The PES

Energy & Sustainability Statement

30th November 2023

Belmont Close
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Contents

Appendices

Version Control

V1	23-06-23	DRAFT – Pre-app 2
V2	27-09-23	
V3	24/10/23	Part G included
V4	30/11/23	PV amended

1.0 Executive Summary

The proposed development project at Belmont Close involves the development of the existing site to create a 6-unit new build residential scheme, whilst retaining the existing garaging on site.

It has been designed to achieve the highest of environmental performance standards following the Energy Hierarchy as set down by the London Plan and the London Borough of Enfield's local plan policies.

The report takes on board the latest GLA guidance on writing energy statements (June 2022) as well as taking into account matters raised within the London Plan 2021. Guidance now seeks a minimum on-site improvement over Part L 2021 at 35%, with a benchmark improvement over Part L 2021 at 50%.

A 'Lean, Clean, Green' approach has been adopted and the development achieves an improvement in build fabric at over **14% (min target 10%)** at the "Be Lean" stage and an overall improvement (DER/TER) in regulated emissions at over **84% (min target 60%)** above Part L 2021 standard, through the adoption of very high standards of insulation, heat pump driven heating and hot water systems and a roof mounted PV array.

2.0 The Site & Proposal

The site is located on the east side of Belmont Close, off Mount Pleasant.

The redevelopment proposals are for the development 6 x new build dwellings, above the retained garaging facility.

2.1 Local Planning Context

The project is sited within the London Borough of Enfield Council

This report has been prepared to demonstrate how the proposed development will meet the London Borough of Enfield's Local Development Framework; in particular Core Strategy Policy 20:

CORE POLICY 20

SUSTAINABLE ENERGY USE AND ENERGY INFRASTRUCTURE

The Council will require all new developments, and where possible via a retrofitting process in existing developments to address the causes and impacts of climate change by:

minimising energy use; supplying energy efficiently; and using energy generated from renewable sources in line with London Plan and national policy.

The Council will support appropriate measures to mitigate and adapt to the impacts of climate change and will reduce emissions of carbon dioxide as part of development proposals, in line with the London Plan.

The Council will set local standards and targets, based on an understanding of local potential and opportunities for renewable or low carbon energy and existing or planned decentralised energy infrastructure. Where opportunities are identified, development will be required to contribute towards realising these opportunities subject to the Council and its partners undertaking further work that is required to explore the feasibility and development potential of projects or strategies in order to take them forward.

The Council, working with its partners, will seek to ensure that Enfield's future energy infrastructure needs are managed effectively by ensuring that the necessary infrastructure is in place to accommodate the levels of growth anticipated within the Borough.

Accordingly, this report will adhere to the requirements of the London Plan which lays down the methodology for the use of the energy hierarchy: -

- Be Lean – use energy efficiently
- Be Clean – use clean energy
- Be Green – reduce emissions via the use of renewable technologies

As part of this assessment, it must consider unregulated energy use not covered under the Building Regulations at each stage of the Energy Hierarchy i.e. cooking and appliances.

Further detail is provided in Enfield Development Management Document (DMD), adopted in 2014: -

Policy DMD 49

Sustainable Design and Construction Statements

All new development must achieve the highest sustainable design and construction standards having regard to technical feasibility and economic viability.

All development will be required to include measures capable of mitigating and adapting to climate change to meet future needs having regard to technical feasibility and economic viability.

All planning applications must be accompanied by a Sustainable Design and Construction Statement, to demonstrate compliance with Development Plan.

Policy DMD 51

Energy Efficiency Standards

The Council will require all major residential developments to achieve as a minimum:

a. 25% reduction in carbon dioxide emissions over Part L1A of Building Regulations (2010) in line with best practice to 2013;

b. 40% improvement from 2013 to 2016; and (The equivalent to 35% reduction set against Part L 2013)

For minor development, the Council will seek to encourage all residential or non-residential developments to achieve the above targets where it is demonstrated that this is technically feasible and economically viable.

Policy DMD 50

Further encourages: -

For minor applications the Council will seek to encourage further carbon dioxide reductions through the provision and use of on-site renewable energy generation through the use of low and zero carbon technologies.

The new Enfield Local Plan (Main issues and preferred approaches) - June 2021 – is under development, but not considered to being sufficiently developed to be a material consideration at this stage.

2.2 The London Plan

Chapter 9 deals with Sustainable Infrastructure:-

Policy SI2 Minimising greenhouse gas emissions

Major development should be net zero-carbon.151 This means reducing greenhouse gas emissions in operation and minimising both annual and peak energy demand in accordance with the following energy hierarchy:
1) be lean: use less energy and manage demand during operation
2) be clean: exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly
3) be green: maximise opportunities for renewable energy by producing, storing and using renewable energy on-site
4) be seen: monitor, verify and report on energy performance.

B Major development should include a detailed energy strategy to demonstrate how the zero-carbon target will be met within the framework of the energy hierarchy and will be expected to monitor and report on energy performance.

C In meeting the zero-carbon target a minimum on-site reduction of at least 35 per cent beyond Building Regulations is expected. Residential development should aim to achieve 10 per cent, and non-residential development should aim to achieve 15 per cent through energy efficiency measures. Where it is clearly demonstrated that the zero-carbon target cannot be fully achieved on-site, any shortfall should be provided:

1) through a cash in lieu contribution to the relevant borough's carbon offset fund, and/or
2) off-site provided that an alternative proposal is identified and delivery is certain.

Policy SI3 - Energy infrastructure

A Boroughs and developers should engage at an early stage with relevant energy companies and bodies to establish the future energy and infrastructure requirements arising from large-scale development proposals such as Opportunity Areas, Town Centres, other growth areas or clusters of significant new development.
B Energy masterplans should be developed for large-scale development locations (such as those outlined in Part A and other opportunities) which establish the most effective energy supply options. Energy masterplans should identify:

1) major heat loads (including anchor heat loads, with particular reference to sites such as universities, hospitals and social housing)
2) heat loads from existing buildings that can be connected to future phases of a heat network
3) major heat supply plant including opportunities to utilise heat from energy from waste plants
4) secondary heat sources, including both environmental and waste heat
5) opportunities for low and ambient temperature heat networks
6) possible land for energy centres and/or energy storage

7) possible heating and cooling network routes
8) opportunities for futureproofing utility infrastructure networks to minimise the impact from road works
9) infrastructure and land requirements for electricity and gas supplies
10) implementation options for delivering feasible projects, considering issues of procurement, funding and risk, and the role of the public sector
11) opportunities to maximise renewable electricity generation and incorporate demand-side response measures.

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

1) the heat source for the communal heating system should be selected in accordance with the following heating hierarchy:
a) connect to local existing or planned heat networks
b) use zero-emission or local secondary heat sources (in conjunction with heat pump, if required)
c) use low-emission combined heat and power (CHP) (only where there is a case for CHP to enable the delivery of an area-wide heat network, meet the development's electricity demand and provide demand response to the local electricity network)
d) use ultra-low NOx gas boilers

2) CHP and ultra-low NOx gas boiler communal or district heating systems should be designed to ensure that they meet the requirements in Part B of Policy SI 1 Improving air quality
3) where a heat network is planned but not yet in existence the development should be designed to allow for the cost-effective connection at a later date.

Policy SI4

Managing heat risk

A Development proposals should minimise adverse impacts on the urban heat island through design, layout, orientation, materials and the incorporation of green infrastructure.

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

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

2) minimise internal heat generation through energy efficient design

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

4) provide passive ventilation

5) provide mechanical ventilation

6) provide active cooling systems.

Policy SI5 Water infrastructure

C Development proposals should:

1) through the use of Planning Conditions minimise the use of mains water in line with the Optional Requirement of the Building Regulations (residential development), achieving mains water consumption of 105 litres or less per head per day (excluding allowance of up to five litres for external water consumption)

2) achieve at least the BREEAM excellent standard for the 'Wat 01' water category or equivalent (commercial development)

3) incorporate measures such as smart metering, water saving and recycling measures, including retrofitting, to help to achieve lower water consumption rates and to maximise future-proofing.

Policy SI12 Flood risk management

C Development proposals should ensure that flood risk is minimised and mitigated, and that residual risk is addressed. This should include, where possible, making space for water and aiming for development to be set back from the banks of watercourses.

E Development proposals for utility services should be designed to remain operational under flood conditions and buildings should be designed for quick recovery following a flood.

F Development proposals adjacent to flood defences will be required to protect the integrity of flood defences and allow access for future maintenance and upgrading. Unless exceptional circumstances are demonstrated for not doing so, development proposals should be set back from flood defences to allow for any foreseeable future maintenance and upgrades in a sustainable and cost-effective way.

G Natural flood management methods should be employed in development proposals due to their multiple benefits including increasing flood storage and creating recreational areas and habitat.

Policy SI13 - Sustainable drainage

A Lead Local Flood Authorities should identify – through their Local Flood Risk Management Strategies and Surface Water Management Plans – areas where there are particular surface water management issues and aim to reduce these risks. Increases in surface water run-off outside these areas also need to be identified and addressed.

B Development proposals should aim to achieve greenfield run-off rates and ensure that surface water run-off is managed as close to its source as possible. There should also be a preference for green over grey features, in line with the following drainage hierarchy:

1) rainwater use as a resource (for example rainwater harvesting, blue roofs for irrigation)

2) rainwater infiltration to ground at or close to source

3) rainwater attenuation in green infrastructure features for gradual release (for example green roofs, rain gardens)It is noted that the proposed non-domestic development is greater than 1,000m^2 and would be considered major development.

4) rainwater discharge direct to a watercourse (unless not appropriate)

5) controlled rainwater discharge to a surface water sewer or drain

6) controlled rainwater discharge to a combined sewer.

C Development proposals for impermeable surfacing should normally be resisted unless they can be shown to be unavoidable, including on small surfaces such as front gardens and driveways.

D Drainage should be designed and implemented in ways that promote multiple benefits including increased water use efficiency, improved water quality, and enhanced biodiversity, urban greening, amenity and recreation.

The project at Belmont Close would be considered a non-major residential scheme and this report is informed accordingly.

The design team at utilising SAP10.2 emissions data and Part L 2021, in line with the latest GLA guidance.

The GLA Part L 2021 reporting spreadsheet is attached at **Appendix D**.

3.0 Baseline energy results

The first stage of the Mayor's Energy Hierarchy is to consider the baseline energy model.

The following section details the baseline energy requirements for the development – the starting point when considering the energy hierarchy.

3.1 New Build Dwellings

The baseline emission levels – the Target Emission Rate (TER) - is obtained by applying the design to a reference 'notional' building the characteristics of which are set by regulations – SAP10.2; The new Part L Building Regulations 2021 came into force in June 2022 and introduced a completely new notional dwelling as detailed below:-

Table 1.1 Summary of notional dwelling specification for new dwelling[1]

Element or system	Reference value for target setting
Opening areas (windows, roof windows, rooflights and doors)	Same as for actual dwelling not exceeding a total area of openings of 25% of total floor area[2]
External walls including semi-exposed walls	U = 0.18 W/(m²·K)
Party walls	U = 0
Floors	U = 0.13 W/(m²·K)
Roofs	U = 0.11 W/(m²·K)
Opaque door (less than 30% glazed area)	U = 1.0 W/(m²·K)
Semi-glazed door (30–60% glazed area)	U = 1.0 W/(m²·K)
Windows and glazed doors with greater than 60% glazed area	U = 1.2 W/(m²·K) Frame factor = 0.7
Roof windows	U = 1.2 W/(m²·K), when in vertical position (for correction due to angle, see specification in SAP 10 Appendix R)
Rooflights	U = 1.7 W/(m²·K), when in horizontal position (for correction due to angle, see specification in SAP 10 Appendix R)
Ventilation system	Natural ventilation with intermittent extract fans
Air permeability	5 m³/(h·m²) at 50 Pa
Main heating fuel (space and water)	Mains gas
Heating system	Boiler and radiators Central heating pump 2013 or later, in heated space Design flow temperature = 55 °C
Boiler	Efficiency, SEDBUK 2009 = 89.5%
Heating system controls	Boiler interlock, ErP Class V Either: – single storey dwelling in which the living area is greater than 70% of the total floor area: programmer and room thermostat – any other dwelling: time and temperature zone control, thermostatic radiator valves
Hot water system	Heated by boiler (regular or combi as above) Separate time control for space and water heating
Wastewater heat recovery (WWHR)	All showers connected to WWHR, including showers over baths Instantaneous WWHR with 36% recovery efficiency utilisation of 0.98
Hot water cylinder	If cylinder, declared loss factor = 0.85 x (0.2 + 0.051 $V^{2/3}$) kWh/day where V is the volume of the cylinder in litres
Lighting	Fixed lighting capacity (lm) = 185 x total floor area Efficacy of all fixed lighting = 80 lm/W
Air conditioning	None
Photovoltaic (PV) system	For houses: kWp = 40% of ground floor area, including unheated spaces / 6.5 For flats: kWp = 40% of dwelling floor area / (6.5 x number of storeys in block) System facing south-east or south-west

NOTE:
1. For a dwelling connected to an existing district heat network, an alternative notional building is used. See paragraph 1.8 and SAP 10.
2. See SAP 10 for details.

SAP first creates the notional reference building, based upon the same shape and form as the proposed dwelling and applies the above the characteristics as defined in SAP10.2, prior to applying the actual construction and HVAC solution of the proposed dwellings to generate the Dwelling Emission Rate (DER).

For the project at Belmont Close, a sample of 3 houses has been selected to offer a representative selection to enable an accurate figure for emissions/m^2 which can then be applied to the full gross internal residential floor area.

This is widely accepted practice for non-major schemes and delivers accurate results sufficient for a Stage 2/3 planning submission.

3.2 Unregulated Energy Use

The baseline un-regulated energy use for cooking & appliances in the residential units have been calculated using the SAP Section 16 methodology; the same calculation used for Code for Sustainable Homes (CfSH) Ene 7.

Appliances = E_A = 207.8 X (TFA X N)$^{0.4714}$

Cooking = (119 + 24N)/TFA

N = no of occupant SAP table 1B

TFA – Total Floor Areas

The emissions associated with unregulated energy use per sqm is summarised in Table 1 below.

Table 1 – Unregulated Energy Use

Unit	CO_2 emissions - Unregulated Energy Use SAP10.2 Kg
SAMPLE 1	257
SAMPLE 2	363
SAMPLE 3	268

The un-regulated emission rates are added to the baseline regulated emission rates (as calculated under 3.1 above) in order to set the total baseline emission rates before then applying the energy hierarchy in line with The London Plan and Enfield policies.

3.3 Baseline Results

The baseline building results have been calculated in line with SAP10.2 emission standards and are presented in Table 2 below. The Baseline SAP outputs (which summarise the key data) are attached at **Appendix A**, with the GLA Part L 2021 reporting spreadsheet attached at **Appendix D.**

Table 2 – Baseline energy consumption and CO2 emissions

Unit	Target Emission Rate (regulated energy use) Kg/annum	Unregulated Energy Use Kg/annum	Total baseline emissions Kg
Sample 1	2,159	257	2,416
Sample 2	2,417	363	2,780
Sample 3	2,167	268	2,434
Development Total	**6,743**	**1,593**	**8,336**

4.0 Design for energy efficiency

The first step in the Mayor's 'Energy Hierarchy' as laid out in Chapter 9 of The London Plan, requests that buildings be designed to use improved energy efficiency measures – Be Lean. This will reduce demand for heating, cooling, and lighting, and therefore reduce operational costs while also minimizing associated carbon dioxide emissions.

This section sets out the measures included within the design of the development, to reduce the demand for energy, both gas and electricity (not including energy from renewable sources). The table at the end of this section details the amount of energy used and CO_2 produced by the building after the energy efficiency measures have been included. From these figures the overall reduction in CO_2 emissions, as a result of passive design measures, can be calculated. To achieve reductions in energy demand the following measures have been included within the design and specification of the building:

4.1 Passive Design

The National Planning Policy Framework emphasises the need to take account of climate change over the longer term and plan new developments to avoid increased vulnerability to the range of impacts arising from climate change. The UK Climate Impacts Programme 2009 projections suggest that by the 2080's the UK is likely to experience summer temperatures that are up to 4.2°C higher than they are today.

Accordingly, designers are to ensure buildings are designed and constructed to be comfortable in higher temperatures, without resorting to energy intensive air conditioning.

In line with current GLA Guidance, the project at Belmont Close has had been designed to ensure the building is not vulnerable to overheating; to instigate consideration of the risk of overheating with the proposed development, the design team have followed the guidance within the London Plan, which consider the control of overheating using the Cooling Hierarchy:-

1. **minimise internal heat generation through energy efficient design**

The project will be designed to best practice thermal insulation levels as noted, full details of which are noted under 4.3 below.

Not only does good insulation assist in reducing heat losses in the winter, but it also has a significant impact on preventing heat travelling through the build fabric during the summer.

2. **reduce the amount of heat entering a building in summer through orientation, shading, albedo, fenestration, insulation and green roofs and wall**

The development site is located on a east-west facing plot within an areas of low-rise townscape. There will be very limited topographical solar shading.

The design incorporates living areas with the main aspects to the east and west, giving the livings areas the benefit of large, glazed areas introducing natural daylight and attracting useful solar gain, whilst avoiding the peak southern sun.

Across the scheme, the glazing to the secondary spaces – bedrooms and bathrooms – is much reduced glazing in keeping with the reduced heat demand associated.

Glazing specification has been a significant consideration as part of the overheating risk mitigation and the specified new glazing will achieve a low g-value at 0.5 or better in order to further assist in reducing overheating risk from excessive solar gain.

A green roof at top floor levels will also aid local evaporative cooling.

3. **manage the heat within the building through exposed internal thermal mass and high ceilings**

All dwelling are designed with floor to ceiling heights at circa 2.5m.

The new build structure is expected to be of a highly insulated lightweight framed system to minimise loads on the existing structures.

4. **passive ventilation**

All glazing is designed to have opening areas to introduce high levels of natural "purge" ventilation to further assist in the reduction of overheating risks in appropriate areas.

5. **mechanical ventilation**

Given the above passive design proposals, the design team will be a promoting a low energy natural ventilation strategy.

4.2 Heating System

The "notional" heating system considered under the "be lean – use less energy" section of the Energy Hierarchy, will consist of high efficiency condensing gas boilers providing under floor heating and domestic hot water to the project

- High efficiency boiler – (92+%+ SEDBUK efficiency) & load compensation.
- High insulated primary and secondary pipework to prevent distribution heat losses.

To increase the efficiency in the use of the heating system, the following controls will be used to eliminate needless firing of the boilers.

- Boilers fitted with weather compensation and delayed start thermostats.

4.3 Fabric heat loss

Insulation measures will be utilised to ensure the calculated U-values exceed the Building Regulations minima, with specific guidance taken from the design team: -

- New wall and brick mansard constructions will be of a brick clad framed construction and will target a U-Value of 0.14W/m^2k or better.
- New flat roof constructions are to be of a lightweight frame/warm-roof type, achieving a U-Value of 0.11W/m^2k
- The newly laid floors will achieve a minimum u value of 0.14W/m^2k subject to perimeter/area ratios

All of the above standards are at Passivhaus minimum fabric standards or better and aligns with the LETI guidance;

LETI (Low Energy Transformation Initiative) is a network of over 1,000 built environment professionals who are working together to put London on the path to a zero carbon future

The guidance document published in 2019 set out performance standards for fabric, operational carbon and embedded carbon to enable new building to contribute the London's emission reduction targets.

Glazing

- The new glazing for windows and doors for the residential units will be triple glazed with an area weighted average U-Value of 1.0W/m^2K or better.

Air Tightness

- The project be tested to 5m^3/hr/m^2 in line with best practice for naturally ventilated dwellings.

Construction Details

- Heat loss via non-repeating thermal bridging within the new build elements will be minimised by the use of approved construction details for these new build units. An overall Y-Value <0.07 is targeted.

4.4 Ventilation

As noted above, the residential accommodation is to be naturally ventilated with background ventilation, opening windows and wet room extraction.

4.5 Lighting and appliances

The development will incorporate high efficiency light fittings utilising LED lamps.

The use of LED lighting will also minimise the internal gains commonly associated with tungsten and fluorescent lighting systems and thereby further reduce the potential for the dwellings to overheat.

External lighting will utilise daylight controls to ensure lights are not active during the day.

4.7 Waste Water Heat Recovery

The project will include waste water heat recovery to the proposed showers.

4.8 Energy efficiency results

The above data has been used to update the SAP models, the Dwelling Emission Rate outputs of which are attached at **Appendix B**, whilst Table 3 sets out the total emissions using SAP10.2 data.

Table 3 – Energy Efficient emission levels

Unit	Emission Rate (regulated energy use) Kg/annum	Unregulated Energy Use Kg/annum	Total "be lean" emissions Kg
Sample 1	1,824	257	2,080
Sample 2	2,131	363	2,494
Sample 3	1,842	268	2,109
Development Total	**5,797**	**1,593**	**7,390**

The results show that the energy efficiency measures introduced have resulted in the reduction in regulated and unregulated CO_2 emissions from the development of **9.9%.**

Regulated emissions have been reduced by **14.%** via the passive design measures highlighted above.

The total Part L Fabric Energy Efficiency Standard (FEES) for the development – set out in Table 4 below:-

Table 4 – Residential FEES

	Target Fabric Energy Efficiency (MWh/year)	Design Fabric Energy Efficiency (MWh/year)	Improvement (percent)
Development total	43.54	39.41	9%

5.0 Supplying Energy Efficiently

5.1 Community Heating/Combined Heat and Power (CHP)

The London Plan, Chapter 9, requires that major developments exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly.

Development in Heat Network Priority Areas should follow the heating hierarchy in Policy SI3 Energy infrastructure.

Therefore, this report must consider the availability of heat networks in the Enfield area.

The map below shows the location of the site, and it is located in heat network priority area (HNPA) and located on the projected route of the Cockfoster Extension under development by Energetik. It sits outside of the Potential Heat Network Project areas.

Extract from London Heat Map

As a non-major project of only 6 units, there is no obligation for the Belmont Close to be DEN connection ready, indeed, within such a small scheme the required plant space, circulation losses would render such an arrangement non-viable.

However, at Stage 2/3, the current proposals at Belmont Close will be designed with an LTHW heating systems that would actually be compatible with a connection, should it become available.

5.2 On-site CHP/District Heating

The heat production facility for a district heating scheme is generally considered to include heat only boilers (HOB) and/or the production of both electricity and heat i.e. CHP.

CHP is, as a rule of thumb, only operated as a base load as, depending on the technology, it may be difficult and/or inefficient to operate according to daily variations in demand. In a well-designed district heating network heat from CHP will provide between 60% and 80% of the annual baseline heat (heating and hot water) requirement with heat-only boiler plants providing the peak load and back-up. To maximise efficiency of the engine it needs to run for at least 17 hours a day; therefore, the heat load needs to be present for this period.

The key benefit from running a CHP engine is that it produces electricity, which can displace grid supplied electricity, which has significant carbon savings. It is for this reason that CHP is designed to run for as many hours of the year as possible.

GLA Guidance states non-domestic developments providing a substantial coincidence of demand for heat and power for the majority of hours in the year (5,000 hours per annum) and the heat to power ratio is low (e.g. 1:1), will still be expected to include on-site CHP as part of their energy strategy to meet the London Plan CO_2 reduction targets.

A small scale residential development – at 6 units – simply does not provide the constant heat demand required and as such, the potential use of on-site CHP is dismissed.

6.0 Renewable Energy Options

The final element of the Mayor's 'Energy Hierarchy' requires development proposals should provide a reduction in expected carbon dioxide emissions through the use of on-site renewable energy generation, where feasible – Be Green.

Renewable energy can be defined as energy taken from naturally occurring or renewable sources, such as sunlight, wind, wave's tides, geothermal etc. Harnessing these energy sources can involve a direct use of natural energy, such as solar water heating panels, or it can be a more indirect process, such as the use of Biofuels produced from plants, which have harnessed and embodied the suns energy through photosynthesis.

The energy efficiency measures and the sourcing the energy efficiently outlined above have the most significant impact on the heating and hot water energy requirements for the development, and the associated reduction in energy consumption.

This section then sets out the feasibility of implementing different energy technologies in consideration of: -

- Potential for Carbon savings
- Capital costs
- Running costs
- Payback period as a result of energy saved/Government incentives
- Maturity/availability of technology
- Reliability of the technology and need for back up or alternative systems.

6.1 Government incentives

6.1.1 Smart Export Guarantee (SEG)

Introduced in 2020, the SEG will enable solar photovoltaic (PV), wind, hydro and anaerobic digestion (AD) installations up to 5MW and micro-combined heat and power (micro-CHP) up to 50kW will be able to receive an export tariff under the policy.

The SEG is a market-led initiative, requiring electricity supply licensees to offer export tariffs to eligible generators. Suppliers are free to set their own SEG compliant tariff price (provided it is above zero pence at all times) and decide how their tariffs work.

Installation owners are able to shop around and select the Licensee of their choice based upon an offer of the most appropriate tariff.

Payment are made against metered exports only.

6.1.1 Renewable Heat Incentive

The Renewable Heat Incentive (RHI) was formally withdrawn for all new projects in March 2022.

6.2 Wind turbines

Wind turbines come in two main types'- horizontal axis and vertical axis. The more traditional horizontal axis systems rotate around the central pivot to face into the wind, whilst vertical axis systems work with wind from all directions.

The potential application of wind energy technologies at a particular site is dependent upon a variety of factors. But mainly these are: -

- Wind speed
- Wind turbulence
- Visual impact
- Noise impact
- Impact upon ecology

The availability and consistency of wind in urban environments is largely dependent upon the proximity, scale and orientation of surrounding obstructions. The site is surrounded by other residential buildings in all directions. To overcome these obstructions and to receive practical amounts of non-turbulent wind, the blades of a wind turbine would need to be placed significantly above the roof level of the surrounding buildings and the proposed project at Belmont Close itself.

It is inconceivable that any wind turbines of this size would be considered acceptable in this location.

6.3 Solar Energy

The proposed development has areas of flat roof that could accommodate solar panels orientated to the south.

In general, the roofs will have an unrestricted aspect, so there is scope therefore to site solar photovoltaic (PV) or water heating equipment at roof level.

6.3.1 Solar water heating

Solar water heating panels come in two main types; flat plate collectors and evacuated tubes. Flat plate collectors feed water, or other types of fluid used specifically to carry heat, through a roof mounted collector and into a hot water storage tank. Evacuated tube collectors are slightly more advanced as they employ sealed vacuum tubes, which capture and harness the heat more effectively.

Both collector types can capture heat whether the sky is overcast or clear. Depending on location, approximately 900–1100 kWh of solar energy falls on each m^2 of unshaded UK roof surface annually. The usable energy output per m^2 of solar panel as a result of this amount of insolation ranges from between 380 – 550 kWh/yr.

Solar hot water systems are of course, displacing heat pumps for DHW provision (as noted below), and due to the efficiency as a source of energy, solar thermal systems tend

to have a very poor pay back model unless there is a reliable and consultant demand for hot water; a medium size residential scheme simply does not provide this.

In addition, the use of solar thermal would work against the baseload requirements for any DEN connection.

Accordingly, given the limited roof space available and the strategy to off-set the electrical use, solar PV may be a stronger candidate (see below) and offer a greater return in terms of a return on investment.

6.3.2 Photovoltaics (PV)

A 1kWp (1 kilowatt peak) system in the UK could be expected to produce between 790-800kWh of electricity per year based upon a southeast orientation according to SAP2005 methodology used by the Microgeneration Certification Scheme (MCS). The figure given in the London Renewables Toolkit is 783 kWh per year for a development in London.

Despite the withdrawal of the Feed in Tariff, the returns on PV installations are still able to achieve 6-7% returns via the reduction in (ever more expensive) electricity consumption.

Accordingly, the design team are proposing to utilise the available roof space to install a 9 panel PV array to houses 1-3 and a 6 panel array to houses 4-6, utilising high power 440w panels, a total 19.8kWp array generating some 14,650kWh/annum.

6.4 Biomass heating

Biomass is a term given to fuel derived directly from biological sources for example rapeseed oil, wood chip/pellets or gas from anaerobic digestion. It can only be considered as a renewable energy source if the carbon dioxide emitted from burning the fuel is later recaptured in reproducing the fuel source (i.e. trees that are grown to become wood fuel, capture carbon as they grow).

Biomass heating systems require space to site a boiler and fuel hopper along with a supply of fuel – which can be very bulky items. There also needs to be a local source of biomass fuel that can be delivered on a regular basis. There are also issues with fuel storage and delivery which mitigate against this technology.

Additionally, a boiler of this type would replace the need for a conventional gas boiler and therefore offset all the gas energy typically used for space and water heating. However, biomass releases high levels of NO_x emissions and particulate matters, as well as other pollutants and would therefore have to be considered carefully against the high standard of air quality requirements within Enfield's Borough wide AQMA. Accordingly, the use of biomass is not considered appropriate for this project.

6.5 Ground source heat pump

All heat pump technologies utilise electricity as the primary fuel source – in this case displacing gas, as such, the overall reduction in emissions when using this technology can be less effective when opposed to a technology that is actually displacing electricity.

Ground source heating or cooling requires a source of consistent ground temperature, which could be a vertical borehole or a spread of pipework loops and a 'heat pump'. The system uses a loop of fluid to collect the more constant temperature in the ground and transport it to a heat pump. In a cooling system this principle works in reverse and the heat is distributed into the ground.

The heat pump then generates increased temperatures by 'condensing' the heat taken from the ground, producing hot water temperatures in the region of 45°C. This water can then be used as pre-heated water for a conventional boiler or to provide space heating with an under-floor heating system.

