Wind factor	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)		
Adj infilt rate	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)		
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.4230	0.4147	0.4065	0.3650	0.3567	0.3152	0.3152	0.3069	0.3318	0.3567	0.3733	0.3899 (22b)		
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												0.0000 (23b)		
Effective ac	0.5895	0.5860	0.5826	0.5666	0.5636	0.5497	0.5497	0.5471	0.5550	0.5636	0.5697	0.0000 (23c)		
												0.5760 (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					3.3600		1.0000		3.3600				(26)	
TER Opening Type (Uw = 1.20)					18.8000		1.1450		21.5267				(27)	
GF					38.0000		0.1300		4.9400				(28a)	
EW	62.1600		22.1600		40.0000		0.1800		7.2000				(29a)	
ER	38.0000				38.0000		0.1100		4.1800				(30)	
Total net area of external elements Aum(A, m2)					138.1600								(31)	
Fabric heat loss, W/K = Sum (A x U)							(26)...(30) + (32) =		41.2067				(33)	
PW					172.7000		0.0000		0.0000				(32)	
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K												250.0000 (35)		
List of Thermal Bridges														
K1 Element	Length		Psi-value		Total									
E5 Ground floor (normal)	7.4000		0.1600		1.1840									
E6 Intermediate floor within a dwelling	7.4000		0.0000		0.0000									
E18 Party wall between dwellings	30.0000		0.0600		1.8000									
P2 Party wall - Intermediate floor within a dwelling	20.4000		0.0000		0.0000									
P4 Party wall - Roof (insulation at ceiling level)	20.4000		0.1200		2.4480									
E15 Flat roof with parapet	27.9000		0.5600		15.6240									
P1 Party wall - Ground floor	20.4000		0.0800		1.6320									
E2 Other lintels (including other steel lintels)	11.3700		0.0500		0.5685									
E3 Sill	10.0100		0.0500		0.5005									
E4 Jamb	26.8500		0.0500		1.3425									
Thermal bridges (Sum(L x Psi) calculated using Appendix K)												25.0995 (36)		
Point Thermal bridges												(36a) = 0.0000		
Total fabric heat loss												(33) + (36) + (36a) = 66.3062 (37)		
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)														
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Heat transfer coeff	55.4408	55.1140	54.7937	53.2892	53.0077	51.6972	51.6972	51.4546	52.2020	53.0077	53.5771	54.1725 (38)		
Average = Sum(39)m / 12 =	121.7471	121.4203	121.0999	119.5954	119.3139	118.0034	118.0034	117.7608	118.5082	119.3139	119.8833	120.4787 (39)		
												119.5940		
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
HLP (average)	1.0680	1.0651	1.0623	1.0491	1.0466	1.0351	1.0351	1.0330	1.0395	1.0466	1.0516	1.0568 (40)		
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31		

4. Water heating energy requirements (kWh/year)														

Assumed occupancy												2.8368 (42)		
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (42a)		
Hot water usage for baths	30.9927	30.5324	29.8842	28.6891	27.7942	26.8019	26.2659	26.9096	27.6104	28.6722	29.8919	30.8879 (42b)		
Hot water usage for other uses	43.6819	42.0935	40.5050	38.9166	37.3282	35.7397	35.7397	37.3282	38.9166	40.5050	42.0935	43.6819 (42c)		
Average daily hot water use (litres/day)												68.4459 (43)		
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		

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Daily hot water use												
Energy content (annual)	74.6746	72.6259	70.3893	67.6057	65.1224	62.5416	62.0057	64.2377	66.5270	69.1772	71.9854	74.5698 (44)
Distribution loss (46)m = 0.15 x (45)m	118.2663	103.4183	108.1857	92.5488	87.6672	76.9022	74.9905	79.5397	82.0344	93.8728	102.5564	116.7583 (45)
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage												
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 (57)
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 (59)
Total heat required for water heating calculated for each month	100.5263	87.9055	91.9578	78.6665	74.5171	65.3669	63.7419	67.6088	69.7293	79.7919	87.1729	99.2446 (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	100.5263	87.9055	91.9578	78.6665	74.5171	65.3669	63.7419	67.6088	69.7293	79.7919	87.1729	99.2446 (64)
12Total per year (kWh/year)	Total per year (kWh/year) = Sum(64)m = 966.2295 (64)											
Electric shower(s)	57.4870	51.2214	55.9318	53.3750	54.3766	51.8700	53.5990	54.3766	53.3750	55.9318	54.8801	57.4870 (64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 653.9114 (64a)												
Heat gains from water heating, kWh/month	39.5033	34.7817	36.9724	33.0104	32.2234	29.3092	29.3352	30.4963	30.7761	33.9309	35.5132	39.1829 (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	141.8411	141.8411	141.8411	141.8411	141.8411	141.8411	141.8411	141.8411	141.8411	141.8411	141.8411	141.8411 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	145.0060	160.5424	145.0060	149.8395	145.0060	149.8395	145.0060	145.0060	149.8395	145.0060	149.8395	145.0060 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	277.1823	280.0586	272.8104	257.3800	237.9018	219.5951	207.3651	204.4888	211.7369	227.1674	246.6455	264.9523 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.1841	37.1841	37.1841	37.1841	37.1841	37.1841	37.1841	37.1841	37.1841	37.1841	37.1841	37.1841 (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)												
	-113.4729	-113.4729	-113.4729	-113.4729	-113.4729	-113.4729	-113.4729	-113.4729	-113.4729	-113.4729	-113.4729	-113.4729 (71)
Water heating gains (Table 5)	53.0959	51.7585	49.6941	45.8478	43.3111	40.7073	39.4291	40.9897	42.7445	45.6061	49.3239	52.6652 (72)
Total internal gains	540.8365	557.9118	533.0629	518.6196	491.7712	475.6942	457.3525	456.0368	469.8734	483.3318	511.3614	528.1758 (73)
6. Solar gains												
[Jan]				Area m2	Solar flux Table 6a W/m2		Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d	Gains W
North				10.8900	10.6334		0.6300		0.7000		0.7700	35.3893 (74)
South				7.9100	46.7521		0.6300		0.7000		0.7700	113.0184 (78)
Solar gains	148.4077	252.7257	350.6993	451.0733	526.3525	533.4395	509.6409	450.7512	384.4705	280.1478	177.6225	127.1605 (83)
Total gains	689.2442	810.6375	883.7621	969.6929	1018.1237	1009.1337	966.9934	906.7880	854.3439	763.4796	688.9839	655.3363 (84)
7. Mean internal temperature (heating season)												
Temperature during heating periods in the living area from Table 9, Th1 (C)												
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	65.0255	65.2005	65.3730	66.1954	66.3516	67.0884	67.0884	67.2267	66.8027	66.3516	66.0364	65.7101
alpha	5.3350	5.3467	5.3582	5.4130	5.4234	5.4726	5.4726	5.4818	5.4535	5.4234	5.4024	5.3807
util living area	0.9979	0.9947	0.9873	0.9591	0.8782	0.7029	0.5285	0.5826	0.8259	0.9711	0.9950	0.9984 (86)
MIT	19.7157	19.9030	20.1558	20.5047	20.7935	20.9559	20.9922	20.9871	20.8925	20.5213	20.0609	19.6898 (87)
Th 2	20.0271	20.0294	20.0318	20.0426	20.0447	20.0542	20.0542	20.0559	20.0505	20.0447	20.0405	20.0362 (88)
util rest of house	0.9972	0.9929	0.9828	0.9440	0.8347	0.6169	0.4194	0.4705	0.7541	0.9575	0.9930	0.9979 (89)
MIT 2	18.8554	19.0437	19.2958	19.6430	19.9050	20.0340	20.0522	20.0522	19.9921	19.6653	19.2102	18.8368 (90)
Living area fraction	18.9815	19.1696	19.4218	19.7692	20.0351	20.1690	20.1899	20.1892	19.1240	19.7907	19.3349	18.9617 (91)
MIT	18.9815	19.1696	19.4218	19.7692	20.0351	20.1690	20.1899	20.1892	19.1240	19.7907	19.3349	18.9617 (92)
Temperature adjustment	18.9815	19.1696	19.4218	19.7692	20.0351	20.1690	20.1899	20.1892	19.1240	19.7907	19.3349	18.9617 (93)
adjusted MIT	18.9815	19.1696	19.4218	19.7692	20.0351	20.1690	20.1899	20.1892	19.1240	19.7907	19.3349	18.9617 (93)
8. Space heating requirement												