The use of a ground source heating/cooling system will therefore require:

- Vertical borehole or ground loop
- Use of under floor heating
- Space for heat pump unit

Clearly, there is insufficient land area to install low level collector loops or deep bore GSHP boreholes and as such, ground source heating cannot be considered.

6.6 Air source heat pump

Air source heating or cooling also employs the principle of a heat pump. This time either, upgrading the ambient external air temperature to provide higher temperatures for water and space heating, or taking warmth from within the building and dissipating it to the outdoor air.

It must be remembered that heat pumps utilise grid based electricity, so calculations base the benefits on SAP10.2 emissions data

Assuming a seasonal system efficiency of 320% (Coefficient of Performance of 3.2) and that the air source heat pump will replace 100% of the space heating/hot water demand, then the system would reduce the overall CO_2 emissions by approximately 70%. The table below demonstrates, on the assumption of a demand of 1000Kwh/year for heating and hot water.

Table 5 – Air Source Heat Pump Performance

Type of Array	Energy Consumption (kWh/yr.)	Emission factor ($kgCO_2/h$)	Total CO_2 emissions (kg/annum)
90% efficient gas boiler	11111	0.210	2333
320% efficient ASHP	2813	0.136	383
100% efficient immersion (back-up)	1000	0.136	136

A theoretical carbon saving of 77%

With the above data in mind, clearly an ASHP could be an option and the "be green" proposals include the use of air source heat pumps to provide the heat source for the building based centralised LTHW heating systems.

Flow and return temperatures will be at circa 55°/30°, again, to alight with any future DEN connection and the maximise heat pump efficiency.

Overall system efficiency has been advised at 330% and this figure has been used for the final energy calculations.

6.7 Final Emissions Calculation

Given the outcome of the feasibility study above, the developer is proposing the use the above noted air source heat pump system to deliver the heating and hot water demands to the development, as well as a roof mounted 45 panel PV array, a total 19.8kWp array generating some 14,650kWh/annum.

The final table – Table 6 – summarises the final outputs from the SAP & SBEM models; attached at **Appendix C.**

Table 6 – "Be Green" emission levels

Unit	Emission Rate (regulated energy use) Kg/annum	Unregulated Energy Use Kg/annum	Total baseline emissions Kg
Sample 1	306	257	563
Sample 2	464	363	827
Sample 3	280	268	547
Development Total	**1,050**	**1,593**	**2,643**

The data at Table 7 confirms that overall emissions – including unregulated energy use - have been reduced by **68%** over and above the baseline model, with a **57%** reduction in emissions directly from the use of energy generating and renewable technologies, i.e. over and above the energy efficient model.

Excluding the un-regulated use, i.e. considering emissions controlled under AD Part L, then the final reduction in DER/TER equates to **84%.**

The Energy Use Intensity and space heating demand of the development are also reported – Table 7 below:

Table 7 – Energy and Heat Demands

Building Type	Energy Use Intensity ($kWh/m^2/year$)	Space Heating ($kWh/m^2/year$)
Residential	48.72	40.33

7.0 Sustainable Design & Construction

The Sustainability credentials of the proposed residential development at Belmont Close are set out below; based on the assessment criteria developed by the Building Research Establishment.

Materials

The principal issue when considering the environmental impact of new construction materials is the embodied carbon – i.e. the carbon cost extraction of raw material, transport to factory, manufacturing, transport to site and erection on site.

Additional carbon costs are occurred through maintenance and repairs as well as end of life (deconstruction/demolition).

The design team will seek out construction techniques with a lower embodied carbon contents; steel work and lightweight concrete floor slabs.

It is recognised that concrete utilised to form the first floor slab has a significant embodied CO_2e content, the majority of which comes from the cement, which makes up about 10% of concrete by volume, but accounts for around 75-90% of its embodied impact.

The team will aspire to utilise concrete with a significant recyclable content; concrete with a minim 30% GGBS content; higher if such product can be sourced at the time.

Emissions of CO_2 associated with calcium carbonate decomposition during concrete production are partly reversible through carbonation.

The mix design of structural concrete purposefully limits carbonation of the surface layer, preventing corrosion of any embedded steel reinforcement, which might otherwise be affected during the building's life. There is, however, a greater degree of carbonation during the end-of-life stage, when concrete is crushed for reuse as an aggregate. The crushing process substantially increases the material's surface area, allowing CO_2 to be more readily absorbed.

It is generally acknowledged that the concrete carbonisation process will remove up to 30% of the up-front embodied CO_2e during the buildings lifespan, including end of life.

Other significant measure considered to reduce the project CO_2e content include:-

- Rebar with a virtual 100% recycled content
- Structural Steels with a 30% recycled content
- Plasterboard with a significant recycled content – subject to market availability

In addition to the above low carbon strategy, the development will source all materials form supplier that can demonstrate that materials are sourced responsibly in line with recognised Environmental Management Systems (FCS, BES6001 etc.)

The principal contractor with be required to produce a site waste management plan and sustainable procure plan, in line with BREEAM standards – this will include a pre-demolition audit to identify demolition/strip-out materials to reuse on-site or salvage appropriate materials to enable their reuse or recycling off-site in order to align with the principles of the circular economy.

The procurement plan will follow the waste hierarchy Reduce; Reuse & Recycle.

The SWMP will inform the adoption of good practice waste minimisation in design. This will set targets to minimise the generation of non-hazardous construction waste using the sustainable procurement plan to avoid over-ordering and to use just-in-time delivery policies.

Operational waste and recycling – appropriate internal and external storage space will be provided to ensure that residents can sort, store and dispose of waste and recyclable materials in line with Enfield's collection policies.

Pollution

The contractor will also monitor the use of energy and water use during the construction phase and incorporate best site practices to reduce the potential for air (dust) and ground water pollution.

The completed development will use zero emission heat pump systems for heating and hot water.

The main contractor will be required to register the site with the Considerate Constructors Scheme and achieve a best practice score of 25 or more.

To avoid the issue of noise pollution, the development will comply with Building Regulations Part E, providing a good level of sound insulation between the proposed development and surrounding buildings.

Energy

The development will incorporate renewables technologies as noted in the main report above; air source heat pumps and PV arrays.

The new homes will also be supplied with a Home User Guide offering practical advice on how to use the home economically and efficiently, including specific advise on how to reduce unregulated energy uses.

This will be further enhanced by the installation of smart energy metering, enabling occupants to accurately assess their energy usage and thereby, manage it.

Water

The development minimise water use as far as practicable by incorporating appropriate water efficiency measures. The applicants will ensure that all dwellings meet the required level of 105 litres maximum daily allowable usage per person in accordance with the former Level 4 of the Code for Sustainable Homes.

A sample Part G calculation is attached at **Appendix E.**

Sustainable Urban Drainage (SuDs)

It is noted that the area is subject to potential flood risk from reservoirs, and this will be considered further under the submitted floor risk assessment.

The existing site is currently made up of the existing building and hard surfaces. Accordingly, the introduction of new green roof and planted areas will help to reduce the levels of surface water run-off.

A formal FRA/SuDs report has been prepared under separate cover.

Ecology and Biodiversity

Clearly, the existing site is 100% building and hard landscaping, so any improvement on this situation would increase biodiversity.

The development would employ an ecologist to consider the landscaping and planting regime and any other opportunities to achieve an overall improvement in the levels of fauna and flora utilising indigenous species where possible and appropriate.

It is expected to achieve an uplift in net biodiversity.

8.0 Conclusions

This report has detailed the baseline energy requirements for the proposed development, the reduction in energy demand as a result of energy efficiency measures and the potential to achieve further CO_2 reductions using renewable energy technologies.

The baseline results have shown that if the development was built to a standard to meet only the minimum requirements of current building regulations, following the guidance from the GLA (June 2022), the total amount of CO_2 emissions would be **8,336Kg/year**.

Following the introduction of passive energy efficiency measures into the development, as detailed in section 4, the total amount of CO_2 emissions would be reduced to **7,390Kg/year**

There is also a requirement to reduce CO_2 emissions across the development using renewable or low-carbon energy sources. Therefore, the report has considered the feasibility of the following technologies:

- Wind turbines
- Solar hot water
- Photovoltaic systems
- Biomass heating
- CHP (Combined heat and power)
- Ground & Air source heating

The results of the assessment of suitable technologies relative to the nature, locations and type of development suggest that the most suitable solution to meeting reduction in CO_2 emissions would be via the use of heat pump driven heating and hot water systems and the generation of electricity on site via an 19.86kwp PV array.

This has been used in the SAP models (reproduced at **Appendix C**) for the development which have also been detailed above in Table 6, which show a final gross emission level of **2,643Kg/year**, representing a total reduction in emission over the baseline model, taking into account unregulated energy, of **68%.**

In addition, the final SAP outputs at Appendix C demonstrate that the building achieves an overall improvement in regulated emissions over the Building Regulations Part L standards for regulated emissions of minimum of 84%.

The GLA Part L 2021 Spreadsheet is attached at **Appendix D.**

Tables 8 & 9 Demonstrate how the Belmont Close project complies with the London Plan requirements and the GLA guidance relating to zero carbon development based up SAP10.2 emissions data.

Table 8– Carbon Emission Reductions – Domestic Buildings

Key	Tonnes/annum
Baseline CO_2 emissions (Part L 2021 of the Building Regulations Compliant Development)	6.7
CO2 emissions after energy demand reduction (be lean)	5.8
CO2 emissions after energy demand reduction (be lean) AND heat network (be clean)	5.8
CO2 emissions after energy demand reduction (be lean) AND heat network (be clean) AND renewable energy (be green)	1.0

Table 9 – Regulated Emissions Savings – Domestic Buildings

	Regulated Carbon Dioxide Savings	
	(Tonnes CO2 per annum)	%
Savings from energy demand reduction	0.9	14%
Savings from heat network	0.0	0%
Savings from renewable energy	4.7	70%
Total Cumulative Savings	**5.7**	**84%**
	(Tonnes CO_2)	
Carbon Shortfall	1.0	
Cumulative savings for off-set payment	31	
Cash-in-lieu Contribution	**£N/A**	

Appendix A

Baseline/Un-regulated Energy Use:-

SAP Outputs & Target Emission Rates

Property Reference	Sample 1	**Issued on Date**	26/09/2023
Assessment Reference	Belmont Close	**Prop Type Ref**	Belmont Close
Property			

SAP Rating	85 B	**DER**	14.02	**TER**	11.50
Environmental	87 B	**% DER < TER**			-21.91
CO₂ Emissions (t/year)	1.29	**DFEE**	41.87	**TFEE**	46.76
Compliance Check	See BREL	**% DFEE < TFEE**			10.46
% DPER < TPER	-28.13	**DPER**	77.57	**TPER**	60.54

Assessor Details	Mr. George Farr	**Assessor ID**	T355-0001

Full SAP Calculation Print
Energy Efficiency

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	70.6200 (1b)	x	2.8500 (2b)	=	201.2670 (1b)	-
First floor	34.1100 (1c)	x	2.8500 (2c)	=	97.2135 (1c)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	104.7300					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	298.4805	(5)

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2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1005	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		4.0000	(17)
Infiltration rate		0.3005	(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) =	0.2554	(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	0.3257	0.3193	0.3129	0.2810	0.2746	0.2427	0.2427	0.2363	0.2554	0.2746	0.2874	0.3001	(22b)
Effective ac	0.5530	0.5510	0.5490	0.5395	0.5377	0.5294	0.5294	0.5279	0.5326	0.5377	0.5413	0.5450	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
DOOR			2.3500	1.0000	2.3500			(26)
G (Uw = 1.00)			22.4100	0.9615	21.5481			(27)
GF			70.6200	0.1200	8.4744	110.0000	7768.2000	(28a)
EW	142.5700	24.7600	117.8100	0.1500	17.6715	60.0000	7068.6000	(29a)
FR	70.6200		70.6200	0.1100	7.7682	9.0000	635.5800	(30)
Total net area of external elements Aum(A, m2)			283.8100					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	57.8122			(33)

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PW	28.7700	0.0000	0.0000	45.0000	1294.6500 (32)
IW	165.9900			9.0000	1493.9100 (32c)
IF	34.1100			18.0000	613.9800 (32d)
IF	34.1100			9.0000	306.9900 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 19181.9100 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 183.1558 (35)
Thermal bridges (User defined value 0.030 * total exposed area) 8.5143 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 66.3265 (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	
		2701	54.0713	53.1374	52.9627	52.1493	52.1493	51.9987	52.4626	52.9627	53.3161	53.6857	(38)
	120.7994	120.5966	120.3977	119.4639	119.2891	118.4758	118.4758	118.3251	118.7891	119.2891	119.6426	120.0121	(39)

Average = Sum(39)m / 12 = 119.4630

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1534	1.1515	1.1496	1.1407	1.1390	1.1312	1.1312	1.1298	1.1342	1.1390	1.1424	1.1459	(40)
HLP (average)												1.1407	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.7792 (42)
Hot water usage for mixer showers

70.8180	69.7538	68.2029	65.2357	63.0460	60.6040	59.2159	60.7550	62.4422	65.0641	68.0951	70.5467	(42a)

Hot water usage for baths

30.5773	30.1232	29.4837	28.3046	27.4217	26.4427	25.9139	26.5489	27.2403	28.2879	29.4913	30.4739	(42b)

Hot water usage for other uses

43.0919	41.5249	39.9579	38.3910	36.8240	35.2570	35.2570	36.8240	38.3910	39.9579	41.5249	43.0919	(42c)

Average daily hot water use (litres/day) 132.8163 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	144.4872	141.4019	137.6446	131.9312	127.2916	122.3037	120.3868	124.1279	128.0735	133.3099	139.1113	144.1125	(44)
Energy conte	228.8324	201.3544	211.5546	180.6073	171.3590	150.3866	145.5974	153.6963	157.9274	180.9003	198.1895	225.6454	(45)

Energy content (annual) Total = Sum(45)m = 2206.0506

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

34.3249	30.2032	31.7332	27.0911	25.7038	22.5580	21.8396	23.0544	23.6891	27.1350	29.7284	33.8468	(46)

Water storage loss:
Total storage loss

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

If cylinder contains dedicated solar storage

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss 50.9589	46.0274	50.9589	49.3151	50.9589	49.3151	50.9589	50.9589	49.3151	50.9589	49.3151	50.9589	(61)

Total heat required for water heating calculated for each month

279.7913	247.3818	262.5135	229.9223	222.3179	199.7017	196.5563	204.6552	207.2424	231.8592	247.5046	276.6043	(62)
WWHRS -63.1023	-55.8082	-58.4392	-48.3899	-45.0977	-38.5904	-36.1724	-38.4657	-39.9271	-47.0697	-53.3242	-61.9338	(63a)
PV diverter 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63b)
Solar input 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)

Output from w/h

216.6890	191.5735	204.0743	181.5324	177.2202	161.1113	160.3840	166.1895	167.3153	184.7896	194.1804	214.6705	(64)

Total per year (kWh/year) = Sum(64)m = 2219.7300 (64)
12Total per year (kWh/year) 2220 (64)
Electric shower(s)

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

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

Heat gains from water heating, kWh/month

88.8265	78.4572	83.0816	72.3807	69.7166	62.3323	61.1509	63.8437	64.8396	72.8891	78.2268	87.7668	(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	138.9605	138.9605	138.9605	138.9605	138.9605	138.9605	138.9605	138.9605	138.9605	138.9605	138.9605	138.9605	(66)

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

135.0701	149.5419	135.0701	139.5725	135.0701	139.5725	135.0701	135.0701	139.5725	135.0701	139.5725	135.0701	(67)

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

263.7555	266.4925	259.5954	244.9125	226.3778	208.9579	197.3203	194.5833	201.4804	216.1634	234.6980	252.1179	(68)

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

36.8961	36.8961	36.8961	36.8961	36.8961	36.8961	36.8961	36.8961	36.8961	36.8961	36.8961	36.8961	(69)
Pumps, fans 3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)

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

-111.1684	-111.1684	-111.1684	-111.1684	-111.1684	-111.1684	-111.1684	-111.1684	-111.1684	-111.1684	-111.1684	-111.1684	(71)

Water heating gains (Table 5)

119.3905	116.7518	111.6688	100.5287	93.7051	86.5727	82.1920	85.8115	90.0550	97.9692	108.6483	117.9661	(72)

Total internal gains

585.9043	600.4743	574.0226	552.7018	522.8412	499.7912	479.2706	480.1531	495.7960	516.8909	550.6069	572.8424	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.2500	11.2829	0.5700	0.7000	0.7700	19.4988	(75)
Southwest	8.7300	36.7938	0.5700	0.7000	0.7700	88.8169	(79)
Northwest	7.4300	11.2829	0.5700	0.7000	0.7700	23.1802	(81)

Solar gains	131.4959	238.1624	363.5188	513.5324	632.8075	653.5714	619.5672	526.7086	414.8580	273.3728	160.0834	110.8626	(83)
Total gains	717.4002	838.6367	937.5414	1066.2343	1155.6487	1153.3626	1098.8378	1006.8617	910.6541	790.2637	710.6903	683.7050	(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	44.1087	44.1829	44.2559	44.6018	44.6672	44.9738	44.9738	45.0311	44.8552	44.6672	44.5352	44.3981	
alpha	3.9406	3.9455	3.9504	3.9735	3.9778	3.9983	3.9983	4.0021	3.9903	3.9778	3.9690	3.9599	
util living area	0.9890	0.9790	0.9584	0.8996	0.7825	0.6094	0.4614	0.5184	0.7555	0.9325	0.9801	0.9908	(86)
MIT	19.6496	19.8313	20.0970	20.4479	20.7222	20.8687	20.9089	20.9010	20.7940	20.4308	19.9798	19.6176	(87)
Th 2	19.9574	19.9590	19.9605	19.9677	19.9691	19.9754	19.9754	19.9766	19.9730	19.9691	19.9664	19.9635	(88)
util rest of house	0.9863	0.9739	0.9480	0.8747	0.7315	0.5279	0.3598	0.4126	0.6819	0.9102	0.9744	0.9886	(89)
MIT 2	18.3794	18.6108	18.9461	19.3804	19.6928	19.8412	19.8707	19.8678	19.7776	19.3707	18.8069	18.3433	(90)
Living area fraction									fLA = Living area / (4) =			0.4373	(91)
MIT	18.9349	19.1446	19.4494	19.8472	20.1430	20.2905	20.3247	20.3197	20.2221	19.8343	19.3198	18.9006	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.7849	18.9946	19.2994	19.6972	19.9930	20.1405	20.1747	20.1697	20.0721	19.6843	19.1698	18.7506	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9822	0.9678	0.9399	0.8671	0.7328	0.5417	0.3801	0.4334	0.6898	0.9027	0.9686	0.9850	(94)
Useful gains	704.6331	811.6523	881.1698	924.5092	846.8174	624.8264	417.7108	436.3267	628.1787	713.3503	688.3882	673.4561	(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	1749.7612	1699.7559	1541.0222	1289.8776	989.2629	656.4183	423.5133	446.0451	709.4203	1083.6608	1444.0633	1746.2445	(97)
Space heating kWh	777.5753	596.8056	490.9302	263.0653	105.9795	0.0000	0.0000	0.0000	0.0000	275.5110	544.0861	798.1546	(98a)
Space heating requirement - total per year (kWh/year)												3852.1075	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	777.5753	596.8056	490.9302	263.0653	105.9795	0.0000	0.0000	0.0000	0.0000	275.5110	544.0861	798.1546	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3852.1075	
Space heating per m2											(98c) / (4) =	36.7813	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	92.0000	(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	777.5753	596.8056	490.9302	263.0653	105.9795	0.0000	0.0000	0.0000	0.0000	275.5110	544.0861	798.1546	(98)
Space heating efficiency (main heating system 1)	92.0000	92.0000	92.0000	92.0000	92.0000	0.0000	0.0000	0.0000	0.0000	92.0000	92.0000	92.0000	(210)
Space heating fuel (main heating system)	845.1905	648.7018	533.6198	285.9405	115.1951	0.0000	0.0000	0.0000	0.0000	299.4685	591.3979	867.5593	(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	216.6890	191.5735	204.0743	181.5324	177.2202	161.1113	160.3840	166.1895	167.3153	184.7896	194.1804	214.6705	(64)
Efficiency of water heater												80.0000	(216)
(217)m	89.0876	88.7646	88.1188	86.6905	84.1053	80.0000	80.0000	80.0000	80.0000	86.7746	88.5081	89.1652	(217)
Fuel for water heating, kWh/month	243.2312	215.8221	231.5899	209.4028	210.7123	201.3891	200.4800	207.7369	209.1442	212.9535	219.3928	240.7559	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	3.4822	3.1452	3.4822	3.3699	3.4822	3.3699	3.4822	3.4822	3.3699	3.4822	3.3699	3.4822	(231)
Lighting	31.4642	25.2418	22.7274	16.6511	12.8618	10.5082	11.7329	15.2509	19.8094	25.9911	29.3568	32.3387	(232)

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Electricity generated by PVs (Appendix M) (negative quantity)
(233a)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)
(234a)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)
(235a)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)
(235c)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)
(233b)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)
(234b)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)
0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (235b)
icity 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 4187.0734 (211)
Space heating fuel - main system 2 0.0000 (213)
Space heating fuel - secondary 0.0000 (215)
Efficiency of water heater 80.0000
Water heating fuel used 2602.6107 (219)
Space cooling fuel 0.0000 (221)

Electricity for pumps and fans:
central heating pump 41.0000 (230c)
Total electricity for the above, kWh/year 41.0000 (231)
Electricity for lighting (calculated in Appendix L) 253.9344 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV generation 0.0000 (233)
Wind generation 0.0000 (234)
Hydro-electric generation (Appendix N) 0.0000 (235a)
Electricity generated - Micro CHP (Appendix N) 0.0000 (235)
Appendix Q - special features
Energy saved or generated -0.0000 (236)
Energy used 0.0000 (237)
Total delivered energy for all uses 7084.6186 (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	4187.0734	0.2100	879.2854	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2602.6107	0.2100	546.5483	(264)
Space and water heating			1425.8337	(265)
Pumps, fans and electric keep-hot	41.0000	0.1387	5.6872	(267)
Energy for lighting	253.9344	0.1443	36.6506	(268)
Total CO2, kg/year			1468.1715	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			14.0200	(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	4187.0734	1.1300	4731.3930	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2602.6107	1.1300	2940.9501	(278)
Space and water heating			7672.3431	(279)
Pumps, fans and electric keep-hot	41.0000	1.5128	62.0248	(281)
Energy for lighting	253.9344	1.5338	389.4931	(282)
Total Primary energy kWh/year			8123.8610	(286)
Dwelling Primary energy Rate (DPER)			77.5700	(287)

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	70.6200 (1b)	x	2.8500 (2b)	=	201.2670 (1b)	-
First floor	34.1100 (1c)	x	2.8500 (2c)	=	97.2135 (1c)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 104.7300						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	298.4805	(5)

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2. Ventilation rate

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		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
	0 * 20 =	0.0000	(6f)
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) =	0.1340	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3840	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3264	(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	0.4162	0.4080	0.3999	0.3591	0.3509	0.3101	0.3101	0.3019	0.3264	0.3509	0.3672	0.3835	(22b)
Effective ac	0.5866	0.5832	0.5799	0.5645	0.5616	0.5481	0.5481	0.5456	0.5533	0.5616	0.5674	0.5735	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.3500	1.0000	2.3500			(26)
TER Opening Type (Uw = 1.20)			22.4100	1.1450	25.6603			(27)
GF			70.6200	0.1300	9.1806			(28a)
EW	142.5700	24.7600	117.8100	0.1800	21.2058			(29a)
FR	70.6200		70.6200	0.1100	7.7682			(30)
Total net area of external elements Aum(A, m2)			283.8100					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	66.1649			(33)
PW			28.7700	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	183.1558 (35)

List of Thermal Bridges

	K1 Element	Length	Psi-value	Total
E2	Other lintels (including other steel lintels)	9.0500	0.0500	0.4525
E3	Sill	9.0500	0.0500	0.4525
E4	Jamb	19.0600	0.0500	0.9530
E5	Ground floor (normal)	27.8800	0.1600	4.4608
E14	Flat roof	27.8800	0.0800	2.2304
E16	Corner (normal)	9.8000	0.0900	0.8820

Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.4312	(36)
Point Thermal bridges	(36a) = 0.0000	
Total fabric heat loss	(33) + (36) + (36a) = 75.5961	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	57.7793	57.4480	57.1234	55.5984	55.3131	53.9849	53.9849	53.7389	54.4965	55.3131	55.8903	56.4937	(38)
Heat transfer coeff	133.3754	133.0441	132.7195	131.1945	130.9092	129.5810	129.5810	129.3350	130.0926	130.9092	131.4864	132.0898	(39)
Average = Sum(39)m / 12 =												131.1931	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2735	1.2704	1.2673	1.2527	1.2500	1.2373	1.2373	1.2349	1.2422	1.2500	1.2555	1.2612	(40)
HLP (average)												1.2527	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7792 (42)

Hot water usage for mixer showers

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
70.8180	69.7538	68.2029	65.2357	63.0460	60.6040	59.2159	60.7550	62.4422	65.0641	68.0951	70.5467	(42a)

Hot water usage for baths

30.5773	30.1232	29.4837	28.3046	27.4217	26.4427	25.9139	26.5489	27.2403	28.2879	29.4913	30.4739	(42b)

Hot water usage for other uses

43.0919	41.5249	39.9579	38.3910	36.8240	35.2570	35.2570	36.8240	38.3910	39.9579	41.5249	43.0919	(42c)

Average daily hot water use (litres/day)	132.8163 (43)

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

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Daily hot water use

	144.4872	141.4019	137.6446	131.9312	127.2916	122.3037	120.3868	124.1279	128.0735	133.3099	139.1113	144.1125 (44)
Energy conte	228.8324	201.3544	211.5546	180.6073	171.3590	150.3866	145.5974	153.6963	157.9274	180.9003	198.1895	225.6454 (45)
Energy content (annual)										Total = Sum(45)m =		2206.0506
Distribution loss (46)m = 0.15 x (45)m												
	34.3249	30.2032	31.7332	27.0911	25.7038	22.5580	21.8396	23.0544	23.6891	27.1350	29.7284	33.8468 (46)
Water storage loss:												
Total storage loss												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Combi loss	50.9589	46.0274	50.9589	49.3151	50.9589	49.3151	50.9589	50.9589	49.3151	50.9589	49.3151	50.9589 (61)
			heating calculated for each month									
			3818	262.5135	229.9223	222.3179	199.7017	196.5563	204.6552	207.2424	231.8592	247.5046	276.6043 (62)
WWHRS	-32.3750	-28.6328	-29.9826	-24.8268	-23.1376	-19.7990	-18.5584	-19.7350	-20.4849	-24.1494	-27.3583	-31.7755 (63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000 (63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63d)
Output from w/h												
	247.4163	218.7490	232.5309	205.0956	199.1802	179.9026	177.9979	184.9202	186.7576	207.7098	220.1463	244.8288 (64)
										Total per year (kWh/year) = Sum(64)m =		2505.2352 (64)
12Total per year (kWh/year)												2505 (64)
Electric shower(s)												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (64a)
							Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =					0.0000 (64a)
Heat gains from water heating, kWh/month												
	88.8265	78.4572	83.0816	72.3807	69.7166	62.3323	61.1509	63.8437	64.8396	72.8891	78.2268	87.7668 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	138.9605	138.9605	138.9605	138.9605	138.9605	138.9605	138.9605	138.9605	138.9605	138.9605	138.9605	138.9605	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	133.2420	147.5179	133.2420	137.6834	133.2420	137.6834	133.2420	133.2420	137.6834	133.2420	137.6834	133.2420	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	263.7555	266.4925	259.5954	244.9125	226.3778	208.9579	197.3203	194.5833	201.4804	216.1634	234.6980	252.1179	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.8961	36.8961	36.8961	36.8961	36.8961	36.8961	36.8961	36.8961	36.8961	36.8961	36.8961	36.8961	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-111.1684	-111.1684	-111.1684	-111.1684	-111.1684	-111.1684	-111.1684	-111.1684	-111.1684	-111.1684	-111.1684	-111.1684	(71)
Water heating gains (Table 5)													
	119.3905	116.7518	111.6688	100.5287	93.7051	86.5727	82.1920	85.8115	90.0550	97.9692	108.6483	117.9661	(72)
Total internal gains													
	584.0761	598.4503	572.1944	550.8127	521.0131	497.9021	477.4425	478.3250	493.9069	515.0627	548.7178	571.0142	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.2500	11.2829	0.6300	0.7000	0.7700	21.5513	(75)
Southwest	8.7300	36.7938	0.6300	0.7000	0.7700	98.1660	(79)
Northwest	7.4300	11.2829	0.6300	0.7000	0.7700	25.6202	(81)

Solar gains	145.3376	263.2321	401.7840	567.5885	699.4188	722.3684	684.7848	582.1516	458.5273	302.1489	176.9343	122.5323	(83)
Total gains	729.4137	861.6824	973.9784	1118.4012	1220.4319	1220.2705	1162.2273	1060.4766	952.4342	817.2116	725.6521	693.5465	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	39.9497	40.0492	40.1471	40.6138	40.7023	41.1195	41.1195	41.1977	40.9578	40.7023	40.5237	40.3385	
alpha	3.6633	3.6699	3.6765	3.7076	3.7135	3.7413	3.7413	3.7465	3.7305	3.7135	3.7016	3.6892	
util living area													
	0.9887	0.9786	0.9579	0.9002	0.7869	0.6185	0.4726	0.5308	0.7646	0.9340	0.9800	0.9905	(86)
MIT	19.0993	19.3599	19.7471	20.2637	20.6738	20.9051	20.9734	20.9592	20.7848	20.2411	19.5853	19.0613	(87)
Th 2	19.8616	19.8641	19.8666	19.8781	19.8802	19.8903	19.8903	19.8922	19.8864	19.8802	19.8759	19.8713	(88)
util rest of house													
	0.9858	0.9732	0.9470	0.8743	0.7336	0.5313	0.3613	0.4157	0.6878	0.9112	0.9741	0.9882	(89)
MIT 2	17.6652	17.9970	18.4857	19.1257	19.5944	19.8296	19.8799	19.8745	19.7271	19.1148	18.2939	17.6230	(90)
Living area fraction											fLA = Living area / (4) =	0.4373	(91)
MIT	18.2923	18.5930	19.0373	19.6234	20.0665	20.3000	20.3581	20.3489	20.1896	19.6074	18.8587	18.2520	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2923	18.5930	19.0373	19.6234	20.0665	20.3000	20.3581	20.3489	20.1896	19.6074	18.8587	18.2520	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9802	0.9652	0.9370	0.8674	0.7433	0.5650	0.4094	0.4649	0.7108	0.9044	0.9668	0.9833	(94)
Useful gains	715.0070	831.6728	912.5809	970.1125	907.1367	689.5047	475.8722	493.0380	676.9505	739.0477	701.5469	681.9335	(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	1866.2347	1821.7723	1663.9444	1406.8512	1095.2475	738.6062	486.9729	510.7313	792.2124	1179.1461	1546.1067	1856.1213	(97)
Space heating kWh	856.5134	665.3469	559.0144	314.4519	139.9545	0.0000	0.0000	0.0000	0.0000	327.4332	608.0830	873.5957	(98a)
Space heating requirement - total per year (kWh/year)												4344.3932	
Solar heating kWh	0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
otal per year (kWh/year)												0.0000	
Space heating kWh	856.5134	665.3469	559.0144	314.4519	139.9545	0.0000	0.0000	0.0000	0.0000	327.4332	608.0830	873.5957	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4344.3932	
Space heating per m2											(98c) / (4) =	41.4818	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	92.4000	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	856.5134	665.3469	559.0144	314.4519	139.9545	0.0000	0.0000	0.0000	0.0000	327.4332	608.0830	873.5957	(98)
Space heating efficiency (main heating system 1)	92.4000	92.4000	92.4000	92.4000	92.4000	0.0000	0.0000	0.0000	0.0000	92.4000	92.4000	92.4000	(210)
Space heating fuel (main heating system)	926.9626	720.0724	604.9940	340.3159	151.4659	0.0000	0.0000	0.0000	0.0000	354.3650	658.0985	945.4499	(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	247.4163	218.7490	232.5309	205.0956	199.1802	179.9026	177.9979	184.9202	186.7576	207.7098	220.1463	244.8288	(64)
Efficiency of water heater												80.3000	(216)
(217)m	86.8161	86.6051	86.1883	85.2939	83.6390	80.3000	80.3000	80.3000	80.3000	85.3520	86.4393	86.8635	(217)
Fuel for water heating, kWh/month	284.9888	252.5823	269.7939	240.4574	238.1427	224.0382	221.6661	230.2866	232.5748	243.3567	254.6830	281.8545	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	27.6851	22.2100	19.9976	14.6511	11.3169	9.2460	10.3237	13.4191	17.4301	22.8693	25.8308	28.4545	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-59.4222	-80.5979	-111.5050	-120.5010	-125.9487	-116.1078	-114.5792	-110.0090	-101.5091	-89.7001	-64.1479	-51.7472	(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	-43.9794	-91.0825	-178.4883	-264.5214	-346.4529	-346.9710	-342.9599	-291.9445	-216.0397	-129.1284	-58.3324	-34.8951	(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	4701.7242	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	80.3000	
Water heating fuel used	2974.4251	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
Total electricity for the above, kWh/year	86.0000	(231)
Electricity for lighting (calculated in Appendix L)	223.4342	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-3490.5704	(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	4495.0131	(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	4701.7242	0.2100	987.3621	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2974.4251	0.2100	624.6293	(264)
Space and water heating			1611.9914	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	223.4342	0.1443	32.2485	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1145.7751	0.1354	-155.1753	
PV Unit electricity exported	-2344.7954	0.1263	-296.1239	
Total			-451.2992	(269)
Total CO2, kg/year			1204.8698	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			11.5000	(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	4701.7242	1.1300	5312.9484	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2974.4251	1.1300	3361.1004	(278)
Space and water heating			8674.0487	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	223.4342	1.5338	342.7109	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1145.7751	1.5006	-1719.3302	
PV Unit electricity exported	-2344.7954	0.4636	-1087.0193	
Total			-2806.3495	(283)
Total Primary energy kWh/year			6340.5109	(286)
Target Primary Energy Rate (TPER)			60.5400	(287)

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Property Reference	Sample 2	**Issued on Date**	26/09/2023
Assessment Reference	Belmont Close	**Prop Type Ref**	Belmont Close
Property			

SAP Rating	87 B	**DER**	12.03	**TER**	9.11
Environmental	88 B	**% DER < TER**			-32.05
CO₂ Emissions (t/year)	1.55	**DFEE**	38.99	**TFEE**	42.22
Compliance Check	See BREL	**% DFEE < TFEE**			7.65
% DPER < TPER	-38.58	**DPER**	66.56	**TPER**	48.03

Assessor Details	Mr. George Farr	**Assessor ID**	T355-0001

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Energy Efficiency

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

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1. Overall dwelling characteristics

		Area (m2)		Storey height (m)		Volume (m3)	
Ground floor		92.5300 (1b)	x	2.8500 (2b)	=	263.7105 (1b)	-
First floor		55.4300 (1c)	x	2.8500 (2c)	=	157.9755 (1c)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	147.9600						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	421.6860	(5)

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2. Ventilation rate

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		m3 per hour	
Number of open chimneys	0 * 80	= 0.0000	(6a)
Number of open flues	0 * 20	= 0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10	= 0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20	= 0.0000	(6d)
Number of flues attached to other heater	0 * 35	= 0.0000	(6e)
Number of blocked chimneys	0 * 20	= 0.0000	(6f)
Number of intermittent extract fans	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)	= 0.0949	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		4.0000	(17)
Infiltration rate		0.2949	(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)	= 0.2506	(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	0.3196	0.3133	0.3070	0.2757	0.2694	0.2381	0.2381	0.2318	0.2506	0.2694	0.2820	0.2945	(22b)
Effective ac	0.5511	0.5491	0.5471	0.5380	0.5363	0.5283	0.5283	0.5269	0.5314	0.5363	0.5397	0.5434	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
DOOR			2.3500	1.0000	2.3500			(26)
G (Uw = 1.00)			35.2200	0.9615	33.8654			(27)
GF			92.5300	0.1200	11.1036	110.0000	10178.3000	(28a)
EW	191.7600	37.5700	154.1900	0.1500	23.1285	60.0000	9251.4000	(29a)
FR	93.4200		93.4200	0.1100	10.2762	9.0000	840.7800	(30)
Total net area of external elements Aum(A, m2)			377.7100					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	80.7237			(33)

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PW	38.8800	0.0000	0.0000	45.0000	1749.6000 (32)
IW	241.2900			9.0000	2171.6100 (32c)
IF	55.4300			18.0000	997.7400 (32d)
IF	55.4300			9.0000	498.8700 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 25688.3000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 173.6165 (35)
Thermal bridges (User defined value 0.030 * total exposed area) 11.3313 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 92.0550 (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	
	4072	76.1367	74.8665	74.6289	73.5226	73.5226	73.3177	73.9487	74.6289	75.1097	75.6123	(38)	
	168.7380	168.4621	168.1917	166.9215	166.6839	165.5776	165.5776	165.3727	166.0037	166.6839	167.1646	167.6672	(39)

Average = Sum(39)m / 12 = 166.9204

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1404	1.1386	1.1367	1.1282	1.1265	1.1191	1.1191	1.1177	1.1219	1.1265	1.1298	1.1332	(40)
HLP (average)												1.1281	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.9310 (42)
Hot water usage for mixer showers

73.3623	72.2598	70.6533	67.5794	65.3110	62.7813	61.3434	62.9378	64.6856	67.4017	70.5416	73.0812	(42a)

Hot water usage for baths

31.6714	31.2011	30.5387	29.3174	28.4029	27.3889	26.8411	27.4989	28.2150	29.3001	30.5465	31.5644	(42b)

Hot water usage for other uses

44.6459	43.0224	41.3989	39.7754	38.1520	36.5285	36.5285	38.1520	39.7754	41.3989	43.0224	44.6459	(42c)

Average daily hot water use (litres/day) 137.5892 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	149.6797	146.4833	142.5909	136.6723	131.8659	126.6986	124.7130	128.5886	132.6760	138.1007	144.1105	149.2915	(44)
Energy conte	237.0560	208.5903	219.1569	187.0975	177.5168	155.7908	150.8296	159.2196	163.6028	187.4014	205.3119	233.7544	(45)

Energy content (annual) Total = Sum(45)m = 2285.3280
Distribution loss (46)m = 0.15 x (45)m

35.5584	31.2885	32.8735	28.0646	26.6275	23.3686	22.6244	23.8829	24.5404	28.1102	30.7968	35.0632	(46)

Water storage loss:
Total storage loss

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

If cylinder contains dedicated solar storage

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss 50.9589	46.0274	50.9589	49.3151	50.9589	49.3151	50.9589	50.9589	49.3151	50.9589	49.3151	50.9589	(61)

Total heat required for water heating calculated for each month

288.0149	254.6177	270.1158	236.4126	228.4757	205.1058	201.7885	210.1785	212.9179	238.3603	254.6269	284.7133	(62)
WWHRS -65.3694	-57.8133	-60.5387	-50.1285	-46.7179	-39.9769	-37.4719	-39.8476	-41.3616	-48.7608	-55.2400	-64.1589	(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

222.6455	196.8044	209.5771	186.2841	181.7578	165.1290	164.3166	170.3309	171.5563	189.5995	199.3869	220.5544	(64)

Total per year (kWh/year) = Sum(64)m = 2277.9425 (64)
12Total per year (kWh/year) 2278 (64)
Electric shower(s)

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

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

91.5608	80.8631	85.6094	74.5387	71.7641	64.1292	62.8906	65.6802	66.7267	75.0507	80.5950	90.4631	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	146.5478	146.5478	146.5478	146.5478	146.5478	146.5478	146.5478	146.5478	146.5478	146.5478	146.5478	146.5478	(66)

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

161.0804	178.3390	161.0804	166.4497	161.0804	166.4497	161.0804	161.0804	166.4497	161.0804	166.4497	161.0804	(67)

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

318.2949	321.5978	313.2746	295.5554	273.1882	252.1662	238.1221	234.8192	243.1425	260.8616	283.2288	304.2509	(68)

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

37.6548	37.6548	37.6548	37.6548	37.6548	37.6548	37.6548	37.6548	37.6548	37.6548	37.6548	37.6548	(69)
Pumps, fans 3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)

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

-117.2382	-117.2382	-117.2382	-117.2382	-117.2382	-117.2382	-117.2382	-117.2382	-117.2382	-117.2382	-117.2382	-117.2382	(71)

Water heating gains (Table 5)

123.0656	120.3320	115.0664	103.5260	96.4571	89.0683	84.5303	88.2799	92.6760	100.8746	111.9374	121.5901	(72)
Total internal gains 672.4052	690.2331	659.3857	635.4955	600.6900	574.6486	550.6972	551.1439	569.2325	592.7809	631.5803	656.8857	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.3400	11.2829	0.5700	0.7000	0.7700	19.7796	(75)
Southeast	12.2100	36.7938	0.5700	0.7000	0.7700	124.2215	(77)
Southwest	16.6700	36.7938	0.5700	0.7000	0.7700	169.5965	(79)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	313.5976	540.7427	757.3188	967.6053	1110.4972	1114.2105	1069.3306	960.9314	829.8616	602.3411	376.8141	267.6000	(83)
Total gains	986.0028	1230.9758	1416.7045	1603.1008	1711.1872	1688.8591	1620.0278	1512.0753	1399.0941	1195.1220	1008.3944	924.4857	(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	42.2883	42.3575	42.4256	42.7485	42.8094	43.0954	43.0954	43.1488	42.9848	42.8094	42.6863	42.5583	
alpha	3.8192	3.8238	3.8284	3.8499	3.8540	3.8730	3.8730	3.8766	3.8657	3.8540	3.8458	3.8372	
util living area	0.9881	0.9728	0.9435	0.8742	0.7530	0.5846	0.4383	0.4850	0.7086	0.9113	0.9768	0.9906	(86)
MIT	19.5954	19.8311	20.1273	20.4746	20.7315	20.8681	20.9070	20.9007	20.8091	20.4557	19.9561	19.5522	(87)
Th 2	19.9680	19.9695	19.9709	19.9779	19.9792	19.9853	19.9853	19.9864	19.9829	19.9792	19.9766	19.9738	(88)
util rest of house	0.9854	0.9666	0.9307	0.8463	0.7013	0.5060	0.3423	0.3858	0.6344	0.8852	0.9705	0.9884	(89)
MIT 2	18.3235	18.6226	18.9941	19.4200	19.7101	19.8487	19.8775	19.8753	19.7982	19.4092	18.7892	18.2729	(90)
Living area fraction									fLA = Living area / (4) =			0.3244	(91)
MIT	18.7361	19.0147	19.3617	19.7621	20.0415	20.1794	20.2114	20.2079	20.1261	19.7487	19.1678	18.6879	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.5861	18.8647	19.2117	19.6121	19.8915	20.0294	20.0614	20.0579	19.9761	19.5987	19.0178	18.5379	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9803	0.9581	0.9191	0.8348	0.6964	0.5096	0.3497	0.3931	0.6339	0.8733	0.9626	0.9841	(94)
Useful gains	966.5706	1179.3963	1302.1052	1338.1988	1191.7506	860.6386	566.4739	594.3948	886.8878	1043.6436	970.6962	909.8034	(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	2410.6129	2352.5201	2138.0044	1788.0838	1365.3879	898.9835	573.1364	604.9249	975.4614	1499.9325	1992.2279	2403.9989	(97)
Space heating kWh	1074.3675	788.3392	621.9090	323.9172	129.1862	0.0000	0.0000	0.0000	0.0000	339.4789	735.5028	1111.6815	(98a)
Space heating requirement - total per year (kWh/year)												5124.3823	
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	1074.3675	788.3392	621.9090	323.9172	129.1862	0.0000	0.0000	0.0000	0.0000	339.4789	735.5028	1111.6815	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												5124.3823	
Space heating per m2											(98c) / (4) =	34.6336	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (201)
Fraction of space heat from main system(s)	1.0000 (202)
Efficiency of main space heating system 1 (in %)	92.0000 (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	1074.3675	788.3392	621.9090	323.9172	129.1862	0.0000	0.0000	0.0000	0.0000	339.4789	735.5028	1111.6815	(98)
Space heating efficiency (main heating system 1)	92.0000	92.0000	92.0000	92.0000	92.0000	0.0000	0.0000	0.0000	0.0000	92.0000	92.0000	92.0000	(210)
Space heating fuel (main heating system)	1167.7907	856.8905	675.9880	352.0839	140.4197	0.0000	0.0000	0.0000	0.0000	368.9989	799.4596	1208.3495	(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	222.6455	196.8044	209.5771	186.2841	181.7578	165.1290	164.3166	170.3309	171.5563	189.5995	199.3869	220.5544	(64)
Efficiency of water heater												80.0000	(216)
(217)m	89.6906	89.3234	88.6484	87.2230	84.5837	80.0000	80.0000	80.0000	80.0000	87.3069	89.1481	89.7707	(217)
Fuel for water heating, kWh/month	248.2374	220.3281	236.4138	213.5723	214.8852	206.4112	205.3957	212.9136	214.4454	217.1643	223.6581	245.6863	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	3.4822	3.1452	3.4822	3.3699	3.4822	3.3699	3.4822	3.4822	3.3699	3.4822	3.3699	3.4822	(231)
Lighting	39.3696	31.5837	28.4376	20.8346	16.0933	13.1483	14.6808	19.0827	24.7865	32.5213	36.7327	40.4638	(232)

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

(233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (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 (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 (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 (235c)

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

(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (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 (234b)

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

	0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)

icity 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 (235d)

Annual totals kWh/year

Space heating fuel - main system 1	5569.9808 (211)
Space heating fuel - main system 2	0.0000 (213)
Space heating fuel - secondary	0.0000 (215)
Efficiency of water heater	80.0000
Water heating fuel used	2659.1115 (219)
Space cooling fuel	0.0000 (221)
Electricity for pumps and fans:	
central heating pump	41.0000 (230c)
Total electricity for the above, kWh/year	41.0000 (231)
Electricity for lighting (calculated in Appendix L)	317.7349 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	0.0000 (233)
Wind generation	0.0000 (234)
Hydro-electric generation (Appendix N)	0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)	0.0000 (235)
Appendix Q - special features	
Energy saved or generated	-0.0000 (236)
Energy used	0.0000 (237)
Total delivered energy for all uses	8587.8272 (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	5569.9808	0.2100	1169.6960	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2659.1115	0.2100	558.4134	(264)
Space and water heating			1728.1094	(265)
Pumps, fans and electric keep-hot	41.0000	0.1387	5.6872	(267)
Energy for lighting	317.7349	0.1443	45.8590	(268)
Total CO2, kg/year			1779.6555	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			12.0300	(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	5569.9808	1.1300	6294.0783	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2659.1115	1.1300	3004.7960	(278)
Space and water heating			9298.8743	(279)
Pumps, fans and electric keep-hot	41.0000	1.5128	62.0248	(281)
Energy for lighting	317.7349	1.5338	487.3524	(282)
Total Primary energy kWh/year			9848.2515	(286)
Dwelling Primary energy Rate (DPER)			66.5600	(287)

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	92.5300 (1b)	x	2.8500 (2b)	=	263.7105 (1b)	-
First floor	55.4300 (1c)	x	2.8500 (2c)	=	157.9755 (1c)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 147.9600						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	421.6860	(5)

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2. Ventilation rate

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		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
	0 * 20 =	0.0000	(6f)
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) =	0.0949	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3449	(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) =	0.2931	(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	0.3737	0.3664	0.3591	0.3224	0.3151	0.2785	0.2785	0.2711	0.2931	0.3151	0.3298	0.3444	(22b)
Effective ac	0.5698	0.5671	0.5645	0.5520	0.5496	0.5388	0.5388	0.5368	0.5430	0.5496	0.5544	0.5593	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.3500	1.0000	2.3500			(26)
TER Opening Type (Uw = 1.20)			34.6500	1.1450	39.6756			(27)
GF			92.5300	0.1300	12.0289			(28a)
EW	191.7600	37.0000	154.7600	0.1800	27.8568			(29a)
FR	93.4200		93.4200	0.1100	10.2762			(30)
Total net area of external elements Aum(A, m2)			377.7100					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	92.1875			(33)
PW			38.8800	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	173.6165 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	9.0500	0.0500	0.4525
E3 Sill	9.0500	0.0500	0.4525
E4 Jamb	19.0600	0.0500	0.9530
E5 Ground floor (normal)	27.8800	0.1600	4.4608
E14 Flat roof	27.8800	0.0800	2.2304
E16 Corner (normal)	9.8000	0.0900	0.8820

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		9.4312 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	101.6187 (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	79.2969	78.9195	78.5496	76.8121	76.4871	74.9738	74.9738	74.6935	75.5567	76.4871	77.1447	77.8322	(38)
Heat transfer coeff	180.9156	180.5382	180.1683	178.4308	178.1057	176.5924	176.5924	176.3122	177.1753	178.1057	178.7634	179.4509	(39)
Average = Sum(39)m / 12 =												178.4293	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2227	1.2202	1.2177	1.2059	1.2037	1.1935	1.1935	1.1916	1.1975	1.2037	1.2082	1.2128	(40)
HLP (average)												1.2059	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.9310	(42)

Hot water usage for mixer showers

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
73.3623	72.2598	70.6533	67.5794	65.3110	62.7813	61.3434	62.9378	64.6856	67.4017	70.5416	73.0812	(42a)

Hot water usage for baths

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
31.6714	31.2011	30.5387	29.3174	28.4029	27.3889	26.8411	27.4989	28.2150	29.3001	30.5465	31.5644	(42b)

Hot water usage for other uses

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
44.6459	43.0224	41.3989	39.7754	38.1520	36.5285	36.5285	38.1520	39.7754	41.3989	43.0224	44.6459	(42c)

Average daily hot water use (litres/day)	137.5892 (43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	149.6797	146.4833	142.5909	136.6723	131.8659	126.6986	124.7130	128.5886	132.6760	138.1007	144.1105	149.2915	(44)
Energy conte	237.0560	208.5903	219.1569	187.0975	177.5168	155.7908	150.8296	159.2196	163.6028	187.4014	205.3119	233.7544	(45)

Energy content (annual) Total = Sum(45)m = 2285.3280

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Distribution loss (46)m = 0.15 x (45)m	35.5584	31.2885	32.8735	28.0646	26.6275	23.3686	22.6244	23.8829	24.5404	28.1102	30.7968	35.0632	(46)
Water storage loss: Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	50.9589	46.0274	50.9589	49.3151	50.9589	49.3151	50.9589	50.9589	49.3151	50.9589	49.3151	50.9589	(61)
...heating calculated for each month	[illegible]	...6177	270.1158	236.4126	228.4757	205.1058	201.7885	210.1785	212.9179	238.3603	254.6269	284.7133	(62)
WWHRS	-33.5382	-29.6615	-31.0598	-25.7187	-23.9689	-20.5104	-19.2252	-20.4441	-21.2208	-25.0170	-28.3412	-32.9171	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	254.4767	224.9562	239.0560	210.6939	204.5068	184.5955	182.5633	189.7344	191.6971	213.3433	226.2857	251.7962	(64)

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Total per year (kWh/year) = Sum(64)m = 2573.7051 (64)

12Total per year (kWh/year) 2574 (64)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat gains from water heating, kWh/month	91.5608	80.8631	85.6094	74.5387	71.7641	64.1292	62.8906	65.6802	66.7267	75.0507	80.5950	90.4631	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	146.5478	146.5478	146.5478	146.5478	146.5478	146.5478	146.5478	146.5478	146.5478	146.5478	146.5478	146.5478	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	160.5432	177.7443	160.5432	165.8946	160.5432	165.8946	160.5432	160.5432	165.8946	160.5432	165.8946	160.5432	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	318.2949	321.5978	313.2746	295.5554	273.1882	252.1662	238.1221	234.8192	243.1425	260.8616	283.2288	304.2509	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.6548	37.6548	37.6548	37.6548	37.6548	37.6548	37.6548	37.6548	37.6548	37.6548	37.6548	37.6548	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-117.2382	-117.2382	-117.2382	-117.2382	-117.2382	-117.2382	-117.2382	-117.2382	-117.2382	-117.2382	-117.2382	-117.2382	(71)
Water heating gains (Table 5)	123.0656	120.3320	115.0664	103.5260	96.4571	89.0683	84.5303	88.2799	92.6760	100.8746	111.9374	121.5901	(72)
Total internal gains	671.8680	689.6384	658.8485	634.9404	600.1528	574.0935	550.1600	550.6067	568.6774	592.2437	631.0252	656.3485	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.2400	11.2829	0.6300	0.7000	0.7700	21.5169	(75)
Southeast	12.0100	36.7938	0.6300	0.7000	0.7700	135.0485	(77)
Southwest	16.4000	36.7938	0.6300	0.7000	0.7700	184.4126	(79)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	340.9780	587.9588	823.4546	1052.1199	1207.5056	1211.5488	1162.7458	1044.8681	902.3375	654.9382	409.7146	290.9639	(83)
Total gains	1012.8461	1277.5971	1482.3031	1687.0603	1807.6584	1785.6423	1712.9059	1595.4747	1471.0149	1247.1819	1040.7399	947.3125	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	39.4418	39.5243	39.6054	39.9911	40.0641	40.4074	40.4074	40.4716	40.2744	40.0641	39.9167	39.7637	
alpha	3.6295	3.6350	3.6404	3.6661	3.6709	3.6938	3.6938	3.6981	3.6850	3.6709	3.6611	3.6509	
util living area	0.9873	0.9711	0.9408	0.8706	0.7503	0.5844	0.4399	0.4870	0.7086	0.9092	0.9756	0.9899	(86)
MIT	19.1024	19.4350	19.8552	20.3493	20.7170	20.9180	20.9778	20.9678	20.8299	20.3226	19.6156	19.0455	(87)
Th 2	19.9019	19.9039	19.9059	19.9153	19.9170	19.9252	19.9252	19.9267	19.9220	19.9170	19.9135	19.9097	(88)
util rest of house	0.9843	0.9645	0.9271	0.8412	0.6964	0.5021	0.3385	0.3823	0.6313	0.8818	0.9688	0.9875	(89)
MIT 2	17.7025	18.1241	18.6503	19.2546	19.6694	19.8720	19.9162	19.9124	19.7974	19.2397	18.3634	17.6353	(90)

Living area fraction fLA = Living area / (4) = 0.3244 (91)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
MIT	18.1567	18.5494	19.0412	19.6097	20.0093	20.2114	20.2606	20.2548	20.1324	19.5910	18.7696	18.0928	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.1567	18.5494	19.0412	19.6097	20.0093	20.2114	20.2606	20.2548	20.1324	19.5910	18.7696	18.0928	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9774	0.9536	0.9137	0.8317	0.7014	0.5250	0.3709	0.4154	0.6477	0.8717	0.9591	0.9817	(94)
Useful gains	989.9984	1218.2761	1354.3065	1403.1645	1267.8865	937.4644	635.3128	662.7175	952.7386	1087.2227	998.1829	929.9551	(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	2506.8848	2464.2311	2259.5180	1910.9479	1479.9252	990.9233	646.4293	679.6459	1068.7850	1601.3526	2086.1038	2493.0680	(97)
Space heating kWh	1128.5635	837.2818	673.4774	365.6040	157.7568	0.0000	0.0000	0.0000	0.0000	382.5126	783.3030	1162.9560	(98a)

Space heating requirement - total per year (kWh/year) 5491.4551

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar heating kWh	[illegible]	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)

Full SAP Calculation Printout elmhurst energy

...otal per year (kWh/year) 0.0000

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating kWh	1128.5635	837.2818	673.4774	365.6040	157.7568	0.0000	0.0000	0.0000	0.0000	382.5126	783.3030	1162.9560	(98c)

Space heating requirement after solar contribution - total per year (kWh/year) 5491.4551

Space heating per m2 (98c) / (4) = 37.1145 (99)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	92.4000	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1128.5635	837.2818	673.4774	365.6040	157.7568	0.0000	0.0000	0.0000	0.0000	382.5126	783.3030	1162.9560	(98)
Space heating efficiency (main heating system 1)	92.4000	92.4000	92.4000	92.4000	92.4000	0.0000	0.0000	0.0000	0.0000	92.4000	92.4000	92.4000	(210)
Space heating fuel (main heating system)	1221.3890	906.1491	728.8716	395.6753	170.7325	0.0000	0.0000	0.0000	0.0000	413.9747	847.7306	1258.6104	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water heating requirement	254.4767	224.9562	239.0560	210.6939	204.5068	184.5955	182.5633	189.7344	191.6971	213.3433	226.2857	251.7962	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.1820	86.9284	86.4738	85.5503	83.8316	80.3000	80.3000	80.3000	80.3000	85.6169	86.8160	87.2371	(217)
Fuel for water heating, kWh/month	291.8913	258.7834	276.4490	246.2808	243.9496	229.8823	227.3516	236.2820	238.7261	249.1835	260.6497	288.6342	(219)
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	33.3577	26.7608	24.0951	17.6531	13.6358	11.1405	12.4390	16.1687	21.0015	27.5552	31.1235	34.2848	(232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-75.7581	-101.7352	-139.3381	-148.9742	-154.3440	-141.7236	-139.7711	-134.8114	-125.4521	-112.3398	-81.3729	-66.0906	(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	-59.7240	-123.2094	-240.6263	-355.5021	-464.6210	-465.0264	-459.7204	-391.8490	-290.6169	-174.3808	-79.1071	-47.4326	(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	5943.1332	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	80.3000	
Water heating fuel used	3048.0634	(219)
Space cooling fuel	0.0000	(221)

Electricity for pumps and fans:

Total electricity for the above, kWh/year	86.0000	(231)
Electricity for lighting (calculated in Appendix L)	269.2158	(232)

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

PV generation	-4573.5271	(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	4772.8853	(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	5943.1332	0.2100	1248.0580	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3048.0634	0.2100	640.0933	(264)
Space and water heating			1888.1513	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	269.2158	0.1443	38.8562	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1421.7112	0.1357	-192.8854	
PV Unit electricity exported	-3151.8159	0.1264	-398.3280	
Total			-591.2134	(269)
Total CO2, kg/year			1347.7233	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			9.1100	(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	5943.1332	1.1300	6715.7405	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3048.0634	1.1300	3444.3117	(278)
Space and water heating			10160.0522	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	269.2158	1.5338	412.9322	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1421.7112	1.5015	-2134.6679	
PV Unit electricity exported	-3151.8159	0.4639	-1462.2038	
Total			-3596.8717	(283)
Total Primary energy kWh/year			7106.2134	(286)
Target Primary Energy Rate (TPER)			48.0300	(287)

Property Reference	Sample 3			**Issued on Date**	26/09/2023
Assessment Reference	Belmont Close		**Prop Type Ref**	Belmont Close	
Property					

SAP Rating	86 B	**DER**	12.85	**TER**	11.08
Environmental	88 B	**% DER < TER**			-15.97
CO_2 Emissions (t/year)	1.23	**DFEE**	37.61	**TFEE**	42.23
Compliance Check	See BREL	**% DFEE < TFEE**			10.93
% DPER < TPER	-22.97	**DPER**	71.25	**TPER**	57.94