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9962	0.9908	0.9791	0.9386	0.8342	0.6281	0.4354	0.4869	0.7604	0.9528	0.9910	0.9971	(94)
Useful gains	686.6143	803.1452	865.2628	910.1938	849.3585	633.7885	421.0037	441.5238	649.6683	727.4054	682.7701	653.4104	(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	1787.4257	1732.6135	1564.8307	1299.9042	994.4969	657.1635	423.6164	446.2182	713.8903	1096.5763	1466.7552	1778.4720	(97)
Space heating kWh	819.0037	624.6027	520.4786	280.5914	107.9830	0.0000	0.0000	0.0000	0.0000	274.6631	564.4693	837.0458	(98a)
Space heating requirement - total per year (kWh/year)												4028.8376	
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	819.0037	624.6027	520.4786	280.5914	107.9830	0.0000	0.0000	0.0000	0.0000	274.6631	564.4693	837.0458	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4028.8376	
Space heating per m2												35.3407	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	1109.2324	873.2255	894.9819	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8482	0.9173	0.8894	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	940.7986	801.0240	795.9858	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1116.2435	1069.9168	1002.4629	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	126.3204	200.0563	153.6189	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction									fC = cooled area /	(4) =		1.0000	(105)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	(106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	31.5801	50.0141	38.4047	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												119.9989	(107)
Energy for space heating												35.3407	(99)
Energy for space cooling												1.0526	(108)
Total												36.3933	(109)
Fabric Energy Efficiency (TFEE)												36.4	(109)

BRUKL Output Document

Compliance with England Building Regulations Part L 2021

Project name	Shell and Core
Amethyst Lane	As designed
Date: Wed Apr 05 14:23:54 2023	

Administrative information	
Building Details	Certification tool
Address: Address 1, Reading, RG30	Calculation engine: Apache
	Calculation engine version: 7.0.18
	Interface to calculation engine: IES Virtual Environment
	Interface to calculation engine version: 7.0.18
	BRUKL compliance module version: v6.1.d.0
Certifier details	
Name: Name	
Telephone number: Phone	
Address: Street Address, City, Postcode	
	Foundation area [m²]: 458.36

The CO ₂ emission and primary energy rates of the building must not exceed the targets		
Target CO ₂ emission rate (TER), kgCO ₂ /m²annum	4.43	
Building CO ₂ emission rate (BER), kgCO ₂ /m²annum	-3.07	
Target primary energy rate (TPER), kWh/m²annum	46.43	
Building primary energy rate (BPER), kWh/m²annum	-36.86	
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-Limit}	U _{a-Calc}	U _{i-Calc}	First surface with maximum value
Walls*	0.26	0.13	0.13	DJ000004:Surf[3]
Floors	0.18	0.1	0.1	DJ000004:Surf[0]
Pitched roofs	0.16	-	-	No pitched roofs in building
Flat roofs	0.18	0.11	0.11	DJ000004:Surf[1]
Windows** and roof windows	1.6	0.8	0.8	DJ000004:Surf[2]
Rooflights***	2.2	-	-	No roof lights in building
Personnel doors^	1.6	1	1	DJ00000C:Surf[2]
Vehicle access & similar large doors	1.3	-	-	No vehicle access doors in building
High usage entrance doors	3	-	-	No high usage entrance doors in building
U _{a-Limit} = Limiting area-weighted average U-values [W/(m²K)] U _{a-Calc} = Calculated area-weighted average U-values [W/(m²K)] U _{i-Calc} = Calculated maximum individual element U-values [W/(m²K)] * 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/m²K 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		
m³/(h.m²) at 50 Pa	8	1		

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	>0.95

1- Space Heating_DHW

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3.96	-	0.2	0	0.85
Standard value	2.5*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps.					