Assessor Details	Mr. George Farr	**Assessor ID**	T355-0001

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

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1. Overall dwelling characteristics

		Area (m2)		Storey height (m)		Volume (m3)	
Ground floor		58.5700 (1b)	x	2.8500 (2b)	=	166.9245 (1b)	-
First floor		50.5000 (1c)	x	2.8500 (2c)	=	143.9250 (1c)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	109.0700						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	310.8495	(5)

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2. Ventilation rate

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		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	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) =	0.1287	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		4.0000	(17)
Infiltration rate		0.3287	(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) =	0.2794	(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	0.3562	0.3492	0.3422	0.3073	0.3003	0.2654	0.2654	0.2584	0.2794	0.3003	0.3143	0.3283	(22b)
Effective ac	0.5634	0.5610	0.5586	0.5472	0.5451	0.5352	0.5352	0.5334	0.5390	0.5451	0.5494	0.5539	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
DOOR			2.3500	1.0000	2.3500			(26)
G (Uw = 1.00)			27.2400	0.9615	26.1923			(27)
GF			58.5700	0.1200	7.0284	110.0000	6442.7000	(28a)
EW	149.6200	29.5900	120.0300	0.1500	18.0045	60.0000	7201.8000	(29a)
FR	59.5600		59.5600	0.1100	6.5516	9.0000	536.0400	(30)
Total net area of external elements Aum(A, m2)			267.7500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	60.1268			(33)

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PW	44.9900	0.0000	0.0000	45.0000	2024.5500 (32)
IW	177.1000			9.0000	1593.9000 (32c)
IF	50.5000			18.0000	909.0000 (32d)
IF	50.5000			9.0000	454.5000 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 19162.4900 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 175.6898 (35)
Thermal bridges (User defined value 0.030 * total exposed area) 8.0325 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 68.1593 (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	
	5453	57.2976	56.1342	55.9165	54.9031	54.9031	54.7155	55.2935	55.9165	56.3568	56.8172	(38)	
	125.9573	125.7046	125.4569	124.2935	124.0758	123.0624	123.0624	122.8748	123.4528	124.0758	124.5161	124.9765	(39)

Average = Sum(39)m / 12 = 124.2924

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1548	1.1525	1.1502	1.1396	1.1376	1.1283	1.1283	1.1266	1.1319	1.1376	1.1416	1.1458	(40)
HLP (average)												1.1396	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.8091 (42)
Hot water usage for mixer showers

71.3196	70.2478	68.6860	65.6978	63.4925	61.0332	59.6354	61.1854	62.8845	65.5250	68.5774	71.0464	(42a)

Hot water usage for baths

30.7930	30.3357	29.6917	28.5043	27.6151	26.6292	26.0967	26.7362	27.4325	28.4874	29.6993	30.6889	(42b)

Hot water usage for other uses

43.3983	41.8201	40.2420	38.6639	37.0858	35.5077	35.5077	37.0858	38.6639	40.2420	41.8201	43.3983	(42c)

Average daily hot water use (litres/day) 133.7572 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	145.5109	142.4037	138.6197	132.8659	128.1934	123.1701	121.2397	125.0073	128.9808	134.2544	140.0969	145.1335	(44)
Energy conte	230.4537	202.7809	213.0534	181.8868	172.5730	151.4520	146.6290	154.7852	159.0463	182.1820	199.5937	227.2440	(45)

Energy content (annual) Total = Sum(45)m = 2221.6800

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

34.5681	30.4171	31.9580	27.2830	25.8859	22.7178	21.9943	23.2178	23.8569	27.3273	29.9391	34.0866	(46)

Water storage loss:
Total storage loss

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

If cylinder contains dedicated solar storage

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss 50.9589	46.0274	50.9589	49.3151	50.9589	49.3151	50.9589	50.9589	49.3151	50.9589	49.3151	50.9589	(61)

Total heat required for water heating calculated for each month

281.4126	248.8083	264.0123	231.2019	223.5319	200.7671	197.5879	205.7441	208.3613	233.1409	248.9087	278.2030	(62)
WWHRS -63.5493	-56.2035	-58.8531	-48.7327	-45.4171	-38.8637	-36.4286	-38.7381	-40.2099	-47.4031	-53.7019	-62.3725	(63a)
PV diverter 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63b)
Solar input 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)

Output from w/h

217.8633	192.6048	205.1592	182.4692	178.1148	161.9034	161.1593	167.0060	168.1514	185.7378	195.2068	215.8305	(64)

Total per year (kWh/year) = Sum(64)m = 2231.2065 (64)
12Total per year (kWh/year) 2231 (64)
Electric shower(s)

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

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

Heat gains from water heating, kWh/month

89.3656	78.9315	83.5800	72.8061	70.1202	62.6866	61.4939	64.2058	65.2117	73.3152	78.6937	88.2984	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	140.4563	140.4563	140.4563	140.4563	140.4563	140.4563	140.4563	140.4563	140.4563	140.4563	140.4563	140.4563	(66)

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

136.3702	150.9813	136.3702	140.9159	136.3702	140.9159	136.3702	136.3702	140.9159	136.3702	140.9159	136.3702	(67)

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

270.2130	273.0170	265.9511	250.9086	231.9202	214.0738	202.1513	199.3473	206.4132	221.4557	240.4441	258.2905	(68)

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

37.0456	37.0456	37.0456	37.0456	37.0456	37.0456	37.0456	37.0456	37.0456	37.0456	37.0456	37.0456	(69)
Pumps, fans 3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)

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

-112.3651	-112.3651	-112.3651	-112.3651	-112.3651	-112.3651	-112.3651	-112.3651	-112.3651	-112.3651	-112.3651	-112.3651	(71)

Water heating gains (Table 5)

120.1150	117.4576	112.3387	101.1196	94.2476	87.0647	82.6530	86.2981	90.5717	98.5420	109.2968	118.6806	(72)

Total internal gains

594.8352	609.5928	582.7969	561.0810	530.6749	507.1912	486.3114	487.1525	503.0377	524.5048	558.7936	581.4782	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.3600	11.2829	0.5700	0.7000	0.7700	19.8420	(75)
Southeast	2.3500	36.7938	0.5700	0.7000	0.7700	23.9083	(77)
Southwest	18.5300	36.7938	0.5700	0.7000	0.7700	188.5196	(79)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	232.2700	402.2324	567.8580	732.9465	847.7440	853.3945	817.8607	730.4155	624.7467	449.2726	279.4061	197.9980	(83)
Total gains	827.1051	1011.8252	1150.6548	1294.0275	1378.4190	1360.5857	1304.1720	1217.5680	1127.7844	973.7773	838.1997	779.4763	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	42.2597	42.3446	42.4282	42.8254	42.9005	43.2538	43.2538	43.3198	43.1170	42.9005	42.7488	42.5913	
alpha	3.8173	3.8230	3.8285	3.8550	3.8600	3.8836	3.8836	3.8880	3.8745	3.8600	3.8499	3.8394	
util living area	0.9826	0.9634	0.9285	0.8491	0.7185	0.5475	0.4071	0.4513	0.6717	0.8890	0.9674	0.9859	(86)
MIT	19.6769	19.9091	20.1961	20.5285	20.7620	20.8792	20.9103	20.9054	20.8291	20.5096	20.0317	19.6358	(87)
Th 2	19.9563	19.9582	19.9600	19.9686	19.9703	19.9778	19.9778	19.9792	19.9749	19.9703	19.9670	19.9636	(88)
util rest of house	0.9786	0.9554	0.9130	0.8176	0.6645	0.4707	0.3162	0.3568	0.5961	0.8581	0.9589	0.9826	(89)
MIT 2	18.4168	18.7101	19.0677	19.4721	19.7310	19.8493	19.8717	19.8706	19.8069	19.4621	18.8750	18.3702	(90)
Living area fraction									fLA = Living area / (4) =			0.3754	(91)
MIT	18.8899	19.1603	19.4914	19.8687	20.1181	20.2360	20.2616	20.2591	20.1907	19.8554	19.3093	18.8453	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.7399	19.0103	19.3414	19.7187	19.9681	20.0860	20.1116	20.1091	20.0407	19.7054	19.1593	18.6953	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9725	0.9462	0.9019	0.8090	0.6644	0.4792	0.3283	0.3691	0.6014	0.8487	0.9502	0.9773	(94)
Useful gains	804.3210	957.3580	1037.7773	1046.8571	915.7798	651.9953	428.1692	449.4586	678.2119	826.4488	796.4894	761.7482	(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	1818.8134	1773.7281	1611.0391	1344.6977	1025.8729	675.1216	432.1488	455.7601	733.3978	1129.7609	1501.5762	1811.5779	(97)
Space heating kWh	754.7824	548.6007	426.5068	214.4453	81.9092	0.0000	0.0000	0.0000	0.0000	225.6643	507.6625	781.0733	(98a)
Space heating requirement - total per year (kWh/year)												3540.6444	
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	754.7824	548.6007	426.5068	214.4453	81.9092	0.0000	0.0000	0.0000	0.0000	225.6643	507.6625	781.0733	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3540.6444	
Space heating per m2											(98c) / (4) =	32.4621	(99)

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

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

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

Efficiency of main space heating system 1 (in %) 92.0000 (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	754.7824	548.6007	426.5068	214.4453	81.9092	0.0000	0.0000	0.0000	0.0000	225.6643	507.6625	781.0733	(98)
Space heating efficiency (main heating system 1)	92.0000	92.0000	92.0000	92.0000	92.0000	0.0000	0.0000	0.0000	0.0000	92.0000	92.0000	92.0000	(210)
Space heating fuel (main heating system)	820.4157	596.3052	463.5944	233.0927	89.0318	0.0000	0.0000	0.0000	0.0000	245.2872	551.8071	848.9927	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	217.8633	192.6048	205.1592	182.4692	178.1148	161.9034	161.1593	167.0060	168.1514	185.7378	195.2068	215.8305	(64)
Efficiency of water heater												80.0000	(216)
(217)m	89.0094	88.5486	87.7261	86.0651	83.4279	80.0000	80.0000	80.0000	80.0000	86.1648	88.3206	89.1063	(217)
Fuel for water heating, kWh/month	244.7643	217.5132	233.8633	212.0129	213.4956	202.3792	201.4491	208.7575	210.1893	215.5611	221.0206	242.2170	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	3.4822	3.1452	3.4822	3.3699	3.4822	3.3699	3.4822	3.4822	3.3699	3.4822	3.3699	3.4822	(231)
Lighting	31.9800	25.6555	23.0999	16.9240	13.0726	10.6804	11.9253	15.5009	20.1341	26.4171	29.8380	32.8688	(232)

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Electricity generated by PVs (Appendix M) (negative quantity)
(233a)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)
(234a)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)
(235a)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)
(235c)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)
(233b)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)
(234b)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)
0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (235b)
icity 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 3848.5266 (211)
Space heating fuel - main system 2 0.0000 (213)
Space heating fuel - secondary 0.0000 (215)
Efficiency of water heater 80.0000
Water heating fuel used 2623.2232 (219)
Space cooling fuel 0.0000 (221)

Electricity for pumps and fans:
central heating pump 41.0000 (230c)
Total electricity for the above, kWh/year 41.0000 (231)
Electricity for lighting (calculated in Appendix L) 258.0966 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV generation 0.0000 (233)
Wind generation 0.0000 (234)
Hydro-electric generation (Appendix N) 0.0000 (235a)
Electricity generated - Micro CHP (Appendix N) 0.0000 (235)
Appendix Q - special features
Energy saved or generated -0.0000 (236)
Energy used 0.0000 (237)
Total delivered energy for all uses 6770.8463 (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	3848.5266	0.2100	808.1906	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2623.2232	0.2100	550.8769	(264)
Space and water heating			1359.0675	(265)
Pumps, fans and electric keep-hot	41.0000	0.1387	5.6872	(267)
Energy for lighting	258.0966	0.1443	37.2513	(268)
Total CO2, kg/year			1402.0060	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			12.8500	(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	3848.5266	1.1300	4348.8350	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2623.2232	1.1300	2964.2422	(278)
Space and water heating			7313.0773	(279)
Pumps, fans and electric keep-hot	41.0000	1.5128	62.0248	(281)
Energy for lighting	258.0966	1.5338	395.8771	(282)
Total Primary energy kWh/year			7770.9792	(286)
Dwelling Primary energy Rate (DPER)			71.2500	(287)

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	58.5700 (1b)	x	2.8500 (2b)	=	166.9245 (1b)	-
First floor	50.5000 (1c)	x	2.8500 (2c)	=	143.9250 (1c)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 109.0700						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	310.8495	(5)

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2. Ventilation rate

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		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
	0 * 20 =	0.0000	(6f)
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) =	0.1287	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3787	(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) =	0.3219	(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	0.4104	0.4023	0.3943	0.3541	0.3460	0.3058	0.3058	0.2977	0.3219	0.3460	0.3621	0.3782	(22b)
Effective ac	0.5842	0.5809	0.5777	0.5627	0.5599	0.5468	0.5468	0.5443	0.5518	0.5599	0.5656	0.5715	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.3500	1.0000	2.3500			(26)
TER Opening Type (Uw = 1.20)			24.9200	1.1450	28.5344			(27)
GF			58.5700	0.1300	7.6141			(28a)
EW	149.6200	27.2700	122.3500	0.1800	22.0230			(29a)
FR	59.5600		59.5600	0.1100	6.5516			(30)
Total net area of external elements Aum(A, m2)			267.7500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		67.0731			(33)
PW			44.9900	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 175.6898 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	9.0500	0.0500	0.4525
E3 Sill	9.0500	0.0500	0.4525
E4 Jamb	19.0600	0.0500	0.9530
E5 Ground floor (normal)	27.8800	0.1600	4.4608
E14 Flat roof	27.8800	0.0800	2.2304
E16 Corner (normal)	9.8000	0.0900	0.8820

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 9.4312 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 76.5043 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	59.9286	59.5932	59.2644	57.7200	57.4311	56.0860	56.0860	55.8369	56.6041	57.4311	58.0156	58.6267	(38)
Heat transfer coeff	136.4329	136.0974	135.7686	134.2243	133.9353	132.5902	132.5902	132.3412	133.1083	133.9353	134.5199	135.1310	(39)

Average = Sum(39)m / 12 = 134.2229

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2509	1.2478	1.2448	1.2306	1.2280	1.2156	1.2156	1.2134	1.2204	1.2280	1.2333	1.2389	(40)
HLP (average)												1.2306	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.8091 (42)

Hot water usage for mixer showers

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
71.3196	70.2478	68.6860	65.6978	63.4925	61.0332	59.6354	61.1854	62.8845	65.5250	68.5774	71.0464	(42a)

Hot water usage for baths

30.7930	30.3357	29.6917	28.5043	27.6151	26.6292	26.0967	26.7362	27.4325	28.4874	29.6993	30.6889	(42b)

Hot water usage for other uses

43.3983	41.8201	40.2420	38.6639	37.0858	35.5077	35.5077	37.0858	38.6639	40.2420	41.8201	43.3983	(42c)

Average daily hot water use (litres/day) 133.7572 (43)

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

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Daily hot water use
                   145.5109   142.4037   138.6197   132.8659   128.1934   123.1701   121.2397   125.0073   128.9808   134.2544   140.0969   145.1335 (44)
Energy conte       230.4537   202.7809   213.0534   181.8868   172.5730   151.4520   146.6290   154.7852   159.0463   182.1820   199.5937   227.2440 (45)
Energy content (annual)                                                                                             Total = Sum(45)m =    2221.6800
Distribution loss  (46)m = 0.15 x (45)m
                    34.5681    30.4171    31.9580    27.2830    25.8859    22.7178    21.9943    23.2178    23.8569    27.3273    29.9391    34.0866 (46)
Water storage loss:
Total storage loss
                     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
                     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Primary loss         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (59)
Combi loss          50.9589    46.0274    50.9589    49.3151    50.9589    49.3151    50.9589    50.9589    49.3151    50.9589    49.3151    50.9589 (61)
                          heating calculated for each month
                              8083   264.0123   231.2019   223.5319   200.7671   197.5879   205.7441   208.3613   233.1409   248.9087   278.2030 (62)
WWHRS              -32.6044   -28.8356   -30.1949   -25.0026   -23.3015   -19.9393   -18.6899   -19.8748   -20.6299   -24.3204   -27.5521   -32.0006 (63a)
PV diverter         -0.0000    -0.0000    -0.0000    -0.0000    -0.0000    -0.0000    -0.0000    -0.0000    -0.0000    -0.0000    -0.0000    -0.0000 (63b)
Solar input          0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (63c)
FGHRS                0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (63d)
Output from w/h
                   248.8082   219.9728   233.8173   206.1993   200.2304   180.8278   178.8980   185.8693   187.7314   208.8205   221.3566   246.2024 (64)
                                                                                  Total per year (kWh/year) = Sum(64)m =    2518.7339 (64)
12Total per year (kWh/year)                                                                                                        2519 (64)
Electric shower(s)
                     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (64a)
                                               Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =       0.0000 (64a)
Heat gains from water heating, kWh/month
                    89.3656    78.9315    83.5800    72.8061    70.1202    62.6866    61.4939    64.2058    65.2117    73.3152    78.6937    88.2984 (65)
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5. Internal gains (see Table 5 and 5a)
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Metabolic gains (Table 5), Watts
                        Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m              140.4563   140.4563   140.4563   140.4563   140.4563   140.4563   140.4563   140.4563   140.4563   140.4563   140.4563   140.4563 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                   136.2914   150.8941   136.2914   140.8345   136.2914   140.8345   136.2914   136.2914   140.8345   136.2914   140.8345   136.2914 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
                   270.2130   273.0170   265.9511   250.9086   231.9202   214.0738   202.1513   199.3473   206.4132   221.4557   240.4441   258.2905 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                    37.0456    37.0456    37.0456    37.0456    37.0456    37.0456    37.0456    37.0456    37.0456    37.0456    37.0456    37.0456 (69)
Pumps, fans          3.0000     3.0000     3.0000     3.0000     3.0000     0.0000     0.0000     0.0000     0.0000     3.0000     3.0000     3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
                  -112.3651  -112.3651  -112.3651  -112.3651  -112.3651  -112.3651  -112.3651  -112.3651  -112.3651  -112.3651  -112.3651  -112.3651 (71)
Water heating gains (Table 5)
                   120.1150   117.4576   112.3387   101.1196    94.2476    87.0647    82.6530    86.2981    90.5717    98.5420   109.2968   118.6806 (72)
Total internal gains
                   594.7564   609.5056   582.7181   560.9997   530.5962   507.1099   486.2326   487.0738   502.9563   524.4260   558.7122   581.3995 (73)
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6. Solar gains
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[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
-----------------------------------------------------------------------------------------------------
Northeast                                  5.8200            11.2829         0.6300          0.7000          0.7700               20.0686 (75)
Southeast                                  2.1500            36.7938         0.6300          0.7000          0.7700               24.1760 (77)
Southwest                                 16.9500            36.7938         0.6300          0.7000          0.7700              190.5972 (79)
-----------------------------------------------------------------------------------------------------

Solar gains        234.8419   406.6886   574.1551   741.0840   857.1645   862.8814   826.9511   738.5281   631.6779   454.2515   282.5004   200.1902 (83)
Total gains        829.5983  1016.1942  1156.8732  1302.0836  1387.7607  1369.9912  1313.1837  1225.6019  1134.6342   978.6775   841.2126   781.5897 (84)
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7. Mean internal temperature (heating season)
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Temperature during heating periods in the living area from Table 9, Th1 (C)                                                         21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)
                        Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau                 39.0149    39.1111    39.2058    39.6569    39.7424    40.1456    40.1456    40.2212    39.9893    39.7424    39.5697    39.3908
alpha                3.6010     3.6074     3.6137     3.6438     3.6495     3.6764     3.6764     3.6814     3.6660     3.6495     3.6380     3.6261
util living area
                     0.9831     0.9655     0.9339     0.8619     0.7406     0.5741     0.4315     0.4769     0.6961     0.8983     0.9691     0.9862 (86)

MIT                 19.1648    19.4808    19.8841    20.3674    20.7253    20.9214    20.9787    20.9693    20.8375    20.3519    19.6715    19.1136 (87)
Th 2                19.8795    19.8820    19.8843    19.8956    19.8977    19.9075    19.9075    19.9093    19.9037    19.8977    19.8934    19.8890 (88)
util rest of house
                     0.9791     0.9576     0.9188     0.8309     0.6853     0.4911     0.3300     0.3723     0.6172     0.8681     0.9608     0.9829 (89)
MIT 2               17.7653    18.1648    18.6685    19.2583    19.6598    19.8573    19.8990    19.8960    19.7866    19.2573    18.4180    17.7066 (90)
Living area fraction                                                                                  fLA = Living area / (4) =     0.3754 (91)
MIT                 18.2907    18.6589    19.1249    19.6747    20.0598    20.2568    20.3044    20.2990    20.1811    19.6682    18.8886    18.2349 (92)
Temperature adjustment                                                                                                               0.0000
adjusted MIT        18.2907    18.6589    19.1249    19.6747    20.0598    20.2568    20.3044    20.2990    20.1811    19.6682    18.8886    18.2349 (93)

-----------------------------------------------------------------------------------------------------
```

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9712	0.9464	0.9062	0.8238	0.6940	0.5187	0.3677	0.4107	0.6387	0.8606	0.9506	0.9760	(94)
Useful gains	805.7458	961.6957	1048.3455	1072.6812	963.1695	710.6270	482.8131	503.4136	724.6419	842.2616	799.6738	762.8160	(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	1908.7971	1872.5480	1714.0604	1446.2277	1119.6785	750.0389	491.1696	515.9982	809.4508	1214.5589	1585.8057	1896.5481	(97)
Space heating kWh	820.6701	612.0927	495.2918	268.9535	116.4427	0.0000	0.0000	0.0000	0.0000	276.9892	566.0150	843.4967	(98a)
Space heating requirement - total per year (kWh/year)												3999.9517	
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)
[illegible]otal per year (kWh/year)												0.0000	
Space heating kWh	820.6701	612.0927	495.2918	268.9535	116.4427	0.0000	0.0000	0.0000	0.0000	276.9892	566.0150	843.4967	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3999.9517	
Space heating per m2											(98c) / (4) =	36.6733	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	92.4000	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	820.6701	612.0927	495.2918	268.9535	116.4427	0.0000	0.0000	0.0000	0.0000	276.9892	566.0150	843.4967	(98)
Space heating efficiency (main heating system 1)	92.4000	92.4000	92.4000	92.4000	92.4000	0.0000	0.0000	0.0000	0.0000	92.4000	92.4000	92.4000	(210)
Space heating fuel (main heating system)	888.1712	662.4380	536.0301	291.0752	126.0202	0.0000	0.0000	0.0000	0.0000	299.7719	612.5703	912.8752	(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	248.8082	219.9728	233.8173	206.1993	200.2304	180.8278	178.8980	185.8693	187.7314	208.8205	221.3566	246.2024	(64)
Efficiency of water heater												80.3000	(216)
(217)m	86.7388	86.4522	85.9481	84.9517	83.2617	80.3000	80.3000	80.3000	80.3000	84.9876	86.3016	86.7997	(217)
Fuel for water heating, kWh/month	286.8476	254.4443	272.0448	242.7253	240.4831	225.1903	222.7870	231.4686	233.7875	245.7070	256.4921	283.6444	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	28.3187	22.7183	20.4553	14.9864	11.5759	9.4576	10.5600	13.7262	17.8290	23.3927	26.4220	29.1057	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-52.1351	-72.1815	-101.9048	-112.4470	-119.4492	-110.7943	-109.3419	-104.0389	-94.5052	-81.4368	-56.8112	-45.2232	(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	-33.6229	-70.2048	-138.6065	-206.8784	-272.3458	-273.2686	-270.1266	-229.3287	-168.8598	-100.0526	-44.7700	-26.6351	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)

Annual totals kWh/year		
Space heating fuel - main system 1	4328.9521	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	80.3000	
Water heating fuel used	2995.6220	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
Total electricity for the above, kWh/year	86.0000	(231)
Electricity for lighting (calculated in Appendix L)	228.5479	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-2894.9690	(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	4744.1530	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4328.9521	0.2100	909.0799	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2995.6220	0.2100	629.0806	(264)
Space and water heating			1538.1606	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	228.5479	0.1443	32.9865	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1060.2691	0.1350	-143.1252	
PV Unit electricity exported	-1834.6999	0.1261	-231.3109	
Total			-374.4362	(269)
Total CO2, kg/year			1208.6402	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			11.0800	(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	4328.9521	1.1300	4891.7159	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2995.6220	1.1300	3385.0529	(278)
Space and water heating			8276.7687	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	228.5479	1.5338	350.5544	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1060.2691	1.4989	-1589.2596	
PV Unit electricity exported	-1834.6999	0.4628	-849.0844	
Total			-2438.3439	(283)
Total Primary energy kWh/year			6319.0800	(286)
Target Primary Energy Rate (TPER)			57.9400	(287)

Appendix B

Energy Efficient Design:-

SAP Outputs & Dwelling Emission Rates

Property Reference	Sample 1	**Issued on Date**	26/09/2023
Assessment Reference	Belmont Close	**Prop Type Ref**	Belmont Close
Property			

SAP Rating	85 B	**DER**	14.02	**TER**	11.50
Environmental	87 B	**% DER < TER**			-21.91
CO₂ Emissions (t/year)	1.29	**DFEE**	41.87	**TFEE**	46.76
Compliance Check	See BREL	**% DFEE < TFEE**			10.46
% DPER < TPER	-28.13	**DPER**	77.57	**TPER**	60.54

Assessor Details	Mr. George Farr	**Assessor ID**	T355-0001

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Energy Efficiency

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	70.6200 (1b)	x	2.8500 (2b)	=	201.2670 (1b)	-
First floor	34.1100 (1c)	x	2.8500 (2c)	=	97.2135 (1c)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	104.7300					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	298.4805	(5)

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2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1005	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		4.0000	(17)
Infiltration rate		0.3005	(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) =	0.2554	(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	0.3257	0.3193	0.3129	0.2810	0.2746	0.2427	0.2427	0.2363	0.2554	0.2746	0.2874	0.3001	(22b)
Effective ac	0.5530	0.5510	0.5490	0.5395	0.5377	0.5294	0.5294	0.5279	0.5326	0.5377	0.5413	0.5450	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
DOOR			2.3500	1.0000	2.3500			(26)
G (Uw = 1.00)			22.4100	0.9615	21.5481			(27)
GF			70.6200	0.1200	8.4744	110.0000	7768.2000	(28a)
EW	142.5700	24.7600	117.8100	0.1500	17.6715	60.0000	7068.6000	(29a)
FR	70.6200		70.6200	0.1100	7.7682	9.0000	635.5800	(30)
Total net area of external elements Aum(A, m2)			283.8100					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	57.8122			(33)

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PW	28.7700	0.0000	0.0000	45.0000	1294.6500 (32)
IW	165.9900			9.0000	1493.9100 (32c)
IF	34.1100			18.0000	613.9800 (32d)
IF	34.1100			9.0000	306.9900 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 19181.9100 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 183.1558 (35)
Thermal bridges (User defined value 0.030 * total exposed area) 8.5143 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 66.3265 (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	
		2701	54.0713	53.1374	52.9627	52.1493	52.1493	51.9987	52.4626	52.9627	53.3161	53.6857	(38)
	120.7994	120.5966	120.3977	119.4639	119.2891	118.4758	118.4758	118.3251	118.7891	119.2891	119.6426	120.0121	(39)

Average = Sum(39)m / 12 = 119.4630

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1534	1.1515	1.1496	1.1407	1.1390	1.1312	1.1312	1.1298	1.1342	1.1390	1.1424	1.1459	(40)
HLP (average)												1.1407	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.7792 (42)
Hot water usage for mixer showers

70.8180	69.7538	68.2029	65.2357	63.0460	60.6040	59.2159	60.7550	62.4422	65.0641	68.0951	70.5467	(42a)

Hot water usage for baths

30.5773	30.1232	29.4837	28.3046	27.4217	26.4427	25.9139	26.5489	27.2403	28.2879	29.4913	30.4739	(42b)

Hot water usage for other uses

43.0919	41.5249	39.9579	38.3910	36.8240	35.2570	35.2570	36.8240	38.3910	39.9579	41.5249	43.0919	(42c)

Average daily hot water use (litres/day) 132.8163 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	144.4872	141.4019	137.6446	131.9312	127.2916	122.3037	120.3868	124.1279	128.0735	133.3099	139.1113	144.1125	(44)
Energy conte	228.8324	201.3544	211.5546	180.6073	171.3590	150.3866	145.5974	153.6963	157.9274	180.9003	198.1895	225.6454	(45)

Energy content (annual) Total = Sum(45)m = 2206.0506

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

34.3249	30.2032	31.7332	27.0911	25.7038	22.5580	21.8396	23.0544	23.6891	27.1350	29.7284	33.8468	(46)

Water storage loss:
Total storage loss

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

If cylinder contains dedicated solar storage

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss 50.9589	46.0274	50.9589	49.3151	50.9589	49.3151	50.9589	50.9589	49.3151	50.9589	49.3151	50.9589	(61)

Total heat required for water heating calculated for each month

279.7913	247.3818	262.5135	229.9223	222.3179	199.7017	196.5563	204.6552	207.2424	231.8592	247.5046	276.6043	(62)
WWHRS -63.1023	-55.8082	-58.4392	-48.3899	-45.0977	-38.5904	-36.1724	-38.4657	-39.9271	-47.0697	-53.3242	-61.9338	(63a)
PV diverter 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63b)
Solar input 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)

Output from w/h

216.6890	191.5735	204.0743	181.5324	177.2202	161.1113	160.3840	166.1895	167.3153	184.7896	194.1804	214.6705	(64)

Total per year (kWh/year) = Sum(64)m = 2219.7300 (64)
12Total per year (kWh/year) 2220 (64)
Electric shower(s)

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

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

Heat gains from water heating, kWh/month

88.8265	78.4572	83.0816	72.3807	69.7166	62.3323	61.1509	63.8437	64.8396	72.8891	78.2268	87.7668	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	138.9605	138.9605	138.9605	138.9605	138.9605	138.9605	138.9605	138.9605	138.9605	138.9605	138.9605	138.9605	(66)

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

135.0701	149.5419	135.0701	139.5725	135.0701	139.5725	135.0701	135.0701	139.5725	135.0701	139.5725	135.0701	(67)

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

263.7555	266.4925	259.5954	244.9125	226.3778	208.9579	197.3203	194.5833	201.4804	216.1634	234.6980	252.1179	(68)

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

36.8961	36.8961	36.8961	36.8961	36.8961	36.8961	36.8961	36.8961	36.8961	36.8961	36.8961	36.8961	(69)
Pumps, fans 3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)

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

-111.1684	-111.1684	-111.1684	-111.1684	-111.1684	-111.1684	-111.1684	-111.1684	-111.1684	-111.1684	-111.1684	-111.1684	(71)

Water heating gains (Table 5)

119.3905	116.7518	111.6688	100.5287	93.7051	86.5727	82.1920	85.8115	90.0550	97.9692	108.6483	117.9661	(72)

Total internal gains

585.9043	600.4743	574.0226	552.7018	522.8412	499.7912	479.2706	480.1531	495.7960	516.8909	550.6069	572.8424	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.2500	11.2829	0.5700	0.7000	0.7700	19.4988	(75)
Southwest	8.7300	36.7938	0.5700	0.7000	0.7700	88.8169	(79)
Northwest	7.4300	11.2829	0.5700	0.7000	0.7700	23.1802	(81)

Solar gains	131.4959	238.1624	363.5188	513.5324	632.8075	653.5714	619.5672	526.7086	414.8580	273.3728	160.0834	110.8626	(83)
Total gains	717.4002	838.6367	937.5414	1066.2343	1155.6487	1153.3626	1098.8378	1006.8617	910.6541	790.2637	710.6903	683.7050	(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	44.1087	44.1829	44.2559	44.6018	44.6672	44.9738	44.9738	45.0311	44.8552	44.6672	44.5352	44.3981	
alpha	3.9406	3.9455	3.9504	3.9735	3.9778	3.9983	3.9983	4.0021	3.9903	3.9778	3.9690	3.9599	
util living area	0.9890	0.9790	0.9584	0.8996	0.7825	0.6094	0.4614	0.5184	0.7555	0.9325	0.9801	0.9908	(86)
MIT	19.6496	19.8313	20.0970	20.4479	20.7222	20.8687	20.9089	20.9010	20.7940	20.4308	19.9798	19.6176	(87)
Th 2	19.9574	19.9590	19.9605	19.9677	19.9691	19.9754	19.9754	19.9766	19.9730	19.9691	19.9664	19.9635	(88)
util rest of house	0.9863	0.9739	0.9480	0.8747	0.7315	0.5279	0.3598	0.4126	0.6819	0.9102	0.9744	0.9886	(89)
MIT 2	18.3794	18.6108	18.9461	19.3804	19.6928	19.8412	19.8707	19.8678	19.7776	19.3707	18.8069	18.3433	(90)
Living area fraction									fLA = Living area / (4) =			0.4373	(91)
MIT	18.9349	19.1446	19.4494	19.8472	20.1430	20.2905	20.3247	20.3197	20.2221	19.8343	19.3198	18.9006	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.7849	18.9946	19.2994	19.6972	19.9930	20.1405	20.1747	20.1697	20.0721	19.6843	19.1698	18.7506	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9822	0.9678	0.9399	0.8671	0.7328	0.5417	0.3801	0.4334	0.6898	0.9027	0.9686	0.9850	(94)
Useful gains	704.6331	811.6523	881.1698	924.5092	846.8174	624.8264	417.7108	436.3267	628.1787	713.3503	688.3882	673.4561	(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	1749.7612	1699.7559	1541.0222	1289.8776	989.2629	656.4183	423.5133	446.0451	709.4203	1083.6608	1444.0633	1746.2445	(97)
Space heating kWh	777.5753	596.8056	490.9302	263.0653	105.9795	0.0000	0.0000	0.0000	0.0000	275.5110	544.0861	798.1546	(98a)
Space heating requirement - total per year (kWh/year)												3852.1075	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	777.5753	596.8056	490.9302	263.0653	105.9795	0.0000	0.0000	0.0000	0.0000	275.5110	544.0861	798.1546	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3852.1075	
Space heating per m2											(98c) / (4) =	36.7813	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	92.0000	(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	777.5753	596.8056	490.9302	263.0653	105.9795	0.0000	0.0000	0.0000	0.0000	275.5110	544.0861	798.1546	(98)
Space heating efficiency (main heating system 1)	92.0000	92.0000	92.0000	92.0000	92.0000	0.0000	0.0000	0.0000	0.0000	92.0000	92.0000	92.0000	(210)
Space heating fuel (main heating system)	845.1905	648.7018	533.6198	285.9405	115.1951	0.0000	0.0000	0.0000	0.0000	299.4685	591.3979	867.5593	(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	216.6890	191.5735	204.0743	181.5324	177.2202	161.1113	160.3840	166.1895	167.3153	184.7896	194.1804	214.6705	(64)
Efficiency of water heater												80.0000	(216)
(217)m	89.0876	88.7646	88.1188	86.6905	84.1053	80.0000	80.0000	80.0000	80.0000	86.7746	88.5081	89.1652	(217)
Fuel for water heating, kWh/month	243.2312	215.8221	231.5899	209.4028	210.7123	201.3891	200.4800	207.7369	209.1442	212.9535	219.3928	240.7559	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	3.4822	3.1452	3.4822	3.3699	3.4822	3.3699	3.4822	3.4822	3.3699	3.4822	3.3699	3.4822	(231)
Lighting	31.4642	25.2418	22.7274	16.6511	12.8618	10.5082	11.7329	15.2509	19.8094	25.9911	29.3568	32.3387	(232)

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Electricity generated by PVs (Appendix M) (negative quantity)
(233a)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)
(234a)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)
(235a)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)
(235c)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)
(233b)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)
(234b)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)
0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (235b)
icity 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 4187.0734 (211)
Space heating fuel - main system 2 0.0000 (213)
Space heating fuel - secondary 0.0000 (215)
Efficiency of water heater 80.0000
Water heating fuel used 2602.6107 (219)
Space cooling fuel 0.0000 (221)

Electricity for pumps and fans:
central heating pump 41.0000 (230c)
Total electricity for the above, kWh/year 41.0000 (231)
Electricity for lighting (calculated in Appendix L) 253.9344 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV generation 0.0000 (233)
Wind generation 0.0000 (234)
Hydro-electric generation (Appendix N) 0.0000 (235a)
Electricity generated - Micro CHP (Appendix N) 0.0000 (235)
Appendix Q - special features
Energy saved or generated -0.0000 (236)
Energy used 0.0000 (237)
Total delivered energy for all uses 7084.6186 (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	4187.0734	0.2100	879.2854	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2602.6107	0.2100	546.5483	(264)
Space and water heating			1425.8337	(265)
Pumps, fans and electric keep-hot	41.0000	0.1387	5.6872	(267)
Energy for lighting	253.9344	0.1443	36.6506	(268)
Total CO2, kg/year			1468.1715	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			14.0200	(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	4187.0734	1.1300	4731.3930	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2602.6107	1.1300	2940.9501	(278)
Space and water heating			7672.3431	(279)
Pumps, fans and electric keep-hot	41.0000	1.5128	62.0248	(281)
Energy for lighting	253.9344	1.5338	389.4931	(282)
Total Primary energy kWh/year			8123.8610	(286)
Dwelling Primary energy Rate (DPER)			77.5700	(287)

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	70.6200 (1b)	x	2.8500 (2b)	=	201.2670 (1b)	-
First floor	34.1100 (1c)	x	2.8500 (2c)	=	97.2135 (1c)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 104.7300						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	298.4805	(5)

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2. Ventilation rate

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		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
	0 * 20 =	0.0000	(6f)
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) =	0.1340	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3840	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3264	(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	0.4162	0.4080	0.3999	0.3591	0.3509	0.3101	0.3101	0.3019	0.3264	0.3509	0.3672	0.3835	(22b)
Effective ac	0.5866	0.5832	0.5799	0.5645	0.5616	0.5481	0.5481	0.5456	0.5533	0.5616	0.5674	0.5735	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.3500	1.0000	2.3500			(26)
TER Opening Type (Uw = 1.20)			22.4100	1.1450	25.6603			(27)
GF			70.6200	0.1300	9.1806			(28a)
EW	142.5700	24.7600	117.8100	0.1800	21.2058			(29a)
FR	70.6200		70.6200	0.1100	7.7682			(30)
Total net area of external elements Aum(A, m2)			283.8100					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	66.1649			(33)
PW			28.7700	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	183.1558 (35)

List of Thermal Bridges

	K1 Element	Length	Psi-value	Total
E2	Other lintels (including other steel lintels)	9.0500	0.0500	0.4525
E3	Sill	9.0500	0.0500	0.4525
E4	Jamb	19.0600	0.0500	0.9530
E5	Ground floor (normal)	27.8800	0.1600	4.4608
E14	Flat roof	27.8800	0.0800	2.2304
E16	Corner (normal)	9.8000	0.0900	0.8820

Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.4312	(36)
Point Thermal bridges	(36a) = 0.0000	
Total fabric heat loss	(33) + (36) + (36a) = 75.5961	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	57.7793	57.4480	57.1234	55.5984	55.3131	53.9849	53.9849	53.7389	54.4965	55.3131	55.8903	56.4937	(38)
Heat transfer coeff	133.3754	133.0441	132.7195	131.1945	130.9092	129.5810	129.5810	129.3350	130.0926	130.9092	131.4864	132.0898	(39)
Average = Sum(39)m / 12 =												131.1931	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2735	1.2704	1.2673	1.2527	1.2500	1.2373	1.2373	1.2349	1.2422	1.2500	1.2555	1.2612	(40)
HLP (average)												1.2527	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7792 (42)

Hot water usage for mixer showers

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
70.8180	69.7538	68.2029	65.2357	63.0460	60.6040	59.2159	60.7550	62.4422	65.0641	68.0951	70.5467	(42a)

Hot water usage for baths

30.5773	30.1232	29.4837	28.3046	27.4217	26.4427	25.9139	26.5489	27.2403	28.2879	29.4913	30.4739	(42b)

Hot water usage for other uses

43.0919	41.5249	39.9579	38.3910	36.8240	35.2570	35.2570	36.8240	38.3910	39.9579	41.5249	43.0919	(42c)

Average daily hot water use (litres/day)	132.8163 (43)

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

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Daily hot water use

	144.4872	141.4019	137.6446	131.9312	127.2916	122.3037	120.3868	124.1279	128.0735	133.3099	139.1113	144.1125 (44)
Energy conte	228.8324	201.3544	211.5546	180.6073	171.3590	150.3866	145.5974	153.6963	157.9274	180.9003	198.1895	225.6454 (45)
Energy content (annual)										Total = Sum(45)m =		2206.0506
Distribution loss (46)m = 0.15 x (45)m												
	34.3249	30.2032	31.7332	27.0911	25.7038	22.5580	21.8396	23.0544	23.6891	27.1350	29.7284	33.8468 (46)
Water storage loss:												
Total storage loss												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Combi loss	50.9589	46.0274	50.9589	49.3151	50.9589	49.3151	50.9589	50.9589	49.3151	50.9589	49.3151	50.9589 (61)
			heating calculated for each month									
			3818	262.5135	229.9223	222.3179	199.7017	196.5563	204.6552	207.2424	231.8592	247.5046	276.6043 (62)
WWHRS	-32.3750	-28.6328	-29.9826	-24.8268	-23.1376	-19.7990	-18.5584	-19.7350	-20.4849	-24.1494	-27.3583	-31.7755 (63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000 (63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63d)
Output from w/h												
	247.4163	218.7490	232.5309	205.0956	199.1802	179.9026	177.9979	184.9202	186.7576	207.7098	220.1463	244.8288 (64)
										Total per year (kWh/year) = Sum(64)m =		2505.2352 (64)
12Total per year (kWh/year)												2505 (64)
Electric shower(s)												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (64a)
							Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =					0.0000 (64a)
Heat gains from water heating, kWh/month												
	88.8265	78.4572	83.0816	72.3807	69.7166	62.3323	61.1509	63.8437	64.8396	72.8891	78.2268	87.7668 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	138.9605	138.9605	138.9605	138.9605	138.9605	138.9605	138.9605	138.9605	138.9605	138.9605	138.9605	138.9605	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	133.2420	147.5179	133.2420	137.6834	133.2420	137.6834	133.2420	133.2420	137.6834	133.2420	137.6834	133.2420	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	263.7555	266.4925	259.5954	244.9125	226.3778	208.9579	197.3203	194.5833	201.4804	216.1634	234.6980	252.1179	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.8961	36.8961	36.8961	36.8961	36.8961	36.8961	36.8961	36.8961	36.8961	36.8961	36.8961	36.8961	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-111.1684	-111.1684	-111.1684	-111.1684	-111.1684	-111.1684	-111.1684	-111.1684	-111.1684	-111.1684	-111.1684	-111.1684	(71)
Water heating gains (Table 5)													
	119.3905	116.7518	111.6688	100.5287	93.7051	86.5727	82.1920	85.8115	90.0550	97.9692	108.6483	117.9661	(72)
Total internal gains													
	584.0761	598.4503	572.1944	550.8127	521.0131	497.9021	477.4425	478.3250	493.9069	515.0627	548.7178	571.0142	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.2500	11.2829	0.6300	0.7000	0.7700	21.5513	(75)
Southwest	8.7300	36.7938	0.6300	0.7000	0.7700	98.1660	(79)
Northwest	7.4300	11.2829	0.6300	0.7000	0.7700	25.6202	(81)

Solar gains	145.3376	263.2321	401.7840	567.5885	699.4188	722.3684	684.7848	582.1516	458.5273	302.1489	176.9343	122.5323	(83)
Total gains	729.4137	861.6824	973.9784	1118.4012	1220.4319	1220.2705	1162.2273	1060.4766	952.4342	817.2116	725.6521	693.5465	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	39.9497	40.0492	40.1471	40.6138	40.7023	41.1195	41.1195	41.1977	40.9578	40.7023	40.5237	40.3385	
alpha	3.6633	3.6699	3.6765	3.7076	3.7135	3.7413	3.7413	3.7465	3.7305	3.7135	3.7016	3.6892	
util living area													
	0.9887	0.9786	0.9579	0.9002	0.7869	0.6185	0.4726	0.5308	0.7646	0.9340	0.9800	0.9905	(86)
MIT	19.0993	19.3599	19.7471	20.2637	20.6738	20.9051	20.9734	20.9592	20.7848	20.2411	19.5853	19.0613	(87)
Th 2	19.8616	19.8641	19.8666	19.8781	19.8802	19.8903	19.8903	19.8922	19.8864	19.8802	19.8759	19.8713	(88)
util rest of house													
	0.9858	0.9732	0.9470	0.8743	0.7336	0.5313	0.3613	0.4157	0.6878	0.9112	0.9741	0.9882	(89)
MIT 2	17.6652	17.9970	18.4857	19.1257	19.5944	19.8296	19.8799	19.8745	19.7271	19.1148	18.2939	17.6230	(90)
Living area fraction											fLA = Living area / (4) =	0.4373	(91)
MIT	18.2923	18.5930	19.0373	19.6234	20.0665	20.3000	20.3581	20.3489	20.1896	19.6074	18.8587	18.2520	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2923	18.5930	19.0373	19.6234	20.0665	20.3000	20.3581	20.3489	20.1896	19.6074	18.8587	18.2520	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9802	0.9652	0.9370	0.8674	0.7433	0.5650	0.4094	0.4649	0.7108	0.9044	0.9668	0.9833	(94)
Useful gains	715.0070	831.6728	912.5809	970.1125	907.1367	689.5047	475.8722	493.0380	676.9505	739.0477	701.5469	681.9335	(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	1866.2347	1821.7723	1663.9444	1406.8512	1095.2475	738.6062	486.9729	510.7313	792.2124	1179.1461	1546.1067	1856.1213	(97)
Space heating kWh	856.5134	665.3469	559.0144	314.4519	139.9545	0.0000	0.0000	0.0000	0.0000	327.4332	608.0830	873.5957	(98a)
Space heating requirement - total per year (kWh/year)												4344.3932	
Solar heating kWh	0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
otal per year (kWh/year)												0.0000	
Space heating kWh	856.5134	665.3469	559.0144	314.4519	139.9545	0.0000	0.0000	0.0000	0.0000	327.4332	608.0830	873.5957	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4344.3932	
Space heating per m2											(98c) / (4) =	41.4818	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	92.4000	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	856.5134	665.3469	559.0144	314.4519	139.9545	0.0000	0.0000	0.0000	0.0000	327.4332	608.0830	873.5957	(98)
Space heating efficiency (main heating system 1)	92.4000	92.4000	92.4000	92.4000	92.4000	0.0000	0.0000	0.0000	0.0000	92.4000	92.4000	92.4000	(210)
Space heating fuel (main heating system)	926.9626	720.0724	604.9940	340.3159	151.4659	0.0000	0.0000	0.0000	0.0000	354.3650	658.0985	945.4499	(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	247.4163	218.7490	232.5309	205.0956	199.1802	179.9026	177.9979	184.9202	186.7576	207.7098	220.1463	244.8288	(64)
Efficiency of water heater												80.3000	(216)
(217)m	86.8161	86.6051	86.1883	85.2939	83.6390	80.3000	80.3000	80.3000	80.3000	85.3520	86.4393	86.8635	(217)
Fuel for water heating, kWh/month	284.9888	252.5823	269.7939	240.4574	238.1427	224.0382	221.6661	230.2866	232.5748	243.3567	254.6830	281.8545	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	27.6851	22.2100	19.9976	14.6511	11.3169	9.2460	10.3237	13.4191	17.4301	22.8693	25.8308	28.4545	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-59.4222	-80.5979	-111.5050	-120.5010	-125.9487	-116.1078	-114.5792	-110.0090	-101.5091	-89.7001	-64.1479	-51.7472	(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	-43.9794	-91.0825	-178.4883	-264.5214	-346.4529	-346.9710	-342.9599	-291.9445	-216.0397	-129.1284	-58.3324	-34.8951	(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	4701.7242	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	80.3000	
Water heating fuel used	2974.4251	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
Total electricity for the above, kWh/year	86.0000	(231)
Electricity for lighting (calculated in Appendix L)	223.4342	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-3490.5704	(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	4495.0131	(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	4701.7242	0.2100	987.3621	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2974.4251	0.2100	624.6293	(264)
Space and water heating			1611.9914	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	223.4342	0.1443	32.2485	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1145.7751	0.1354	-155.1753	
PV Unit electricity exported	-2344.7954	0.1263	-296.1239	
Total			-451.2992	(269)
Total CO2, kg/year			1204.8698	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			11.5000	(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	4701.7242	1.1300	5312.9484	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2974.4251	1.1300	3361.1004	(278)
Space and water heating			8674.0487	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	223.4342	1.5338	342.7109	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1145.7751	1.5006	-1719.3302	
PV Unit electricity exported	-2344.7954	0.4636	-1087.0193	
Total			-2806.3495	(283)
Total Primary energy kWh/year			6340.5109	(286)
Target Primary Energy Rate (TPER)			60.5400	(287)

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Property Reference	Sample 2	**Issued on Date**	26/09/2023
Assessment Reference	Belmont Close	**Prop Type Ref**	Belmont Close
Property			

SAP Rating	87 B	**DER**	12.03	**TER**	9.11
Environmental	88 B	**% DER < TER**			-32.05
CO₂ Emissions (t/year)	1.55	**DFEE**	38.99	**TFEE**	42.22
Compliance Check	See BREL	**% DFEE < TFEE**			7.65
% DPER < TPER	-38.58	**DPER**	66.56	**TPER**	48.03

Assessor Details	Mr. George Farr	**Assessor ID**	T355-0001

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

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1. Overall dwelling characteristics

		Area (m2)		Storey height (m)		Volume (m3)	
Ground floor		92.5300 (1b)	x	2.8500 (2b)	=	263.7105 (1b)	-
First floor		55.4300 (1c)	x	2.8500 (2c)	=	157.9755 (1c)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	147.9600						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	421.6860	(5)

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2. Ventilation rate

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		m3 per hour	
Number of open chimneys	0 * 80	= 0.0000	(6a)
Number of open flues	0 * 20	= 0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10	= 0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20	= 0.0000	(6d)
Number of flues attached to other heater	0 * 35	= 0.0000	(6e)
Number of blocked chimneys	0 * 20	= 0.0000	(6f)
Number of intermittent extract fans	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)	= 0.0949	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		4.0000	(17)
Infiltration rate		0.2949	(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)	= 0.2506	(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	0.3196	0.3133	0.3070	0.2757	0.2694	0.2381	0.2381	0.2318	0.2506	0.2694	0.2820	0.2945	(22b)
Effective ac	0.5511	0.5491	0.5471	0.5380	0.5363	0.5283	0.5283	0.5269	0.5314	0.5363	0.5397	0.5434	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
DOOR			2.3500	1.0000	2.3500			(26)
G (Uw = 1.00)			35.2200	0.9615	33.8654			(27)
GF			92.5300	0.1200	11.1036	110.0000	10178.3000	(28a)
EW	191.7600	37.5700	154.1900	0.1500	23.1285	60.0000	9251.4000	(29a)
FR	93.4200		93.4200	0.1100	10.2762	9.0000	840.7800	(30)
Total net area of external elements Aum(A, m2)			377.7100					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	80.7237			(33)

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PW	38.8800	0.0000	0.0000	45.0000	1749.6000 (32)
IW	241.2900			9.0000	2171.6100 (32c)
IF	55.4300			18.0000	997.7400 (32d)
IF	55.4300			9.0000	498.8700 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 25688.3000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 173.6165 (35)
Thermal bridges (User defined value 0.030 * total exposed area) 11.3313 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 92.0550 (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	
	4072	76.1367	74.8665	74.6289	73.5226	73.5226	73.3177	73.9487	74.6289	75.1097	75.6123	(38)	
	168.7380	168.4621	168.1917	166.9215	166.6839	165.5776	165.5776	165.3727	166.0037	166.6839	167.1646	167.6672	(39)

Average = Sum(39)m / 12 = 166.9204

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1404	1.1386	1.1367	1.1282	1.1265	1.1191	1.1191	1.1177	1.1219	1.1265	1.1298	1.1332	(40)
HLP (average)												1.1281	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.9310 (42)
Hot water usage for mixer showers

73.3623	72.2598	70.6533	67.5794	65.3110	62.7813	61.3434	62.9378	64.6856	67.4017	70.5416	73.0812	(42a)

Hot water usage for baths

31.6714	31.2011	30.5387	29.3174	28.4029	27.3889	26.8411	27.4989	28.2150	29.3001	30.5465	31.5644	(42b)

Hot water usage for other uses

44.6459	43.0224	41.3989	39.7754	38.1520	36.5285	36.5285	38.1520	39.7754	41.3989	43.0224	44.6459	(42c)

Average daily hot water use (litres/day) 137.5892 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	149.6797	146.4833	142.5909	136.6723	131.8659	126.6986	124.7130	128.5886	132.6760	138.1007	144.1105	149.2915	(44)
Energy conte	237.0560	208.5903	219.1569	187.0975	177.5168	155.7908	150.8296	159.2196	163.6028	187.4014	205.3119	233.7544	(45)

Energy content (annual) Total = Sum(45)m = 2285.3280
Distribution loss (46)m = 0.15 x (45)m

35.5584	31.2885	32.8735	28.0646	26.6275	23.3686	22.6244	23.8829	24.5404	28.1102	30.7968	35.0632	(46)

Water storage loss:
Total storage loss

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

If cylinder contains dedicated solar storage

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss 50.9589	46.0274	50.9589	49.3151	50.9589	49.3151	50.9589	50.9589	49.3151	50.9589	49.3151	50.9589	(61)

Total heat required for water heating calculated for each month

288.0149	254.6177	270.1158	236.4126	228.4757	205.1058	201.7885	210.1785	212.9179	238.3603	254.6269	284.7133	(62)
WWHRS -65.3694	-57.8133	-60.5387	-50.1285	-46.7179	-39.9769	-37.4719	-39.8476	-41.3616	-48.7608	-55.2400	-64.1589	(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

222.6455	196.8044	209.5771	186.2841	181.7578	165.1290	164.3166	170.3309	171.5563	189.5995	199.3869	220.5544	(64)

Total per year (kWh/year) = Sum(64)m = 2277.9425 (64)
12Total per year (kWh/year) 2278 (64)
Electric shower(s)

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

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

91.5608	80.8631	85.6094	74.5387	71.7641	64.1292	62.8906	65.6802	66.7267	75.0507	80.5950	90.4631	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	146.5478	146.5478	146.5478	146.5478	146.5478	146.5478	146.5478	146.5478	146.5478	146.5478	146.5478	146.5478	(66)

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

161.0804	178.3390	161.0804	166.4497	161.0804	166.4497	161.0804	161.0804	166.4497	161.0804	166.4497	161.0804	(67)

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

318.2949	321.5978	313.2746	295.5554	273.1882	252.1662	238.1221	234.8192	243.1425	260.8616	283.2288	304.2509	(68)

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

37.6548	37.6548	37.6548	37.6548	37.6548	37.6548	37.6548	37.6548	37.6548	37.6548	37.6548	37.6548	(69)
Pumps, fans 3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)

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

-117.2382	-117.2382	-117.2382	-117.2382	-117.2382	-117.2382	-117.2382	-117.2382	-117.2382	-117.2382	-117.2382	-117.2382	(71)

Water heating gains (Table 5)

123.0656	120.3320	115.0664	103.5260	96.4571	89.0683	84.5303	88.2799	92.6760	100.8746	111.9374	121.5901	(72)
Total internal gains 672.4052	690.2331	659.3857	635.4955	600.6900	574.6486	550.6972	551.1439	569.2325	592.7809	631.5803	656.8857	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.3400	11.2829	0.5700	0.7000	0.7700	19.7796	(75)
Southeast	12.2100	36.7938	0.5700	0.7000	0.7700	124.2215	(77)
Southwest	16.6700	36.7938	0.5700	0.7000	0.7700	169.5965	(79)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	313.5976	540.7427	757.3188	967.6053	1110.4972	1114.2105	1069.3306	960.9314	829.8616	602.3411	376.8141	267.6000	(83)
Total gains	986.0028	1230.9758	1416.7045	1603.1008	1711.1872	1688.8591	1620.0278	1512.0753	1399.0941	1195.1220	1008.3944	924.4857	(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	42.2883	42.3575	42.4256	42.7485	42.8094	43.0954	43.0954	43.1488	42.9848	42.8094	42.6863	42.5583	
alpha	3.8192	3.8238	3.8284	3.8499	3.8540	3.8730	3.8730	3.8766	3.8657	3.8540	3.8458	3.8372	
util living area	0.9881	0.9728	0.9435	0.8742	0.7530	0.5846	0.4383	0.4850	0.7086	0.9113	0.9768	0.9906	(86)
MIT	19.5954	19.8311	20.1273	20.4746	20.7315	20.8681	20.9070	20.9007	20.8091	20.4557	19.9561	19.5522	(87)
Th 2	19.9680	19.9695	19.9709	19.9779	19.9792	19.9853	19.9853	19.9864	19.9829	19.9792	19.9766	19.9738	(88)
util rest of house	0.9854	0.9666	0.9307	0.8463	0.7013	0.5060	0.3423	0.3858	0.6344	0.8852	0.9705	0.9884	(89)
MIT 2	18.3235	18.6226	18.9941	19.4200	19.7101	19.8487	19.8775	19.8753	19.7982	19.4092	18.7892	18.2729	(90)
Living area fraction									fLA = Living area / (4) =			0.3244	(91)
MIT	18.7361	19.0147	19.3617	19.7621	20.0415	20.1794	20.2114	20.2079	20.1261	19.7487	19.1678	18.6879	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.5861	18.8647	19.2117	19.6121	19.8915	20.0294	20.0614	20.0579	19.9761	19.5987	19.0178	18.5379	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9803	0.9581	0.9191	0.8348	0.6964	0.5096	0.3497	0.3931	0.6339	0.8733	0.9626	0.9841	(94)
Useful gains	966.5706	1179.3963	1302.1052	1338.1988	1191.7506	860.6386	566.4739	594.3948	886.8878	1043.6436	970.6962	909.8034	(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	2410.6129	2352.5201	2138.0044	1788.0838	1365.3879	898.9835	573.1364	604.9249	975.4614	1499.9325	1992.2279	2403.9989	(97)
Space heating kWh	1074.3675	788.3392	621.9090	323.9172	129.1862	0.0000	0.0000	0.0000	0.0000	339.4789	735.5028	1111.6815	(98a)
Space heating requirement - total per year (kWh/year)												5124.3823	
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	1074.3675	788.3392	621.9090	323.9172	129.1862	0.0000	0.0000	0.0000	0.0000	339.4789	735.5028	1111.6815	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												5124.3823	
Space heating per m2											(98c) / (4) =	34.6336	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (201)
Fraction of space heat from main system(s)	1.0000 (202)
Efficiency of main space heating system 1 (in %)	92.0000 (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	1074.3675	788.3392	621.9090	323.9172	129.1862	0.0000	0.0000	0.0000	0.0000	339.4789	735.5028	1111.6815	(98)
Space heating efficiency (main heating system 1)	92.0000	92.0000	92.0000	92.0000	92.0000	0.0000	0.0000	0.0000	0.0000	92.0000	92.0000	92.0000	(210)
Space heating fuel (main heating system)	1167.7907	856.8905	675.9880	352.0839	140.4197	0.0000	0.0000	0.0000	0.0000	368.9989	799.4596	1208.3495	(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	222.6455	196.8044	209.5771	186.2841	181.7578	165.1290	164.3166	170.3309	171.5563	189.5995	199.3869	220.5544	(64)
Efficiency of water heater												80.0000	(216)
(217)m	89.6906	89.3234	88.6484	87.2230	84.5837	80.0000	80.0000	80.0000	80.0000	87.3069	89.1481	89.7707	(217)
Fuel for water heating, kWh/month	248.2374	220.3281	236.4138	213.5723	214.8852	206.4112	205.3957	212.9136	214.4454	217.1643	223.6581	245.6863	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	3.4822	3.1452	3.4822	3.3699	3.4822	3.3699	3.4822	3.4822	3.3699	3.4822	3.3699	3.4822	(231)
Lighting	39.3696	31.5837	28.4376	20.8346	16.0933	13.1483	14.6808	19.0827	24.7865	32.5213	36.7327	40.4638	(232)

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

(233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (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 (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 (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 (235c)

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

(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (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 (234b)

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

	0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)

icity 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 (235d)

Annual totals kWh/year

Space heating fuel - main system 1	5569.9808 (211)
Space heating fuel - main system 2	0.0000 (213)
Space heating fuel - secondary	0.0000 (215)
Efficiency of water heater	80.0000
Water heating fuel used	2659.1115 (219)
Space cooling fuel	0.0000 (221)
Electricity for pumps and fans:	
central heating pump	41.0000 (230c)
Total electricity for the above, kWh/year	41.0000 (231)
Electricity for lighting (calculated in Appendix L)	317.7349 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	0.0000 (233)
Wind generation	0.0000 (234)
Hydro-electric generation (Appendix N)	0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)	0.0000 (235)
Appendix Q - special features	
Energy saved or generated	-0.0000 (236)
Energy used	0.0000 (237)
Total delivered energy for all uses	8587.8272 (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	5569.9808	0.2100	1169.6960	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2659.1115	0.2100	558.4134	(264)
Space and water heating			1728.1094	(265)
Pumps, fans and electric keep-hot	41.0000	0.1387	5.6872	(267)
Energy for lighting	317.7349	0.1443	45.8590	(268)
Total CO2, kg/year			1779.6555	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			12.0300	(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	5569.9808	1.1300	6294.0783	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2659.1115	1.1300	3004.7960	(278)
Space and water heating			9298.8743	(279)
Pumps, fans and electric keep-hot	41.0000	1.5128	62.0248	(281)
Energy for lighting	317.7349	1.5338	487.3524	(282)
Total Primary energy kWh/year			9848.2515	(286)
Dwelling Primary energy Rate (DPER)			66.5600	(287)

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	92.5300 (1b)	x	2.8500 (2b)	=	263.7105 (1b)	-
First floor	55.4300 (1c)	x	2.8500 (2c)	=	157.9755 (1c)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 147.9600						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	421.6860	(5)

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2. Ventilation rate

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		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
	0 * 20 =	0.0000	(6f)
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) =	0.0949	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3449	(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) =	0.2931	(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	0.3737	0.3664	0.3591	0.3224	0.3151	0.2785	0.2785	0.2711	0.2931	0.3151	0.3298	0.3444	(22b)
Effective ac	0.5698	0.5671	0.5645	0.5520	0.5496	0.5388	0.5388	0.5368	0.5430	0.5496	0.5544	0.5593	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.3500	1.0000	2.3500			(26)
TER Opening Type (Uw = 1.20)			34.6500	1.1450	39.6756			(27)
GF			92.5300	0.1300	12.0289			(28a)
EW	191.7600	37.0000	154.7600	0.1800	27.8568			(29a)
FR	93.4200		93.4200	0.1100	10.2762			(30)
Total net area of external elements Aum(A, m2)			377.7100					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	92.1875			(33)
PW			38.8800	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	173.6165 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	9.0500	0.0500	0.4525
E3 Sill	9.0500	0.0500	0.4525
E4 Jamb	19.0600	0.0500	0.9530
E5 Ground floor (normal)	27.8800	0.1600	4.4608
E14 Flat roof	27.8800	0.0800	2.2304
E16 Corner (normal)	9.8000	0.0900	0.8820

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		9.4312 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	101.6187 (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	79.2969	78.9195	78.5496	76.8121	76.4871	74.9738	74.9738	74.6935	75.5567	76.4871	77.1447	77.8322	(38)
Heat transfer coeff	180.9156	180.5382	180.1683	178.4308	178.1057	176.5924	176.5924	176.3122	177.1753	178.1057	178.7634	179.4509	(39)
Average = Sum(39)m / 12 =												178.4293	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2227	1.2202	1.2177	1.2059	1.2037	1.1935	1.1935	1.1916	1.1975	1.2037	1.2082	1.2128	(40)
HLP (average)												1.2059	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.9310	(42)

Hot water usage for mixer showers

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
73.3623	72.2598	70.6533	67.5794	65.3110	62.7813	61.3434	62.9378	64.6856	67.4017	70.5416	73.0812	(42a)

Hot water usage for baths

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
31.6714	31.2011	30.5387	29.3174	28.4029	27.3889	26.8411	27.4989	28.2150	29.3001	30.5465	31.5644	(42b)

Hot water usage for other uses

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
44.6459	43.0224	41.3989	39.7754	38.1520	36.5285	36.5285	38.1520	39.7754	41.3989	43.0224	44.6459	(42c)

Average daily hot water use (litres/day)	137.5892 (43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	149.6797	146.4833	142.5909	136.6723	131.8659	126.6986	124.7130	128.5886	132.6760	138.1007	144.1105	149.2915	(44)
Energy conte	237.0560	208.5903	219.1569	187.0975	177.5168	155.7908	150.8296	159.2196	163.6028	187.4014	205.3119	233.7544	(45)
Energy content (annual)										Total = Sum(45)m =		2285.3280	
Distribution loss (46)m = 0.15 x (45)m	35.5584	31.2885	32.8735	28.0646	26.6275	23.3686	22.6244	23.8829	24.5404	28.1102	30.7968	35.0632	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	50.9589	46.0274	50.9589	49.3151	50.9589	49.3151	50.9589	50.9589	49.3151	50.9589	49.3151	50.9589	(61)
[illegible] heating calculated for each month	[illegible]6177	270.1158	236.4126	228.4757	205.1058	201.7885	210.1785	212.9179	238.3603	254.6269	284.7133		(62)
WWHRS	-33.5382	-29.6615	-31.0598	-25.7187	-23.9689	-20.5104	-19.2252	-20.4441	-21.2208	-25.0170	-28.3412	-32.9171	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	254.4767	224.9562	239.0560	210.6939	204.5068	184.5955	182.5633	189.7344	191.6971	213.3433	226.2857	251.7962	(64)
								Total per year (kWh/year) = Sum(64)m =				2573.7051	(64)
12Total per year (kWh/year)												2574	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
				Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =								0.0000	(64a)
Heat gains from water heating, kWh/month	91.5608	80.8631	85.6094	74.5387	71.7641	64.1292	62.8906	65.6802	66.7267	75.0507	80.5950	90.4631	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts (66)m	146.5478	146.5478	146.5478	146.5478	146.5478	146.5478	146.5478	146.5478	146.5478	146.5478	146.5478	146.5478	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	160.5432	177.7443	160.5432	165.8946	160.5432	165.8946	160.5432	160.5432	165.8946	160.5432	165.8946	160.5432	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	318.2949	321.5978	313.2746	295.5554	273.1882	252.1662	238.1221	234.8192	243.1425	260.8616	283.2288	304.2509	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.6548	37.6548	37.6548	37.6548	37.6548	37.6548	37.6548	37.6548	37.6548	37.6548	37.6548	37.6548	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-117.2382	-117.2382	-117.2382	-117.2382	-117.2382	-117.2382	-117.2382	-117.2382	-117.2382	-117.2382	-117.2382	-117.2382	(71)
Water heating gains (Table 5)	123.0656	120.3320	115.0664	103.5260	96.4571	89.0683	84.5303	88.2799	92.6760	100.8746	111.9374	121.5901	(72)
Total internal gains	671.8680	689.6384	658.8485	634.9404	600.1528	574.0935	550.1600	550.6067	568.6774	592.2437	631.0252	656.3485	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.2400	11.2829	0.6300	0.7000	0.7700	21.5169	(75)
Southeast	12.0100	36.7938	0.6300	0.7000	0.7700	135.0485	(77)
Southwest	16.4000	36.7938	0.6300	0.7000	0.7700	184.4126	(79)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	340.9780	587.9588	823.4546	1052.1199	1207.5056	1211.5488	1162.7458	1044.8681	902.3375	654.9382	409.7146	290.9639	(83)
Total gains	1012.8461	1277.5971	1482.3031	1687.0603	1807.6584	1785.6423	1712.9059	1595.4747	1471.0149	1247.1819	1040.7399	947.3125	(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	39.4418	39.5243	39.6054	39.9911	40.0641	40.4074	40.4074	40.4716	40.2744	40.0641	39.9167	39.7637	
alpha	3.6295	3.6350	3.6404	3.6661	3.6709	3.6938	3.6938	3.6981	3.6850	3.6709	3.6611	3.6509	
util living area	0.9873	0.9711	0.9408	0.8706	0.7503	0.5844	0.4399	0.4870	0.7086	0.9092	0.9756	0.9899	(86)
MIT	19.1024	19.4350	19.8552	20.3493	20.7170	20.9180	20.9778	20.9678	20.8299	20.3226	19.6156	19.0455	(87)
Th 2	19.9019	19.9039	19.9059	19.9153	19.9170	19.9252	19.9252	19.9267	19.9220	19.9170	19.9135	19.9097	(88)
util rest of house	0.9843	0.9645	0.9271	0.8412	0.6964	0.5021	0.3385	0.3823	0.6313	0.8818	0.9688	0.9875	(89)
MIT 2	17.7025	18.1241	18.6503	19.2546	19.6694	19.8720	19.9162	19.9124	19.7974	19.2397	18.3634	17.6353	(90)
Living area fraction									fLA = Living area / (4) =			0.3244	(91)
MIT	18.1567	18.5494	19.0412	19.6097	20.0093	20.2114	20.2606	20.2548	20.1324	19.5910	18.7696	18.0928	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.1567	18.5494	19.0412	19.6097	20.0093	20.2114	20.2606	20.2548	20.1324	19.5910	18.7696	18.0928	(93)

Full SAP Calculation Printout elmhurst energy

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9774	0.9536	0.9137	0.8317	0.7014	0.5250	0.3709	0.4154	0.6477	0.8717	0.9591	0.9817	(94)
Useful gains	989.9984	1218.2761	1354.3065	1403.1645	1267.8865	937.4644	635.3128	662.7175	952.7386	1087.2227	998.1829	929.9551	(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	2506.8848	2464.2311	2259.5180	1910.9479	1479.9252	990.9233	646.4293	679.6459	1068.7850	1601.3526	2086.1038	2493.0680	(97)
Space heating kWh	1128.5635	837.2818	673.4774	365.6040	157.7568	0.0000	0.0000	0.0000	0.0000	382.5126	783.3030	1162.9560	(98a)
Space heating requirement - total per year (kWh/year)												5491.4551	
Solar heating kWh	[illegible]	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
[illegible] total per year (kWh/year)												0.0000	
Space heating kWh	1128.5635	837.2818	673.4774	365.6040	157.7568	0.0000	0.0000	0.0000	0.0000	382.5126	783.3030	1162.9560	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												5491.4551	
Space heating per m2											(98c) / (4) =	37.1145	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	92.4000	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1128.5635	837.2818	673.4774	365.6040	157.7568	0.0000	0.0000	0.0000	0.0000	382.5126	783.3030	1162.9560	(98)
Space heating efficiency (main heating system 1)	92.4000	92.4000	92.4000	92.4000	92.4000	0.0000	0.0000	0.0000	0.0000	92.4000	92.4000	92.4000	(210)
Space heating fuel (main heating system)	1221.3890	906.1491	728.8716	395.6753	170.7325	0.0000	0.0000	0.0000	0.0000	413.9747	847.7306	1258.6104	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water heating requirement	254.4767	224.9562	239.0560	210.6939	204.5068	184.5955	182.5633	189.7344	191.6971	213.3433	226.2857	251.7962	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.1820	86.9284	86.4738	85.5503	83.8316	80.3000	80.3000	80.3000	80.3000	85.6169	86.8160	87.2371	(217)
Fuel for water heating, kWh/month	291.8913	258.7834	276.4490	246.2808	243.9496	229.8823	227.3516	236.2820	238.7261	249.1835	260.6497	288.6342	(219)
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	33.3577	26.7608	24.0951	17.6531	13.6358	11.1405	12.4390	16.1687	21.0015	27.5552	31.1235	34.2848	(232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-75.7581	-101.7352	-139.3381	-148.9742	-154.3440	-141.7236	-139.7711	-134.8114	-125.4521	-112.3398	-81.3729	-66.0906	(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	-59.7240	-123.2094	-240.6263	-355.5021	-464.6210	-465.0264	-459.7204	-391.8490	-290.6169	-174.3808	-79.1071	-47.4326	(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	5943.1332	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	80.3000	
Water heating fuel used	3048.0634	(219)
Space cooling fuel	0.0000	(221)

Electricity for pumps and fans:

Total electricity for the above, kWh/year	86.0000	(231)
Electricity for lighting (calculated in Appendix L)	269.2158	(232)

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

PV generation	-4573.5271	(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	4772.8853	(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	5943.1332	0.2100	1248.0580	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3048.0634	0.2100	640.0933	(264)
Space and water heating			1888.1513	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	269.2158	0.1443	38.8562	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1421.7112	0.1357	-192.8854	
PV Unit electricity exported	-3151.8159	0.1264	-398.3280	
Total			-591.2134	(269)
Total CO2, kg/year			1347.7233	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			9.1100	(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	5943.1332	1.1300	6715.7405	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3048.0634	1.1300	3444.3117	(278)
Space and water heating			10160.0522	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	269.2158	1.5338	412.9322	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1421.7112	1.5015	-2134.6679	
PV Unit electricity exported	-3151.8159	0.4639	-1462.2038	
Total			-3596.8717	(283)
Total Primary energy kWh/year			7106.2134	(286)
Target Primary Energy Rate (TPER)			48.0300	(287)

Property Reference	Sample 3			**Issued on Date**	26/09/2023
Assessment Reference	Belmont Close		**Prop Type Ref**	Belmont Close	
Property					

SAP Rating	86 B	**DER**	12.85	**TER**	11.08
Environmental	88 B	**% DER < TER**			-15.97
CO_2 Emissions (t/year)	1.23	**DFEE**	37.61	**TFEE**	42.23
Compliance Check	See BREL	**% DFEE < TFEE**			10.93
% DPER < TPER	-22.97	**DPER**	71.25	**TPER**	57.94

Assessor Details	Mr. George Farr	**Assessor ID**	T355-0001

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

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1. Overall dwelling characteristics

		Area (m2)		Storey height (m)		Volume (m3)	
Ground floor		58.5700 (1b)	x	2.8500 (2b)	=	166.9245 (1b)	-
First floor		50.5000 (1c)	x	2.8500 (2c)	=	143.9250 (1c)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	109.0700						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	310.8495	(5)

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2. Ventilation rate

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		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	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) =	0.1287	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		4.0000	(17)
Infiltration rate		0.3287	(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) =	0.2794	(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	0.3562	0.3492	0.3422	0.3073	0.3003	0.2654	0.2654	0.2584	0.2794	0.3003	0.3143	0.3283	(22b)
Effective ac	0.5634	0.5610	0.5586	0.5472	0.5451	0.5352	0.5352	0.5334	0.5390	0.5451	0.5494	0.5539	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
DOOR			2.3500	1.0000	2.3500			(26)
G (Uw = 1.00)			27.2400	0.9615	26.1923			(27)
GF			58.5700	0.1200	7.0284	110.0000	6442.7000	(28a)
EW	149.6200	29.5900	120.0300	0.1500	18.0045	60.0000	7201.8000	(29a)
FR	59.5600		59.5600	0.1100	6.5516	9.0000	536.0400	(30)
Total net area of external elements Aum(A, m2)			267.7500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	60.1268			(33)

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PW	44.9900	0.0000	0.0000	45.0000	2024.5500 (32)
IW	177.1000			9.0000	1593.9000 (32c)
IF	50.5000			18.0000	909.0000 (32d)
IF	50.5000			9.0000	454.5000 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 19162.4900 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 175.6898 (35)
Thermal bridges (User defined value 0.030 * total exposed area) 8.0325 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 68.1593 (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	
	5453	57.2976	56.1342	55.9165	54.9031	54.9031	54.7155	55.2935	55.9165	56.3568	56.8172	(38)	
	125.9573	125.7046	125.4569	124.2935	124.0758	123.0624	123.0624	122.8748	123.4528	124.0758	124.5161	124.9765	(39)

Average = Sum(39)m / 12 = 124.2924

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1548	1.1525	1.1502	1.1396	1.1376	1.1283	1.1283	1.1266	1.1319	1.1376	1.1416	1.1458	(40)
HLP (average)												1.1396	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.8091 (42)
Hot water usage for mixer showers

71.3196	70.2478	68.6860	65.6978	63.4925	61.0332	59.6354	61.1854	62.8845	65.5250	68.5774	71.0464	(42a)

Hot water usage for baths

30.7930	30.3357	29.6917	28.5043	27.6151	26.6292	26.0967	26.7362	27.4325	28.4874	29.6993	30.6889	(42b)

Hot water usage for other uses

43.3983	41.8201	40.2420	38.6639	37.0858	35.5077	35.5077	37.0858	38.6639	40.2420	41.8201	43.3983	(42c)

Average daily hot water use (litres/day) 133.7572 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	145.5109	142.4037	138.6197	132.8659	128.1934	123.1701	121.2397	125.0073	128.9808	134.2544	140.0969	145.1335	(44)
Energy conte	230.4537	202.7809	213.0534	181.8868	172.5730	151.4520	146.6290	154.7852	159.0463	182.1820	199.5937	227.2440	(45)

Energy content (annual) Total = Sum(45)m = 2221.6800

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

34.5681	30.4171	31.9580	27.2830	25.8859	22.7178	21.9943	23.2178	23.8569	27.3273	29.9391	34.0866	(46)

Water storage loss:
Total storage loss

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

If cylinder contains dedicated solar storage

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss 50.9589	46.0274	50.9589	49.3151	50.9589	49.3151	50.9589	50.9589	49.3151	50.9589	49.3151	50.9589	(61)

Total heat required for water heating calculated for each month

281.4126	248.8083	264.0123	231.2019	223.5319	200.7671	197.5879	205.7441	208.3613	233.1409	248.9087	278.2030	(62)
WWHRS -63.5493	-56.2035	-58.8531	-48.7327	-45.4171	-38.8637	-36.4286	-38.7381	-40.2099	-47.4031	-53.7019	-62.3725	(63a)
PV diverter 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63b)
Solar input 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)

Output from w/h

217.8633	192.6048	205.1592	182.4692	178.1148	161.9034	161.1593	167.0060	168.1514	185.7378	195.2068	215.8305	(64)

Total per year (kWh/year) = Sum(64)m = 2231.2065 (64)
12Total per year (kWh/year) 2231 (64)
Electric shower(s)

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

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

Heat gains from water heating, kWh/month

89.3656	78.9315	83.5800	72.8061	70.1202	62.6866	61.4939	64.2058	65.2117	73.3152	78.6937	88.2984	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	140.4563	140.4563	140.4563	140.4563	140.4563	140.4563	140.4563	140.4563	140.4563	140.4563	140.4563	140.4563	(66)

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

136.3702	150.9813	136.3702	140.9159	136.3702	140.9159	136.3702	136.3702	140.9159	136.3702	140.9159	136.3702	(67)

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

270.2130	273.0170	265.9511	250.9086	231.9202	214.0738	202.1513	199.3473	206.4132	221.4557	240.4441	258.2905	(68)

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

37.0456	37.0456	37.0456	37.0456	37.0456	37.0456	37.0456	37.0456	37.0456	37.0456	37.0456	37.0456	(69)
Pumps, fans 3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)

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

-112.3651	-112.3651	-112.3651	-112.3651	-112.3651	-112.3651	-112.3651	-112.3651	-112.3651	-112.3651	-112.3651	-112.3651	(71)

Water heating gains (Table 5)

120.1150	117.4576	112.3387	101.1196	94.2476	87.0647	82.6530	86.2981	90.5717	98.5420	109.2968	118.6806	(72)

Total internal gains

594.8352	609.5928	582.7969	561.0810	530.6749	507.1912	486.3114	487.1525	503.0377	524.5048	558.7936	581.4782	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.3600	11.2829	0.5700	0.7000	0.7700	19.8420	(75)
Southeast	2.3500	36.7938	0.5700	0.7000	0.7700	23.9083	(77)
Southwest	18.5300	36.7938	0.5700	0.7000	0.7700	188.5196	(79)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	232.2700	402.2324	567.8580	732.9465	847.7440	853.3945	817.8607	730.4155	624.7467	449.2726	279.4061	197.9980	(83)
Total gains	827.1051	1011.8252	1150.6548	1294.0275	1378.4190	1360.5857	1304.1720	1217.5680	1127.7844	973.7773	838.1997	779.4763	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	42.2597	42.3446	42.4282	42.8254	42.9005	43.2538	43.2538	43.3198	43.1170	42.9005	42.7488	42.5913	
alpha	3.8173	3.8230	3.8285	3.8550	3.8600	3.8836	3.8836	3.8880	3.8745	3.8600	3.8499	3.8394	
util living area	0.9826	0.9634	0.9285	0.8491	0.7185	0.5475	0.4071	0.4513	0.6717	0.8890	0.9674	0.9859	(86)
MIT	19.6769	19.9091	20.1961	20.5285	20.7620	20.8792	20.9103	20.9054	20.8291	20.5096	20.0317	19.6358	(87)
Th 2	19.9563	19.9582	19.9600	19.9686	19.9703	19.9778	19.9778	19.9792	19.9749	19.9703	19.9670	19.9636	(88)
util rest of house	0.9786	0.9554	0.9130	0.8176	0.6645	0.4707	0.3162	0.3568	0.5961	0.8581	0.9589	0.9826	(89)
MIT 2	18.4168	18.7101	19.0677	19.4721	19.7310	19.8493	19.8717	19.8706	19.8069	19.4621	18.8750	18.3702	(90)
Living area fraction									fLA = Living area / (4) =			0.3754	(91)
MIT	18.8899	19.1603	19.4914	19.8687	20.1181	20.2360	20.2616	20.2591	20.1907	19.8554	19.3093	18.8453	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.7399	19.0103	19.3414	19.7187	19.9681	20.0860	20.1116	20.1091	20.0407	19.7054	19.1593	18.6953	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9725	0.9462	0.9019	0.8090	0.6644	0.4792	0.3283	0.3691	0.6014	0.8487	0.9502	0.9773	(94)
Useful gains	804.3210	957.3580	1037.7773	1046.8571	915.7798	651.9953	428.1692	449.4586	678.2119	826.4488	796.4894	761.7482	(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	1818.8134	1773.7281	1611.0391	1344.6977	1025.8729	675.1216	432.1488	455.7601	733.3978	1129.7609	1501.5762	1811.5779	(97)
Space heating kWh	754.7824	548.6007	426.5068	214.4453	81.9092	0.0000	0.0000	0.0000	0.0000	225.6643	507.6625	781.0733	(98a)
Space heating requirement - total per year (kWh/year)												3540.6444	
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	754.7824	548.6007	426.5068	214.4453	81.9092	0.0000	0.0000	0.0000	0.0000	225.6643	507.6625	781.0733	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3540.6444	
Space heating per m2											(98c) / (4) =	32.4621	(99)

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

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

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

Efficiency of main space heating system 1 (in %) 92.0000 (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	754.7824	548.6007	426.5068	214.4453	81.9092	0.0000	0.0000	0.0000	0.0000	225.6643	507.6625	781.0733	(98)
Space heating efficiency (main heating system 1)	92.0000	92.0000	92.0000	92.0000	92.0000	0.0000	0.0000	0.0000	0.0000	92.0000	92.0000	92.0000	(210)
Space heating fuel (main heating system)	820.4157	596.3052	463.5944	233.0927	89.0318	0.0000	0.0000	0.0000	0.0000	245.2872	551.8071	848.9927	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	217.8633	192.6048	205.1592	182.4692	178.1148	161.9034	161.1593	167.0060	168.1514	185.7378	195.2068	215.8305	(64)
Efficiency of water heater												80.0000	(216)
(217)m	89.0094	88.5486	87.7261	86.0651	83.4279	80.0000	80.0000	80.0000	80.0000	86.1648	88.3206	89.1063	(217)
Fuel for water heating, kWh/month	244.7643	217.5132	233.8633	212.0129	213.4956	202.3792	201.4491	208.7575	210.1893	215.5611	221.0206	242.2170	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	3.4822	3.1452	3.4822	3.3699	3.4822	3.3699	3.4822	3.4822	3.3699	3.4822	3.3699	3.4822	(231)
Lighting	31.9800	25.6555	23.0999	16.9240	13.0726	10.6804	11.9253	15.5009	20.1341	26.4171	29.8380	32.8688	(232)

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Electricity generated by PVs (Appendix M) (negative quantity)
(233a)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)
(234a)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)
(235a)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)
(235c)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)
(233b)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)
(234b)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)
0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (235b)
icity 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 3848.5266 (211)
Space heating fuel - main system 2 0.0000 (213)
Space heating fuel - secondary 0.0000 (215)
Efficiency of water heater 80.0000
Water heating fuel used 2623.2232 (219)
Space cooling fuel 0.0000 (221)

Electricity for pumps and fans:
central heating pump 41.0000 (230c)
Total electricity for the above, kWh/year 41.0000 (231)
Electricity for lighting (calculated in Appendix L) 258.0966 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV generation 0.0000 (233)
Wind generation 0.0000 (234)
Hydro-electric generation (Appendix N) 0.0000 (235a)
Electricity generated - Micro CHP (Appendix N) 0.0000 (235)
Appendix Q - special features
Energy saved or generated -0.0000 (236)
Energy used 0.0000 (237)
Total delivered energy for all uses 6770.8463 (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	3848.5266	0.2100	808.1906	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2623.2232	0.2100	550.8769	(264)
Space and water heating			1359.0675	(265)
Pumps, fans and electric keep-hot	41.0000	0.1387	5.6872	(267)
Energy for lighting	258.0966	0.1443	37.2513	(268)
Total CO2, kg/year			1402.0060	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			12.8500	(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	3848.5266	1.1300	4348.8350	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2623.2232	1.1300	2964.2422	(278)
Space and water heating			7313.0773	(279)
Pumps, fans and electric keep-hot	41.0000	1.5128	62.0248	(281)
Energy for lighting	258.0966	1.5338	395.8771	(282)
Total Primary energy kWh/year			7770.9792	(286)
Dwelling Primary energy Rate (DPER)			71.2500	(287)

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	58.5700 (1b)	x	2.8500 (2b)	=	166.9245 (1b)	-
First floor	50.5000 (1c)	x	2.8500 (2c)	=	143.9250 (1c)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 109.0700						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	310.8495	(5)

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2. Ventilation rate

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		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
	0 * 20 =	0.0000	(6f)
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) =	0.1287	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3787	(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) =	0.3219	(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	0.4104	0.4023	0.3943	0.3541	0.3460	0.3058	0.3058	0.2977	0.3219	0.3460	0.3621	0.3782	(22b)
Effective ac	0.5842	0.5809	0.5777	0.5627	0.5599	0.5468	0.5468	0.5443	0.5518	0.5599	0.5656	0.5715	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.3500	1.0000	2.3500			(26)
TER Opening Type (Uw = 1.20)			24.9200	1.1450	28.5344			(27)
GF			58.5700	0.1300	7.6141			(28a)
EW	149.6200	27.2700	122.3500	0.1800	22.0230			(29a)
FR	59.5600		59.5600	0.1100	6.5516			(30)
Total net area of external elements Aum(A, m2)			267.7500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		67.0731			(33)
PW			44.9900	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 175.6898 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	9.0500	0.0500	0.4525
E3 Sill	9.0500	0.0500	0.4525
E4 Jamb	19.0600	0.0500	0.9530
E5 Ground floor (normal)	27.8800	0.1600	4.4608
E14 Flat roof	27.8800	0.0800	2.2304
E16 Corner (normal)	9.8000	0.0900	0.8820

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 9.4312 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 76.5043 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	59.9286	59.5932	59.2644	57.7200	57.4311	56.0860	56.0860	55.8369	56.6041	57.4311	58.0156	58.6267	(38)
Heat transfer coeff	136.4329	136.0974	135.7686	134.2243	133.9353	132.5902	132.5902	132.3412	133.1083	133.9353	134.5199	135.1310	(39)

Average = Sum(39)m / 12 = 134.2229

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2509	1.2478	1.2448	1.2306	1.2280	1.2156	1.2156	1.2134	1.2204	1.2280	1.2333	1.2389	(40)
HLP (average)												1.2306	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.8091 (42)

Hot water usage for mixer showers

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
71.3196	70.2478	68.6860	65.6978	63.4925	61.0332	59.6354	61.1854	62.8845	65.5250	68.5774	71.0464	(42a)

Hot water usage for baths

30.7930	30.3357	29.6917	28.5043	27.6151	26.6292	26.0967	26.7362	27.4325	28.4874	29.6993	30.6889	(42b)

Hot water usage for other uses

43.3983	41.8201	40.2420	38.6639	37.0858	35.5077	35.5077	37.0858	38.6639	40.2420	41.8201	43.3983	(42c)

Average daily hot water use (litres/day) 133.7572 (43)

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