"No HWS in project, or hot water is provided by HVAC system"

"No zones in project where local mechanical ventilation, exhaust, or terminal unit is applicable"

Shell and core configuration

Zone	Assumed shell?
GF_Sensory Room	NO
GF_Medical Room	NO
GF_WC	NO
GF_Lobby	NO
GF_Office	NO
GF_Office / Meeting Room	NO
GF_Plant Room	NO
GF_Circulation	NO
GF_Kitchen	NO
GF_Acc. WC	NO
GF_Lounge	NO
GF_Lobby	NO
GF_Quiet Lounge	NO
GF_Circulation	NO
GF_Ensuite Shower Room	NO
GF_Ensuite Shower Room	NO
GF_Ensuite Bathroom	NO
GF_WC	NO
GF_Bedroom	NO
GF_Bedroom	NO
GF_Ensuite Shower Room	NO
GF_Ensuite Shower Room	NO
GF_Bedroom	NO
GF_GF_Ensuite Bathroom	NO
GF_Flatlet	NO
GF_Staff Sleeping Office	NO
GF_WC	NO
GF_Bathing Suite	NO
GF_Bedroom	NO
GF_Bedroom	NO
GF_Circulation	NO

Shell and core configuration

Zone	Assumed shell?
GF_Dining	NO

General lighting and display lighting	General luminaire	Display light source	
	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Zone name			
Standard value	95	80	0.3
GF_Sensory Room	153	-	-
GF_Medical Room	153	-	-
GF_WC	170	-	-
GF_Lobby	170	-	-
GF_Office	153	-	-
GF_Office / Meeting Room	153	-	-
GF_Plant Room	153	-	-
GF_Circulation	170	-	-
GF_Kitchen	170	-	-
GF_Acc. WC	170	-	-
GF_Lounge	170	-	-
GF_Lobby	170	-	-
GF_Quiet Lounge	170	-	-
GF_Circulation	170	-	-
GF_Ensuite Shower Room	170	-	-
GF_Ensuite Shower Room	170	-	-
GF_Ensuite Bathroom	170	-	-
GF_WC	170	-	-
GF_Bedroom	170	-	-
GF_Bedroom	170	-	-
GF_Ensuite Shower Room	170	-	-
GF_Ensuite Shower Room	170	-	-
GF_Bedroom	170	-	-
GF_GF_Ensuite Bathroom	170	-	-
GF_Flatlet	170	-	-
GF_Staff Sleeping Office	153	-	-
GF_WC	170	-	-
GF_Bathing Suite	170	-	-
GF_Bedroom	170	-	-
GF_Bedroom	170	-	-
GF_Circulation	170	-	-
GF_Dining	170	-	-

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?
GF_Sensory Room	NO (-63.8%)	NO
GF_Medical Room	N/A	N/A
GF_Lobby	YES (+35.9%)	NO
GF_Office	NO (-59%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
GF_Office / Meeting Room	NO (-67.1%)	NO
GF_Lounge	NO (-20.2%)	NO
GF_Lobby	YES (+30.4%)	NO
GF_Quiet Lounge	NO (-42.8%)	NO
GF_Bedroom	YES (+20.7%)	NO
GF_Bedroom	YES (+18.9%)	NO
GF_Bedroom	NO (-26%)	NO
GF_Flatlet	NO (-41%)	NO
GF_Staff Sleeping Office	N/A	N/A
GF_Bedroom	NO (-36.7%)	NO
GF_Bedroom	YES (+6.7%)	NO

Regulation 25A: Consideration of high efficiency alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	NO
Is evidence of such assessment available as a separate submission?	NO
Are any such measures included in the proposed design?	NO

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters			Building Use	
	Actual	Notional	% Area	Building Type
Floor area [m²]	458.4	458.4		Retail/Financial and Professional Services
External area [m²]	1441.1	1441.1		Restaurants and Cafes/Drinking Establishments/Takeaways
Weather	LON	LON		Offices and Workshop Businesses
Infiltration [m³/hm²@ 50Pa]	1	3		General Industrial and Special Industrial Groups
Average conductance [W/K]	221.11	416.15		Storage or Distribution
Average U-value [W/m²K]	0.15	0.29		Hotels
Alpha value* [%]	25.44	10		Residential Institutions: Hospitals and Care Homes
* Percentage of the building's average heat transfer coefficient which is due to thermal bridging				Residential Institutions: Residential Schools
				Residential Institutions: Universities and Colleges
				Secure Residential Institutions
			58	Residential Spaces
			42	Non-residential Institutions: Community/Day Centre
				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/m²]

	Actual	Notional
Heating	5.95	14.89
Cooling	0	0
Auxiliary	1.52	3.08
Lighting	4.56	6.07
Hot water	3.02	6.78
Equipment*	20.54	20.54
TOTAL**	15.05	30.82