```
Daily hot water use
                 145.5109    142.4037    138.6197    132.8659    128.1934    123.1701    121.2397    125.0073    128.9808    134.2544    140.0969    145.1335 (44)
Energy conte     230.4537    202.7809    213.0534    181.8868    172.5730    151.4520    146.6290    154.7852    159.0463    182.1820    199.5937    227.2440 (45)
Energy content (annual)                                                                                                          Total = Sum(45)m =    2221.6800
Distribution loss  (46)m = 0.15 x (45)m
                  34.5681     30.4171     31.9580     27.2830     25.8859     22.7178     21.9943     23.2178     23.8569     27.3273     29.9391     34.0866 (46)
Water storage loss:
Total storage loss
                   0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000 (56)
If cylinder contains dedicated solar storage
                   0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000 (57)
Primary loss       0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000 (59)
Combi loss        50.9589     46.0274     50.9589     49.3151     50.9589     49.3151     50.9589     50.9589     49.3151     50.9589     49.3151     50.9589 (61)
                                    heating calculated for each month
                     8083    264.0123    231.2019    223.5319    200.7671    197.5879    205.7441    208.3613    233.1409    248.9087    278.2030 (62)
WWHRS            -32.6044    -28.8356    -30.1949    -25.0026    -23.3015    -19.9393    -18.6899    -19.8748    -20.6299    -24.3204    -27.5521    -32.0006 (63a)
PV diverter       -0.0000     -0.0000     -0.0000     -0.0000     -0.0000     -0.0000     -0.0000     -0.0000     -0.0000     -0.0000     -0.0000     -0.0000 (63b)
Solar input        0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000 (63c)
FGHRS              0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000 (63d)
Output from w/h
                 248.8082    219.9728    233.8173    206.1993    200.2304    180.8278    178.8980    185.8693    187.7314    208.8205    221.3566    246.2024 (64)
                                                                                      Total per year (kWh/year) = Sum(64)m =    2518.7339 (64)
12Total per year (kWh/year)                                                                                                          2519 (64)
Electric shower(s)
                   0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000 (64a)
                                                     Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =      0.0000 (64a)
Heat gains from water heating, kWh/month
                  89.3656     78.9315     83.5800     72.8061     70.1202     62.6866     61.4939     64.2058     65.2117     73.3152     78.6937     88.2984 (65)
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5. Internal gains (see Table 5 and 5a)
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Metabolic gains (Table 5), Watts
                      Jan         Feb         Mar         Apr         May         Jun         Jul         Aug         Sep         Oct         Nov         Dec
(66)m            140.4563    140.4563    140.4563    140.4563    140.4563    140.4563    140.4563    140.4563    140.4563    140.4563    140.4563    140.4563 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                 136.2914    150.8941    136.2914    140.8345    136.2914    140.8345    136.2914    136.2914    140.8345    136.2914    140.8345    136.2914 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
                 270.2130    273.0170    265.9511    250.9086    231.9202    214.0738    202.1513    199.3473    206.4132    221.4557    240.4441    258.2905 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                  37.0456     37.0456     37.0456     37.0456     37.0456     37.0456     37.0456     37.0456     37.0456     37.0456     37.0456     37.0456 (69)
Pumps, fans        3.0000      3.0000      3.0000      3.0000      3.0000      0.0000      0.0000      0.0000      0.0000      3.0000      3.0000      3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
                -112.3651   -112.3651   -112.3651   -112.3651   -112.3651   -112.3651   -112.3651   -112.3651   -112.3651   -112.3651   -112.3651   -112.3651 (71)
Water heating gains (Table 5)
                 120.1150    117.4576    112.3387    101.1196     94.2476     87.0647     82.6530     86.2981     90.5717     98.5420    109.2968    118.6806 (72)
Total internal gains
                 594.7564    609.5056    582.7181    560.9997    530.5962    507.1099    486.2326    487.0738    502.9563    524.4260    558.7122    581.3995 (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
-----------------------------------------------------------------------------------------------------
Northeast                                  5.8200            11.2829          0.6300          0.7000            0.7700            20.0686 (75)
Southeast                                  2.1500            36.7938          0.6300          0.7000            0.7700            24.1760 (77)
Southwest                                 16.9500            36.7938          0.6300          0.7000            0.7700           190.5972 (79)
-----------------------------------------------------------------------------------------------------

Solar gains      234.8419    406.6886    574.1551    741.0840    857.1645    862.8814    826.9511    738.5281    631.6779    454.2515    282.5004    200.1902 (83)
Total gains      829.5983   1016.1942   1156.8732   1302.0836   1387.7607   1369.9912   1313.1837   1225.6019   1134.6342    978.6775    841.2126    781.5897 (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               39.0149     39.1111     39.2058     39.6569     39.7424     40.1456     40.1456     40.2212     39.9893     39.7424     39.5697     39.3908
alpha              3.6010      3.6074      3.6137      3.6438      3.6495      3.6764      3.6764      3.6814      3.6660      3.6495      3.6380      3.6261
util living area
                   0.9831      0.9655      0.9339      0.8619      0.7406      0.5741      0.4315      0.4769      0.6961      0.8983      0.9691      0.9862 (86)

MIT               19.1648     19.4808     19.8841     20.3674     20.7253     20.9214     20.9787     20.9693     20.8375     20.3519     19.6715     19.1136 (87)
Th 2              19.8795     19.8820     19.8843     19.8956     19.8977     19.9075     19.9075     19.9093     19.9037     19.8977     19.8934     19.8890 (88)
util rest of house
                   0.9791      0.9576      0.9188      0.8309      0.6853      0.4911      0.3300      0.3723      0.6172      0.8681      0.9608      0.9829 (89)
MIT 2             17.7653     18.1648     18.6685     19.2583     19.6598     19.8573     19.8990     19.8960     19.7866     19.2573     18.4180     17.7066 (90)
Living area fraction                                                                                     fLA = Living area / (4) =      0.3754 (91)
MIT               18.2907     18.6589     19.1249     19.6747     20.0598     20.2568     20.3044     20.2990     20.1811     19.6682     18.8886     18.2349 (92)
Temperature adjustment                                                                                                                0.0000
adjusted MIT      18.2907     18.6589     19.1249     19.6747     20.0598     20.2568     20.3044     20.2990     20.1811     19.6682     18.8886     18.2349 (93)


-----------------------------------------------------------------------------------------------------
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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9712	0.9464	0.9062	0.8238	0.6940	0.5187	0.3677	0.4107	0.6387	0.8606	0.9506	0.9760	(94)
Useful gains	805.7458	961.6957	1048.3455	1072.6812	963.1695	710.6270	482.8131	503.4136	724.6419	842.2616	799.6738	762.8160	(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	1908.7971	1872.5480	1714.0604	1446.2277	1119.6785	750.0389	491.1696	515.9982	809.4508	1214.5589	1585.8057	1896.5481	(97)
Space heating kWh	820.6701	612.0927	495.2918	268.9535	116.4427	0.0000	0.0000	0.0000	0.0000	276.9892	566.0150	843.4967	(98a)
Space heating requirement - total per year (kWh/year)												3999.9517	
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)
[illegible]otal per year (kWh/year)												0.0000	
Space heating kWh	820.6701	612.0927	495.2918	268.9535	116.4427	0.0000	0.0000	0.0000	0.0000	276.9892	566.0150	843.4967	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3999.9517	
Space heating per m2											(98c) / (4) =	36.6733	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	92.4000	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	820.6701	612.0927	495.2918	268.9535	116.4427	0.0000	0.0000	0.0000	0.0000	276.9892	566.0150	843.4967	(98)
Space heating efficiency (main heating system 1)	92.4000	92.4000	92.4000	92.4000	92.4000	0.0000	0.0000	0.0000	0.0000	92.4000	92.4000	92.4000	(210)
Space heating fuel (main heating system)	888.1712	662.4380	536.0301	291.0752	126.0202	0.0000	0.0000	0.0000	0.0000	299.7719	612.5703	912.8752	(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	248.8082	219.9728	233.8173	206.1993	200.2304	180.8278	178.8980	185.8693	187.7314	208.8205	221.3566	246.2024	(64)
Efficiency of water heater												80.3000	(216)
(217)m	86.7388	86.4522	85.9481	84.9517	83.2617	80.3000	80.3000	80.3000	80.3000	84.9876	86.3016	86.7997	(217)
Fuel for water heating, kWh/month	286.8476	254.4443	272.0448	242.7253	240.4831	225.1903	222.7870	231.4686	233.7875	245.7070	256.4921	283.6444	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	28.3187	22.7183	20.4553	14.9864	11.5759	9.4576	10.5600	13.7262	17.8290	23.3927	26.4220	29.1057	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-52.1351	-72.1815	-101.9048	-112.4470	-119.4492	-110.7943	-109.3419	-104.0389	-94.5052	-81.4368	-56.8112	-45.2232	(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	-33.6229	-70.2048	-138.6065	-206.8784	-272.3458	-273.2686	-270.1266	-229.3287	-168.8598	-100.0526	-44.7700	-26.6351	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)

Annual totals kWh/year		
Space heating fuel - main system 1	4328.9521	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	80.3000	
Water heating fuel used	2995.6220	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
Total electricity for the above, kWh/year	86.0000	(231)
Electricity for lighting (calculated in Appendix L)	228.5479	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-2894.9690	(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	4744.1530	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4328.9521	0.2100	909.0799	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2995.6220	0.2100	629.0806	(264)
Space and water heating			1538.1606	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	228.5479	0.1443	32.9865	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1060.2691	0.1350	-143.1252	
PV Unit electricity exported	-1834.6999	0.1261	-231.3109	
Total			-374.4362	(269)
Total CO2, kg/year			1208.6402	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			11.0800	(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	4328.9521	1.1300	4891.7159	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2995.6220	1.1300	3385.0529	(278)
Space and water heating			8276.7687	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	228.5479	1.5338	350.5544	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1060.2691	1.4989	-1589.2596	
PV Unit electricity exported	-1834.6999	0.4628	-849.0844	
Total			-2438.3439	(283)
Total Primary energy kWh/year			6319.0800	(286)
Target Primary Energy Rate (TPER)			57.9400	(287)

Appendix C

Generating energy on-site:-

SAP Outputs & Dwelling Emission Rates

Property Reference	Sample 1			**Issued on Date**	28/11/2023
Assessment Reference	Belmont Close		**Prop Type Ref**	Belmont Close	
Property					

SAP Rating	89 B	**DER**	1.63	**TER**	11.16
Environmental	99 A	**% DER < TER**			85.39
CO_2 Emissions (t/year)	0.11	**DFEE**	41.87	**TFEE**	46.76
Compliance Check	See BREL	**% DFEE < TFEE**			10.46
% DPER < TPER	52.60	**DPER**	27.81	**TPER**	58.67

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Assessor Details	Mr. George Farr	**Assessor ID**	T355-0001
Client			

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	70.6200 (1b)	x	2.8500 (2b)	=	201.2670	(1b) - (3b)
First floor	34.1100 (1c)	x	2.8500 (2c)	=	97.2135	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	104.7300					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	298.4805	(5)

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2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1005	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		4.0000	(17)
Infiltration rate		0.3005	(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) =	0.2554	(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	0.3257	0.3193	0.3129	0.2810	0.2746	0.2427	0.2427	0.2363	0.2554	0.2746	0.2874	0.3001	(22b)
Effective ac	0.5530	0.5510	0.5490	0.5395	0.5377	0.5294	0.5294	0.5279	0.5326	0.5377	0.5413	0.5450	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
DOOR			2.3500	1.0000	2.3500			(26)
G (Uw = 1.00)			22.4100	0.9615	21.5481			(27)
GF			70.6200	0.1200	8.4744	110.0000	7768.2000	(28a)
EW	142.5700	24.7600	117.8100	0.1500	17.6715	60.0000	7068.6000	(29a)
FR	70.6200		70.6200	0.1100	7.7682	9.0000	635.5800	(30)
Total net area of external elements Aum(A, m2)			283.8100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		57.8122			(33)
PW			28.7700	0.0000	0.0000	45.0000	1294.6500	(32)
IW			165.9900			9.0000	1493.9100	(32c)
IF			34.1100			18.0000	613.9800	(32d)
IF			34.1100			9.0000	306.9900	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	19181.9100	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		183.1558	(35)
Thermal bridges (User defined value 0.030 * total exposed area)		8.5143	(36)
Point Thermal bridges	(36a) =	0.0000	
Total fabric heat loss	(33) + (36) + (36a) =	66.3265	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.4729	54.2701	54.0713	53.1374	52.9627	52.1493	52.1493	51.9987	52.4626	52.9627	53.3161	53.6857	(38)
Heat transfer coeff													
	120.7994	120.5966	120.3977	119.4639	119.2891	118.4758	118.4758	118.3251	118.7891	119.2891	119.6426	120.0121	(39)
Average = Sum(39)m / 12 =												119.4630	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1534	1.1515	1.1496	1.1407	1.1390	1.1312	1.1312	1.1298	1.1342	1.1390	1.1424	1.1459	(40)
HLP (average)												1.1407	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.7792	(42)
Hot water usage for mixer showers													
	70.8180	69.7538	68.2029	65.2357	63.0460	60.6040	59.2159	60.7550	62.4422	65.0641	68.0951	70.5467	(42a)
Hot water usage for baths													
	30.5773	30.1232	29.4837	28.3046	27.4217	26.4427	25.9139	26.5489	27.2403	28.2879	29.4913	30.4739	(42b)
Hot water usage for other uses													
	43.0919	41.5249	39.9579	38.3910	36.8240	35.2570	35.2570	36.8240	38.3910	39.9579	41.5249	43.0919	(42c)
Average daily hot water use (litres/day)												132.8163	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	144.4872	141.4019	137.6446	131.9312	127.2916	122.3037	120.3868	124.1279	128.0735	133.3099	139.1113	144.1125	(44)
Energy conte	228.8324	201.3544	211.5546	180.6073	171.3590	150.3866	145.5974	153.6963	157.9274	180.9003	198.1895	225.6454	(45)
Energy content (annual)										Total = Sum(45)m =		2206.0506	
Distribution loss (46)m = 0.15 x (45)m													
	34.3249	30.2032	31.7332	27.0911	25.7038	22.5580	21.8396	23.0544	23.6891	27.1350	29.7284	33.8468	(46)
Water storage loss:													
Store volume												145.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.1800	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.6372	(55)
Total storage loss													
	19.7532	17.8416	19.7532	19.1160	19.7532	19.1160	19.7532	19.7532	19.1160	19.7532	19.1160	19.7532	(56)
If cylinder contains dedicated solar storage													
	19.7532	17.8416	19.7532	19.1160	19.7532	19.1160	19.7532	19.7532	19.1160	19.7532	19.1160	19.7532	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month													
	271.8480	240.2072	254.5702	222.2353	214.3746	192.0146	188.6130	196.7119	199.5554	223.9159	239.8175	268.6610	(62)
WWHRS	-63.1023	-55.8082	-58.4392	-48.3899	-45.0977	-38.5904	-36.1724	-38.4657	-39.9271	-47.0697	-53.3242	-61.9338	(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													
	208.7457	184.3989	196.1310	173.8453	169.2769	153.4242	152.4407	158.2462	159.6283	176.8463	186.4933	206.7272	(64)
										Total per year (kWh/year) = Sum(64)m =		2126.2040	(64)
12Total per year (kWh/year)												2126	(64)
Electric shower(s)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000	(64a)
Heat gains from water heating, kWh/month													
	110.4993	98.0326	104.7544	93.3543	91.3893	83.3060	82.8236	85.5165	85.8133	94.5618	99.2004	109.4396	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	138.9605	138.9605	138.9605	138.9605	138.9605	138.9605	138.9605	138.9605	138.9605	138.9605	138.9605	138.9605	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	135.0701	149.5419	135.0701	139.5725	135.0701	139.5725	135.0701	135.0701	139.5725	135.0701	139.5725	135.0701	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	263.7555	266.4925	259.5954	244.9125	226.3778	208.9579	197.3203	194.5833	201.4804	216.1634	234.6980	252.1179	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.8961	36.8961	36.8961	36.8961	36.8961	36.8961	36.8961	36.8961	36.8961	36.8961	36.8961	36.8961	(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)													
	-111.1684	-111.1684	-111.1684	-111.1684	-111.1684	-111.1684	-111.1684	-111.1684	-111.1684	-111.1684	-111.1684	-111.1684	(71)
Water heating gains (Table 5)													
	148.5205	145.8818	140.7989	129.6588	122.8351	115.7027	111.3221	114.9415	119.1851	127.0992	137.7784	147.0962	(72)
Total internal gains													
	612.0344	626.6044	600.1526	578.8319	548.9713	528.9212	508.4007	509.2832	524.9261	543.0209	576.7370	598.9724	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.2500	11.2829	0.5700	0.7000	0.7700	19.4988	(75)
Southwest	8.7300	36.7938	0.5700	0.7000	0.7700	88.8169	(79)
Northwest	7.4300	11.2829	0.5700	0.7000	0.7700	23.1802	(81)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	131.4959	238.1624	363.5188	513.5324	632.8075	653.5714	619.5672	526.7086	414.8580	273.3728	160.0834	110.8626	(83)
Total gains	743.5302	864.7668	963.6715	1092.3643	1181.7788	1182.4926	1127.9679	1035.9918	939.7841	816.3937	736.8204	709.8350	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	44.1087	44.1829	44.2559	44.6018	44.6672	44.9738	44.9738	45.0311	44.8552	44.6672	44.5352	44.3981	
alpha	3.9406	3.9455	3.9504	3.9735	3.9778	3.9983	3.9983	4.0021	3.9903	3.9778	3.9690	3.9599	
util living area													
	0.9875	0.9768	0.9548	0.8932	0.7731	0.5976	0.4506	0.5056	0.7416	0.9261	0.9776	0.9896	(86)

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Living	19.6737	19.8544	20.1181	20.4640	20.7313	20.8723	20.9100	20.9028	20.8027	20.4495	20.0029	19.6420	
Non living	18.4099	18.6397	18.9718	19.3988	19.7018	19.8438	19.8712	19.8687	19.7850	19.3924	18.8359	18.3742	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	31	28	31	30	31	30	31	31	30	31	30	31	
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
MIT	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	(87)
Th 2	19.9574	19.9590	19.9605	19.9677	19.9691	19.9754	19.9754	19.9766	19.9730	19.9691	19.9664	19.9635	(88)
util rest of house													
	0.9845	0.9712	0.9437	0.8672	0.7213	0.5166	0.3509	0.4017	0.6671	0.9023	0.9713	0.9870	(89)
MIT 2	19.9574	19.9590	19.9605	19.9677	19.9691	19.9754	19.9754	19.9766	19.9730	19.9691	19.9664	19.9635	(90)
Living area fraction										fLA = Living area / (4) =		0.4373	(91)
MIT	20.4134	20.4142	20.4151	20.4192	20.4199	20.4235	20.4235	20.4241	20.4221	20.4199	20.4184	20.4168	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.4134	20.4142	20.4151	20.4192	20.4199	20.4235	20.4235	20.4241	20.4221	20.4199	20.4184	20.4168	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9859	0.9738	0.9489	0.8794	0.7452	0.5532	0.3953	0.4483	0.7017	0.9136	0.9743	0.9882	(94)
Useful gains	733.0812	842.1324	914.4249	960.5955	880.6553	654.1830	445.8518	464.4520	659.4429	745.8627	717.8621	701.4695	(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													
	1946.4845	1870.9643	1675.3473	1376.1241	1040.1926	689.9401	452.9885	476.1554	750.9969	1171.4106	1593.4467	1946.2106	(97)
Space heating kWh													
	902.7721	691.3751	566.1262	299.1806	118.6957	0.0000	0.0000	0.0000	0.0000	316.6077	630.4209	926.0874	(98a)
Space heating requirement - total per year (kWh/year)												4451.2657	
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													
	902.7721	691.3751	566.1262	299.1806	118.6957	0.0000	0.0000	0.0000	0.0000	316.6077	630.4209	926.0874	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4451.2657	
Space heating per m2											(98c) / (4) =	42.5023	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												320.1190	(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													
	902.7721	691.3751	566.1262	299.1806	118.6957	0.0000	0.0000	0.0000	0.0000	316.6077	630.4209	926.0874	(98)
Space heating efficiency (main heating system 1)													
	320.1190	320.1190	320.1190	320.1190	320.1190	0.0000	0.0000	0.0000	0.0000	320.1190	320.1190	320.1190	(210)
Space heating fuel (main heating system)													
	282.0114	215.9744	176.8487	93.4592	37.0786	0.0000	0.0000	0.0000	0.0000	98.9031	196.9333	289.2947	(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													
	208.7457	184.3989	196.1310	173.8453	169.2769	153.4242	152.4407	158.2462	159.6283	176.8463	186.4933	206.7272	(64)
Efficiency of water heater												112.5000	(216)
(217)m	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	(217)
Fuel for water heating, kWh/month													
	185.5517	163.9102	174.3387	154.5292	150.4684	136.3771	135.5028	140.6633	141.8918	157.1967	165.7718	183.7575	(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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(231)
Lighting	31.4642	25.2418	22.7274	16.6511	12.8618	10.5082	11.7329	15.2509	19.8094	25.9911	29.3568	32.3387	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-53.8988	-81.2053	-123.4626	-141.5787	-151.1653	-136.8905	-135.0665	-126.3812	-109.5600	-92.8142	-60.4248	-45.9272	(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	-18.8356	-43.4835	-96.2694	-161.2665	-228.5059	-238.2235	-234.3459	-193.0217	-135.0050	-68.7281	-26.5369	-14.4559	(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												1390.5033	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												112.5000	
Water heating fuel used												1889.9591	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
Total electricity for the above, kWh/year												0.0000	(231)
Electricity for lighting (calculated in Appendix L)												253.9344	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-2717.0529	(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												817.3439	(238)

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Energy Efficiency Calculator

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	1390.5033	0.1555	216.1834	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1889.9591	0.1407	265.9378	(264)
Space and water heating			482.1212	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	253.9344	0.1443	36.6506	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1258.3750	0.1343	-169.0410	
PV Unit electricity exported	-1458.6779	0.1230	-179.3819	
Total			-348.4229	(269)
Total CO2, kg/year			170.3489	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			1.6300	(273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	1390.5033	1.5756	2190.8576	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1889.9591	1.5203	2873.2821	(278)
Space and water heating			5064.1396	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	253.9344	1.5338	389.4931	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1258.3750	1.4965	-1883.1271	
PV Unit electricity exported	-1458.6779	0.4513	-658.2379	
Total			-2541.3650	(283)
Total Primary energy kWh/year			2912.2678	(286)
Dwelling Primary energy Rate (DPER)			27.8100	(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	70.6200 (1b)	x	2.8500 (2b)	=	201.2670 (1b) - (3b)	
First floor	34.1100 (1c)	x	2.8500 (2c)	=	97.2135 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	104.7300					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	298.4805	(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) =	0.1340	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3840	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3264	(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	0.4162	0.4080	0.3999	0.3591	0.3509	0.3101	0.3101	0.3019	0.3264	0.3509	0.3672	0.3835	(22b)
Effective ac	0.5866	0.5832	0.5799	0.5645	0.5616	0.5481	0.5481	0.5456	0.5533	0.5616	0.5674	0.5735	(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

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TER Opaque door			2.3500	1.0000	2.3500		(26)
TER Opening Type (Uw = 1.20)			22.4100	1.1450	25.6603		(27)
GF			70.6200	0.1300	9.1806		(28a)
EW	142.5700	24.7600	117.8100	0.1800	21.2058		(29a)
FR	70.6200		70.6200	0.1100	7.7682		(30)
Total net area of external elements Aum(A, m2)			283.8100				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	66.1649		(33)
PW			28.7700	0.0000	0.0000		(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 183.1558 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	9.0500	0.0500	0.4525
E3 Sill	9.0500	0.0500	0.4525
E4 Jamb	19.0600	0.0500	0.9530
E5 Ground floor (normal)	27.8800	0.1600	4.4608
[illegible]	27.8800	0.0800	2.2304
E10 Corner (normal)	9.8000	0.0900	0.8820

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		9.4312 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	75.5961 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	57.7793	57.4480	57.1234	55.5984	55.3131	53.9849	53.9849	53.7389	54.4965	55.3131	55.8903	56.4937	(38)
Heat transfer coeff	133.3754	133.0441	132.7195	131.1945	130.9092	129.5810	129.5810	129.3350	130.0926	130.9092	131.4864	132.0898	(39)
Average = Sum(39)m / 12 =												131.1931	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2735	1.2704	1.2673	1.2527	1.2500	1.2373	1.2373	1.2349	1.2422	1.2500	1.2555	1.2612	(40)
HLP (average)												1.2527	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.7792 (42)
Hot water usage for mixer showers												
	70.8180	69.7538	68.2029	65.2357	63.0460	60.6040	59.2159	60.7550	62.4422	65.0641	68.0951	70.5467 (42a)
Hot water usage for baths												
	30.5773	30.1232	29.4837	28.3046	27.4217	26.4427	25.9139	26.5489	27.2403	28.2879	29.4913	30.4739 (42b)
Hot water usage for other uses												
	43.0919	41.5249	39.9579	38.3910	36.8240	35.2570	35.2570	36.8240	38.3910	39.9579	41.5249	43.0919 (42c)
Average daily hot water use (litres/day)												132.8163 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	144.4872	141.4019	137.6446	131.9312	127.2916	122.3037	120.3868	124.1279	128.0735	133.3099	139.1113	144.1125	(44)
Energy conte	228.8324	201.3544	211.5546	180.6073	171.3590	150.3866	145.5974	153.6963	157.9274	180.9003	198.1895	225.6454	(45)
Energy content (annual)										Total = Sum(45)m =		2206.0506	
Distribution loss (46)m = 0.15 x (45)m													
	34.3249	30.2032	31.7332	27.0911	25.7038	22.5580	21.8396	23.0544	23.6891	27.1350	29.7284	33.8468	(46)
Water storage loss:													
Store volume												145.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3665	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7379	(55)
Total storage loss													
	22.8747	20.6610	22.8747	22.1368	22.8747	22.1368	22.8747	22.8747	22.1368	22.8747	22.1368	22.8747	(56)
If cylinder contains dedicated solar storage													
	22.8747	20.6610	22.8747	22.1368	22.8747	22.1368	22.8747	22.8747	22.1368	22.8747	22.1368	22.8747	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month													
	274.9695	243.0266	257.6916	225.2561	217.4961	195.0354	191.7345	199.8334	202.5762	227.0374	242.8383	271.7824	(62)
WWHRS	-32.3750	-28.6328	-29.9826	-24.8268	-23.1376	-19.7990	-18.5584	-19.7350	-20.4849	-24.1494	-27.3583	-31.7755	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h													
	242.5945	214.3938	227.7091	200.4293	194.3584	175.2364	173.1761	180.0983	182.0913	202.8880	215.4800	240.0069	(64)
										Total per year (kWh/year) = Sum(64)m =		2448.4621	(64)
12Total per year (kWh/year)												2448	(64)
Electric shower(s)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000	(64a)
Heat gains from water heating, kWh/month													
	112.9964	100.2881	107.2516	95.7709	93.8865	85.7226	85.3208	88.0137	88.2299	97.0590	101.6170	111.9367	(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	138.9605	138.9605	138.9605	138.9605	138.9605	138.9605	138.9605	138.9605	138.9605	138.9605	138.9605	138.9605	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	133.2420	147.5179	133.2420	137.6834	133.2420	137.6834	133.2420	133.2420	137.6834	133.2420	137.6834	133.2420	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	263.7555	266.4925	259.5954	244.9125	226.3778	208.9579	197.3203	194.5833	201.4804	216.1634	234.6980	252.1179	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.8961	36.8961	36.8961	36.8961	36.8961	36.8961	36.8961	36.8961	36.8961	36.8961	36.8961	36.8961	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-111.1684	-111.1684	-111.1684	-111.1684	-111.1684	-111.1684	-111.1684	-111.1684	-111.1684	-111.1684	-111.1684	-111.1684	(71)
Water heating gains (Table 5)													
	151.8769	149.2382	144.1553	133.0152	126.1916	119.0591	114.6785	118.2980	122.5415	130.4557	141.1348	150.4526	(72)
Total internal gains													
	616.5626	630.9368	604.6809	583.2992	553.4995	530.3886	509.9289	510.8114	526.3934	547.5492	581.2043	603.5007	(73)

6. Solar gains

[Jan]	Area	Solar flux	g	FF	Access	Gains

					m2	Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c		factor Table 6d		W	
Northeast					6.2500	11.2829	0.6300	0.7000		0.7700		21.5513	(75)
Southwest					8.7300	36.7938	0.6300	0.7000		0.7700		98.1660	(79)
Northwest					7.4300	11.2829	0.6300	0.7000		0.7700		25.6202	(81)
Solar gains	145.3376	263.2321	401.7840	567.5885	699.4188	722.3684	684.7848	582.1516	458.5273	302.1489	176.9343	122.5323	(83)
Total gains	761.9002	894.1689	1006.4649	1150.8877	1252.9184	1252.7569	1194.7137	1092.9630	984.9207	849.6981	758.1386	726.0330	(84)