* 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/m²]

	Actual	Notional
Photovoltaic systems	40.32	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	40.32	0

Energy & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	76.52	148.97
Primary energy [kWh/m²]	-36.86	46.43
Total emissions [kg/m²]	-3.07	4.43

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 SSEFF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Central heating using water: radiators, [HS] ASHP, [HFT] Electricity, [CFT] Electricity									
	Actual	76.5	0	6	0	1.5	3.57	0	3.96
	Notional	149	0	14.9	0	1.1	2.78	0	----
[ST] No Heating or Cooling									
	Actual	0	0	0	0	0	0	0	0
	Notional	0	0	0	0	0	0	----	----

6.0 Appendix B - TM59/O Overheating

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

London Gatwick DSY1 2020 High emissions

Natvent room name	Natvent criterion (a) result	Natvent criterion (b) result	Pass/Fail
00-4B8P House A- Livingroom	Pass	NA	Pass
00-4B8P House A-Kitchen	Pass	NA	Pass
01-4B8P House A- Bedroom	Pass	Pass	Pass
01-4B8P House A- Bedroom	Pass	Pass	Pass
02-4B8P House A- Bedroom	Pass	Pass	Pass
02-4B8P House A- Bedroom	Pass	Pass	Pass
00-3B5P House B-Livingroom	Pass	NA	Pass
00-3B5P House B-Kitchen	Pass	NA	Pass
01-3B5P House B-Bedroom	Pass	Pass	Pass
01-3B5P House B-Bedroom	Pass	Pass	Pass
01-3B5P House B-Bedroom	Pass	Pass	Pass
00-Bedroom	Pass	Pass	Pass
00-Bedroom	Pass	Pass	Pass
00-Studio	Pass	Pass	Pass
00-Bedroom	Pass	Pass	Pass
00-Bedroom	Pass	Pass	Pass
Corridor name	Significant overheating risk?		
00-Circulation	No		

London Gatwick DSY2 2020 High emissions

Natvent room name	Natvent criterion (a) result	Natvent criterion (b) result	Pass/Fail
00-4B8P House A- Livingroom	Fail	NA	Fail
00-4B8P House A-Kitchen	Fail	NA	Fail
01-4B8P House A- Bedroom	Pass	Pass	Pass
01-4B8P House A- Bedroom	Pass	Pass	Pass
02-4B8P House A- Bedroom	Fail	Pass	Fail
02-4B8P House A- Bedroom	Pass	Pass	Pass
00-3B5P House B-Livingroom	Fail	NA	Fail
00-3B5P House B-Kitchen	Fail	NA	Fail
01-3B5P House B-Bedroom	Pass	Pass	Pass
01-3B5P House B-Bedroom	Pass	Pass	Pass
01-3B5P House B-Bedroom	Pass	Pass	Pass
00-Bedroom	Pass	Fail	Fail
00-Bedroom	Pass	Fail	Fail
00-Studio	Pass	Fail	Fail
00-Bedroom	Fail	Fail	Fail
00-Bedroom	Pass	Fail	Fail
Corridor name	Significant overheating risk?		
00-Circulation	No		

London Gatwick DSY3 2020 High emissions

Natvent room name	Natvent criterion (a) result	Natvent criterion (b) result	Pass/Fail
00-4B8P House A- Livingroom	Fail	NA	Fail
00-4B8P House A-Kitchen	Fail	NA	Fail
01-4B8P House A- Bedroom	Fail	Pass	Fail
01-4B8P House A- Bedroom	Fail	Pass	Fail
02-4B8P House A- Bedroom	Fail	Pass	Fail
02-4B8P House A- Bedroom	Fail	Pass	Fail
00-3B5P House B-Livingroom	Fail	NA	Fail
00-3B5P House B-Kitchen	Fail	NA	Fail
01-3B5P House B-Bedroom	Fail	Fail	Fail
01-3B5P House B-Bedroom	Fail	Fail	Fail
01-3B5P House B-Bedroom	Fail	Fail	Fail
00-Bedroom	Pass	Fail	Fail
00-Bedroom	Pass	Fail	Fail
00-Studio	Fail	Fail	Fail
00-Bedroom	Fail	Fail	Fail
00-Bedroom	Pass	Fail	Fail
Corridor name	Significant overheating risk?		
00-Circulation	No		

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