7. Mean internal temperature (heating season)

ods 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	39.9497	40.0492	40.1471	40.6138	40.7023	41.1195	41.1195	41.1977	40.9578	40.7023	40.5237	40.3385	
alpha	3.6633	3.6699	3.6765	3.7076	3.7135	3.7413	3.7413	3.7465	3.7305	3.7135	3.7016	3.6892	
util living area	0.9870	0.9760	0.9538	0.8930	0.7764	0.6063	0.4611	0.5174	0.7506	0.9268	0.9771	0.9890	(86)
MIT	19.1382	19.3971	19.7812	20.2904	20.6896	20.9112	20.9754	20.9626	20.7987	20.2719	19.6229	19.1006	(87)
Th 2	19.8616	19.8641	19.8666	19.8781	19.8802	19.8903	19.8903	19.8922	19.8864	19.8802	19.8759	19.8713	(88)
util rest of house	0.9837	0.9701	0.9421	0.8659	0.7221	0.5197	0.3520	0.4043	0.6725	0.9022	0.9704	0.9863	(89)
MIT 2	17.7145	18.0437	18.5274	19.1562	19.6098	19.8340	19.8807	19.8761	19.7389	19.1505	18.3409	17.6729	(90)
Living area fraction									fLA = Living area / (4) =			0.4373	(91)
MIT	18.3371	18.6356	19.0757	19.6522	20.0820	20.3051	20.3595	20.3512	20.2024	19.6409	18.9015	18.2973	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3371	18.6356	19.0757	19.6522	20.0820	20.3051	20.3595	20.3512	20.2024	19.6409	18.9015	18.2973	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9776	0.9616	0.9318	0.8595	0.7328	0.5535	0.3992	0.4527	0.6966	0.8957	0.9626	0.9809	(94)
Useful gains	744.8692	859.8090	937.7910	989.2040	918.1040	693.3870	476.9513	494.8261	686.1448	761.1031	729.8040	712.1475	(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	1872.2033	1827.4357	1669.0418	1410.6247	1097.2841	739.2681	487.1557	511.0334	793.8743	1183.5337	1551.7393	1862.1038	(97)
Space heating kWh	838.7366	650.2451	544.0506	303.4229	133.3100	0.0000	0.0000	0.0000	0.0000	314.2883	591.7935	855.5675	(98a)
Space heating requirement - total per year (kWh/year)												4231.4144	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	838.7366	650.2451	544.0506	303.4229	133.3100	0.0000	0.0000	0.0000	0.0000	314.2883	591.7935	855.5675	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4231.4144	
Space heating per m2										(98c) / (4) =		40.4031	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												92.3000	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	838.7366	650.2451	544.0506	303.4229	133.3100	0.0000	0.0000	0.0000	0.0000	314.2883	591.7935	855.5675	(98)
Space heating efficiency (main heating system 1)	92.3000	92.3000	92.3000	92.3000	92.3000	0.0000	0.0000	0.0000	0.0000	92.3000	92.3000	92.3000	(210)
Space heating fuel (main heating system)	908.7070	704.4909	589.4372	328.7355	144.4312	0.0000	0.0000	0.0000	0.0000	340.5074	641.1630	926.9420	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	242.5945	214.3938	227.7091	200.4293	194.3584	175.2364	173.1761	180.0983	182.0913	202.8880	215.4800	240.0069	(64)
Efficiency of water heater												79.8000	(216)
(217)m	86.6086	86.3843	85.9402	84.9871	83.2320	79.8000	79.8000	79.8000	79.8000	85.0376	86.2049	86.6589	(217)
Fuel for water heating, kWh/month	280.1044	248.1862	264.9622	235.8349	233.5140	219.5944	217.0126	225.6871	228.1846	238.5863	249.9626	276.9559	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	27.6851	22.2100	19.9976	14.6511	11.3169	9.2460	10.3237	13.4191	17.4301	22.8693	25.8308	28.4545	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-59.4222	-80.5979	-111.5050	-120.5010	-125.9487	-116.1078	-114.5792	-110.0090	-101.5091	-89.7001	-64.1479	-51.7472	(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	-43.9794	-91.0825	-178.4883	-264.5214	-346.4529	-346.9710	-342.9599	-291.9445	-216.0397	-129.1284	-58.3324	-34.8951	(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												4584.4142	(211)
Space heating fuel - main system 2												0.0000	(213)

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Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	79.8000	
Water heating fuel used	2918.5853	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
Total electricity for the above, kWh/year	86.0000	(231)
Electricity for lighting (calculated in Appendix L)	223.4342	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-3490.5704	(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)
	0.0000	(237)
Total delivered energy for all uses	4321.8633	(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	4584.4142	0.2100	962.7270	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2918.5853	0.2100	612.9029	(264)
Space and water heating			1575.6299	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	223.4342	0.1443	32.2485	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1145.7751	0.1354	-155.1753	
PV Unit electricity exported	-2344.7954	0.1263	-296.1239	
Total			-451.2992	(269)
Total CO2, kg/year			1168.5084	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			11.1600	(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	4584.4142	1.1300	5180.3881	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2918.5853	1.1300	3298.0014	(278)
Space and water heating			8478.3895	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	223.4342	1.5338	342.7109	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1145.7751	1.5006	-1719.3302	
PV Unit electricity exported	-2344.7954	0.4636	-1087.0193	
Total			-2806.3495	(283)
Total Primary energy kWh/year			6144.8517	(286)
Target Primary Energy Rate (TPER)			58.6700	(287)

Property Reference	Sample 2			**Issued on Date**	28/11/2023
Assessment Reference	Belmont Close		**Prop Type Ref**	Belmont Close	
Property					

SAP Rating	89 B	**DER**	1.75	**TER**	8.88
Environmental	98 A	**% DER < TER**			80.29
CO_2 Emissions (t/year)	0.18	**DFEE**	38.99	**TFEE**	42.22
Compliance Check	See BREL	**% DFEE < TFEE**			7.65
% DPER < TPER	45.79	**DPER**	25.36	**TPER**	46.78
Assessor Details	Mr. George Farr			**Assessor ID**	T355-0001
Client					

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

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1. Overall dwelling characteristics

		Area (m2)		Storey height (m)		Volume (m3)	
Ground floor		92.5300	(1b)	x 2.8500	(2b) =	263.7105	(1b) - (3b)
First floor		55.4300	(1c)	x 2.8500	(2c) =	157.9755	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	147.9600						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		421.6860	(5)

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2. Ventilation rate

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		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	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) =	0.0949	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		4.0000	(17)
Infiltration rate		0.2949	(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) =	0.2506	(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	0.3196	0.3133	0.3070	0.2757	0.2694	0.2381	0.2381	0.2318	0.2506	0.2694	0.2820	0.2945	(22b)
Effective ac	0.5511	0.5491	0.5471	0.5380	0.5363	0.5283	0.5283	0.5269	0.5314	0.5363	0.5397	0.5434	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
DOOR			2.3500	1.0000	2.3500			(26)
G (Uw = 1.00)			35.2200	0.9615	33.8654			(27)
GF			92.5300	0.1200	11.1036	110.0000	10178.3000	(28a)
EW	191.7600	37.5700	154.1900	0.1500	23.1285	60.0000	9251.4000	(29a)
FR	93.4200		93.4200	0.1100	10.2762	9.0000	840.7800	(30)
Total net area of external elements Aum(A, m2)			377.7100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		80.7237			(33)
PW			38.8800	0.0000	0.0000	45.0000	1749.6000	(32)
IW			241.2900			9.0000	2171.6100	(32c)
IF			55.4300			18.0000	997.7400	(32d)
IF			55.4300			9.0000	498.8700	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	25688.3000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		173.6165 (35)
Thermal bridges (User defined value 0.030 * total exposed area)		11.3313 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	92.0550 (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	76.6830	76.4072	76.1367	74.8665	74.6289	73.5226	73.5226	73.3177	73.9487	74.6289	75.1097	75.6123	(38)
Heat transfer coeff													
	168.7380	168.4621	168.1917	166.9215	166.6839	165.5776	165.5776	165.3727	166.0037	166.6839	167.1646	167.6672	(39)
Average = Sum(39)m / 12 =												166.9204	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1404	1.1386	1.1367	1.1282	1.1265	1.1191	1.1191	1.1177	1.1219	1.1265	1.1298	1.1332	(40)
HLP (average)												1.1281	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.9310	(42)
Hot water usage for mixer showers													
	73.3623	72.2598	70.6533	67.5794	65.3110	62.7813	61.3434	62.9378	64.6856	67.4017	70.5416	73.0812	(42a)
Hot water usage for baths													
	31.6714	31.2011	30.5387	29.3174	28.4029	27.3889	26.8411	27.4989	28.2150	29.3001	30.5465	31.5644	(42b)
Hot water usage for other uses													
	44.6459	43.0224	41.3989	39.7754	38.1520	36.5285	36.5285	38.1520	39.7754	41.3989	43.0224	44.6459	(42c)
Average daily hot water use (litres/day)												137.5892	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	149.6797	146.4833	142.5909	136.6723	131.8659	126.6986	124.7130	128.5886	132.6760	138.1007	144.1105	149.2915	(44)
Energy conte	237.0560	208.5903	219.1569	187.0975	177.5168	155.7908	150.8296	159.2196	163.6028	187.4014	205.3119	233.7544	(45)
Energy content (annual)										Total = Sum(45)m =		2285.3280	
Distribution loss (46)m = 0.15 x (45)m													
	35.5584	31.2885	32.8735	28.0646	26.6275	23.3686	22.6244	23.8829	24.5404	28.1102	30.7968	35.0632	(46)
Water storage loss:													
Store volume												145.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.1800	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.6372	(55)
Total storage loss													
	19.7532	17.8416	19.7532	19.1160	19.7532	19.1160	19.7532	19.7532	19.1160	19.7532	19.1160	19.7532	(56)
If cylinder contains dedicated solar storage													
	19.7532	17.8416	19.7532	19.1160	19.7532	19.1160	19.7532	19.7532	19.1160	19.7532	19.1160	19.7532	(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													
	280.0716	247.4431	262.1725	228.7255	220.5324	197.4188	193.8452	202.2352	205.2308	230.4170	246.9399	276.7700	(62)
WWHRS	-65.3694	-57.8133	-60.5387	-50.1285	-46.7179	-39.9769	-37.4719	-39.8476	-41.3616	-48.7608	-55.2400	-64.1589	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h													
	214.7022	189.6298	201.6338	178.5971	173.8145	157.4419	156.3733	162.3876	163.8692	181.6562	191.6998	212.6111	(64)
										Total per year (kWh/year) = Sum(64)m =		2184.4165	(64)
12Total per year (kWh/year)												2184	(64)
Electric shower(s)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000	(64a)
Heat gains from water heating, kWh/month													
	113.2336	100.4385	107.2822	95.5123	93.4368	85.1028	84.5633	87.3530	87.7003	96.7234	101.5686	112.1358	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	146.5478	146.5478	146.5478	146.5478	146.5478	146.5478	146.5478	146.5478	146.5478	146.5478	146.5478	146.5478	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	161.0804	178.3390	161.0804	166.4497	161.0804	166.4497	161.0804	161.0804	166.4497	161.0804	166.4497	161.0804	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	318.2949	321.5978	313.2746	295.5554	273.1882	252.1662	238.1221	234.8192	243.1425	260.8616	283.2288	304.2509	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.6548	37.6548	37.6548	37.6548	37.6548	37.6548	37.6548	37.6548	37.6548	37.6548	37.6548	37.6548	(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)													
	-117.2382	-117.2382	-117.2382	-117.2382	-117.2382	-117.2382	-117.2382	-117.2382	-117.2382	-117.2382	-117.2382	-117.2382	(71)
Water heating gains (Table 5)													
	152.1957	149.4621	144.1964	132.6560	125.5871	118.1984	113.6604	117.4099	121.8060	130.0046	141.0675	150.7202	(72)
Total internal gains													
	698.5353	716.3632	685.5157	661.6255	626.8201	603.7786	579.8273	580.2739	598.3626	618.9109	657.7104	683.0158	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.3400	11.2829	0.5700	0.7000	0.7700	19.7796	(75)
Southeast	12.2100	36.7938	0.5700	0.7000	0.7700	124.2215	(77)
Southwest	16.6700	36.7938	0.5700	0.7000	0.7700	169.5965	(79)

Solar gains	313.5976	540.7427	757.3188	967.6053	1110.4972	1114.2105	1069.3306	960.9314	829.8616	602.3411	376.8141	267.6000	(83)
Total gains	1012.1329	1257.1059	1442.8345	1629.2308	1737.3173	1717.9891	1649.1579	1541.2053	1428.2242	1221.2520	1034.5245	950.6158	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	42.2883	42.3575	42.4256	42.7485	42.8094	43.0954	43.0954	43.1488	42.9848	42.8094	42.6863	42.5583	
alpha	3.8192	3.8238	3.8284	3.8499	3.8540	3.8730	3.8730	3.8766	3.8657	3.8540	3.8458	3.8372	
util living area													
	0.9871	0.9709	0.9405	0.8694	0.7465	0.5766	0.4311	0.4769	0.6992	0.9063	0.9748	0.9897	(86)

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Living	19.6132	19.8477	20.1420	20.4853	20.7375	20.8705	20.9077	20.9018	20.8143	20.4684	19.9730	19.5702	
Non living	18.3460	18.6434	19.0118	19.4322	19.7159	19.8504	19.8778	19.8759	19.8025	19.4236	18.8103	18.2958	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	31	28	31	30	31	30	31	31	30	31	30	31	
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
MIT	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	(87)
Th 2	19.9680	19.9695	19.9709	19.9779	19.9792	19.9853	19.9853	19.9864	19.9829	19.9792	19.9766	19.9738	(88)
util rest of house	0.9841	0.9644	0.9272	0.8408	0.6944	0.4985	0.3364	0.3789	0.6247	0.8790	0.9681	0.9873	(89)
MIT 2	19.9680	19.9695	19.9709	19.9779	19.9792	19.9853	19.9853	19.9864	19.9829	19.9792	19.9766	19.9738	(90)
Living area fraction										fLA = Living area / (4) =		0.3244	(91)
MIT	20.3028	20.3038	20.3048	20.3095	20.3104	20.3145	20.3145	20.3152	20.3129	20.3104	20.3086	20.3067	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.3028	20.3038	20.3048	20.3095	20.3104	20.3145	20.3145	20.3152	20.3129	20.3104	20.3086	20.3067	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9851	0.9667	0.9319	0.8508	0.7123	0.5248	0.3678	0.4115	0.6504	0.8887	0.9705	0.9881	(94)
Useful gains	997.0857	1215.2808	1344.5713	1386.0865	1237.4394	901.5621	606.5083	634.2642	928.9339	1085.3844	1003.9661	939.3340	(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	2700.2743	2594.9539	2321.8499	1904.4889	1435.2095	946.1888	615.0336	647.4731	1031.3631	1618.5618	2208.0084	2700.5700	(97)
Space heating kWh	1267.1723	927.1403	727.0953	373.2498	147.1410	0.0000	0.0000	0.0000	0.0000	396.6839	866.9104	1310.3596	(98a)
Space heating requirement - total per year (kWh/year)												6015.7526	
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	1267.1723	927.1403	727.0953	373.2498	147.1410	0.0000	0.0000	0.0000	0.0000	396.6839	866.9104	1310.3596	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												6015.7526	
Space heating per m2											(98c) / (4) =	40.6580	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	324.8205	(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	1267.1723	927.1403	727.0953	373.2498	147.1410	0.0000	0.0000	0.0000	0.0000	396.6839	866.9104	1310.3596	(98)
Space heating efficiency (main heating system 1)	324.8205	324.8205	324.8205	324.8205	324.8205	0.0000	0.0000	0.0000	0.0000	324.8205	324.8205	324.8205	(210)
Space heating fuel (main heating system)	390.1147	285.4316	223.8453	114.9096	45.2992	0.0000	0.0000	0.0000	0.0000	122.1240	266.8891	403.4104	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	214.7022	189.6298	201.6338	178.5971	173.8145	157.4419	156.3733	162.3876	163.8692	181.6562	191.6998	212.6111	(64)
Efficiency of water heater												112.5000	(216)
(217)m	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	(217)
Fuel for water heating, kWh/month	190.8464	168.5598	179.2300	158.7529	154.5018	139.9484	138.9985	144.3445	145.6615	161.4722	170.3999	188.9877	(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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(231)
Lighting	39.3696	31.5837	28.4376	20.8346	16.0933	13.1483	14.6808	19.0827	24.7865	32.5213	36.7327	40.4638	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-55.5132	-84.3273	-129.1562	-149.4366	-160.7198	-145.8885	-143.8846	-133.9221	-115.2544	-96.5485	-62.4412	-47.2116	(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	-17.2212	-40.3615	-90.5759	-153.4087	-218.9514	-229.2255	-225.5277	-185.4808	-129.3105	-64.9938	-24.5205	-13.1716	(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	1852.0238	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	112.5000	
Water heating fuel used	1941.7036	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
Total electricity for the above, kWh/year	0.0000	(231)
Electricity for lighting (calculated in Appendix L)	317.7349	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-2717.0529	(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	1394.4093	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	1852.0238	0.1558	288.5826	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1941.7036	0.1407	273.2511	(264)
Space and water heating			561.8338	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	317.7349	0.1443	45.8590	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1324.3039	0.1342	-177.6792	
PV Unit electricity exported	-1392.7491	0.1227	-170.8393	
Total			-348.5185	(269)
Total CO2, kg/year			259.1743	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			1.7500	(273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	1852.0238	1.5769	2920.3751	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1941.7036	1.5204	2952.0698	(278)
Space and water heating			5872.4449	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	317.7349	1.5338	487.3524	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1324.3039	1.4959	-1980.9685	
PV Unit electricity exported	-1392.7491	0.4501	-626.8685	
Total			-2607.8370	(283)
Total Primary energy kWh/year			3751.9603	(286)
Dwelling Primary energy Rate (DPER)			25.3600	(287)

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	92.5300 (1b)	x	2.8500 (2b)	=	263.7105	(1b) - (3b)
First floor	55.4300 (1c)	x	2.8500 (2c)	=	157.9755	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 147.9600						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	421.6860	(5)

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2. Ventilation rate

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	m3 per hour		
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	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) =	0.0949	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3449	(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) =	0.2931	(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	0.3737	0.3664	0.3591	0.3224	0.3151	0.2785	0.2785	0.2711	0.2931	0.3151	0.3298	0.3444	(22b)
Effective ac	0.5698	0.5671	0.5645	0.5520	0.5496	0.5388	0.5388	0.5368	0.5430	0.5496	0.5544	0.5593	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K

TER Opaque door			2.3500	1.0000	2.3500	(26)
TER Opening Type (Uw = 1.20)			34.6500	1.1450	39.6756	(27)
GF			92.5300	0.1300	12.0289	(28a)
EW	191.7600	37.0000	154.7600	0.1800	27.8568	(29a)
FR	93.4200		93.4200	0.1100	10.2762	(30)
Total net area of external elements Aum(A, m2)			377.7100			(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		92.1875	(33)
PW			38.8800	0.0000	0.0000	(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 173.6165 (35)

List of Thermal Bridges

	Length	Psi-value	Total	
K1 Element				
E2 Other lintels (including other steel lintels)	9.0500	0.0500	0.4525	
E3 Sill	9.0500	0.0500	0.4525	
E4 Jamb	19.0600	0.0500	0.9530	
E5 Ground floor (normal)	27.8800	0.1600	4.4608	
E6 Corner (normal)	27.8800	0.0800	2.2304	
E10 Corner (normal)	9.8000	0.0900	0.8820	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 9.4312 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 101.6187 (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	79.2969	78.9195	78.5496	76.8121	76.4871	74.9738	74.9738	74.6935	75.5567	76.4871	77.1447	77.8322	(38)
Heat transfer coeff	180.9156	180.5382	180.1683	178.4308	178.1057	176.5924	176.5924	176.3122	177.1753	178.1057	178.7634	179.4509	(39)
Average = Sum(39)m / 12 =												178.4293	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2227	1.2202	1.2177	1.2059	1.2037	1.1935	1.1935	1.1916	1.1975	1.2037	1.2082	1.2128	(40)
HLP (average)												1.2059	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.9310 (42)

Hot water usage for mixer showers

73.3623	72.2598	70.6533	67.5794	65.3110	62.7813	61.3434	62.9378	64.6856	67.4017	70.5416	73.0812	(42a)

Hot water usage for baths

31.6714	31.2011	30.5387	29.3174	28.4029	27.3889	26.8411	27.4989	28.2150	29.3001	30.5465	31.5644	(42b)

Hot water usage for other uses

44.6459	43.0224	41.3989	39.7754	38.1520	36.5285	36.5285	38.1520	39.7754	41.3989	43.0224	44.6459	(42c)

Average daily hot water use (litres/day) 137.5892 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	149.6797	146.4833	142.5909	136.6723	131.8659	126.6986	124.7130	128.5886	132.6760	138.1007	144.1105	149.2915	(44)
Energy conte	237.0560	208.5903	219.1569	187.0975	177.5168	155.7908	150.8296	159.2196	163.6028	187.4014	205.3119	233.7544	(45)
Energy content (annual)										Total = Sum(45)m =		2285.3280	
Distribution loss (46)m = 0.15 x (45)m	35.5584	31.2885	32.8735	28.0646	26.6275	23.3686	22.6244	23.8829	24.5404	28.1102	30.7968	35.0632	(46)
Water storage loss:													
Store volume												145.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3665	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7379	(55)
Total storage loss	22.8747	20.6610	22.8747	22.1368	22.8747	22.1368	22.8747	22.8747	22.1368	22.8747	22.1368	22.8747	(56)
If cylinder contains dedicated solar storage	22.8747	20.6610	22.8747	22.1368	22.8747	22.1368	22.8747	22.8747	22.1368	22.8747	22.1368	22.8747	(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	283.1931	250.2625	265.2940	231.7463	223.6539	200.4396	196.9667	205.3567	208.2516	233.5384	249.9606	279.8915	(62)
WWHRS	-33.5382	-29.6615	-31.0598	-25.7187	-23.9689	-20.5104	-19.2252	-20.4441	-21.2208	-25.0170	-28.3412	-32.9171	(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	249.6549	220.6010	234.2342	206.0276	199.6850	179.9292	177.7415	184.9126	187.0308	208.5214	221.6194	246.9744	(64)
										Total per year (kWh/year) = Sum(64)m =		2516.9320	(64)
12Total per year (kWh/year)												2517	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												0.0000	(64a)
Heat gains from water heating, kWh/month	115.7308	102.6940	109.7793	97.9290	95.9340	87.5195	87.0605	89.8502	90.1170	99.2206	103.9852	114.6330	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	146.5478	146.5478	146.5478	146.5478	146.5478	146.5478	146.5478	146.5478	146.5478	146.5478	146.5478	146.5478	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	160.5432	177.7443	160.5432	165.8946	160.5432	165.8946	160.5432	160.5432	165.8946	160.5432	165.8946	160.5432	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	318.2949	321.5978	313.2746	295.5554	273.1882	252.1662	238.1221	234.8192	243.1425	260.8616	283.2288	304.2509	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.6548	37.6548	37.6548	37.6548	37.6548	37.6548	37.6548	37.6548	37.6548	37.6548	37.6548	37.6548	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-117.2382	-117.2382	-117.2382	-117.2382	-117.2382	-117.2382	-117.2382	-117.2382	-117.2382	-117.2382	-117.2382	-117.2382	(71)
Water heating gains (Table 5)	155.5521	152.8185	147.5529	136.0124	128.9436	121.5548	117.0168	120.7664	125.1625	133.3610	144.4239	154.0766	(72)
Total internal gains	704.3545	722.1249	691.3350	667.4268	632.6393	606.5799	582.6465	583.0931	601.1639	624.7302	663.5117	688.8350	(73)

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6. Solar gains

[Jan]	Area	Solar flux	g	FF	Access	Gains

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	m2	Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c	factor Table 6d	W	
Northeast	6.2400	11.2829	0.6300	0.7000	0.7700	21.5169	(75)
Southeast	12.0100	36.7938	0.6300	0.7000	0.7700	135.0485	(77)
Southwest	16.4000	36.7938	0.6300	0.7000	0.7700	184.4126	(79)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	340.9780	587.9588	823.4546	1052.1199	1207.5056	1211.5488	1162.7458	1044.8681	902.3375	654.9382	409.7146	290.9639	(83)
Total gains	1045.3325	1310.0836	1514.7896	1719.5467	1840.1448	1818.1287	1745.3923	1627.9612	1503.5013	1279.6684	1073.2263	979.7989	(84)

7. Mean internal temperature (heating season)

ods 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	39.4418	39.5243	39.6054	39.9911	40.0641	40.4074	40.4074	40.4716	40.2744	40.0641	39.9167	39.7637	
alpha	3.6295	3.6350	3.6404	3.6661	3.6709	3.6938	3.6938	3.6981	3.6850	3.6709	3.6611	3.6509	
util living area	0.9860	0.9689	0.9372	0.8649	0.7428	0.5761	0.4325	0.4784	0.6989	0.9033	0.9732	0.9888	(86)
MIT	19.1312	19.4619	19.8789	20.3668	20.7269	20.9218	20.9790	20.9696	20.8378	20.3432	19.6431	19.0747	(87)
Th 2	19.9019	19.9039	19.9059	19.9153	19.9170	19.9252	19.9252	19.9267	19.9220	19.9170	19.9135	19.9097	(88)
util rest of house	0.9827	0.9619	0.9229	0.8348	0.6884	0.4943	0.3324	0.3752	0.6212	0.8746	0.9659	0.9861	(89)
MIT 2	17.7390	18.1576	18.6789	19.2743	19.6789	19.8747	19.9167	19.9133	19.8039	19.2633	18.3976	17.6723	(90)
Living area fraction									fLA = Living area / (4) =			0.3244	(91)
MIT	18.1907	18.5808	19.0682	19.6287	20.0189	20.2144	20.2613	20.2560	20.1393	19.6136	18.8017	18.1273	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.1907	18.5808	19.0682	19.6287	20.0189	20.2144	20.2613	20.2560	20.1393	19.6136	18.8017	18.1273	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9754	0.9505	0.9094	0.8257	0.6939	0.5173	0.3644	0.4078	0.6381	0.8649	0.9557	0.9798	(94)
Useful gains	1019.5916	1245.2758	1377.4893	1419.8265	1276.9669	940.5001	636.0739	663.9155	959.4553	1106.7855	1025.7089	960.0342	(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	2513.0363	2469.9019	2264.3939	1914.3366	1481.6483	991.4547	646.5618	679.8537	1070.0172	1605.3794	2091.8302	2499.2633	(97)
Space heating kWh	1111.1229	822.9488	659.8571	356.0473	152.2829	0.0000	0.0000	0.0000	0.0000	370.9538	767.6073	1145.1865	(98a)
Space heating requirement - total per year (kWh/year)												5386.0066	
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	1111.1229	822.9488	659.8571	356.0473	152.2829	0.0000	0.0000	0.0000	0.0000	370.9538	767.6073	1145.1865	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												5386.0066	
Space heating per m2											(98c) / (4) =	36.4018	(99)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1111.1229	822.9488	659.8571	356.0473	152.2829	0.0000	0.0000	0.0000	0.0000	370.9538	767.6073	1145.1865	(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)	1203.8168	891.6022	714.9048	385.7501	164.9869	0.0000	0.0000	0.0000	0.0000	401.9001	831.6439	1240.7221	(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	249.6549	220.6010	234.2342	206.0276	199.6850	179.9292	177.7415	184.9126	187.0308	208.5214	221.6194	246.9744	(64)
Efficiency of water heater												79.8000	(216)
(217)m	86.9998	86.7322	86.2516	85.2747	83.4598	79.8000	79.8000	79.8000	79.8000	85.3367	86.6116	87.0581	(217)
Fuel for water heating, kWh/month	286.9602	254.3474	271.5710	241.6045	239.2589	225.4752	222.7337	231.7201	234.3744	244.3515	255.8773	283.6890	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	33.3577	26.7608	24.0951	17.6531	13.6358	11.1405	12.4390	16.1687	21.0015	27.5552	31.1235	34.2848	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-75.7581	-101.7352	-139.3381	-148.9742	-154.3440	-141.7236	-139.7711	-134.8114	-125.4521	-112.3398	-81.3729	-66.0906	(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	-59.7240	-123.2094	-240.6263	-355.5021	-464.6210	-465.0264	-459.7204	-391.8490	-290.6169	-174.3808	-79.1071	-47.4326	(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												5835.3267	(211)
Space heating fuel - main system 2												0.0000	(213)

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Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	79.8000	
Water heating fuel used	2991.9630	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
Total electricity for the above, kWh/year	86.0000	(231)
Electricity for lighting (calculated in Appendix L)	269.2158	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-4573.5271	(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)
	0.0000	(237)
Total delivered energy for all uses	4608.9785	(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	5835.3267	0.2100	1225.4186	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2991.9630	0.2100	628.3122	(264)
Space and water heating			1853.7309	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	269.2158	0.1443	38.8562	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1421.7112	0.1357	-192.8854	
PV Unit electricity exported	-3151.8159	0.1264	-398.3280	
Total			-591.2134	(269)
Total CO2, kg/year			1313.3029	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			8.8800	(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	5835.3267	1.1300	6593.9192	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2991.9630	1.1300	3380.9182	(278)
Space and water heating			9974.8375	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	269.2158	1.5338	412.9322	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1421.7112	1.5015	-2134.6679	
PV Unit electricity exported	-3151.8159	0.4639	-1462.2038	
Total			-3596.8717	(283)
Total Primary energy kWh/year			6920.9987	(286)
Target Primary Energy Rate (TPER)			46.7800	(287)

Property Reference	Sample 3	**Issued on Date**	28/11/2023
Assessment Reference	Belmont Close	**Prop Type Ref**	Belmont Close
Property			

SAP Rating	90 B	**DER**	1.43	**TER**	10.77
Environmental	99 A	**% DER < TER**			86.72
CO_2 Emissions (t/year)	0.09	**DFEE**	37.61	**TFEE**	42.23
Compliance Check	See BREL	**% DFEE < TFEE**			10.93
% DPER < TPER	54.95	**DPER**	25.35	**TPER**	56.26
Assessor Details	Mr. George Farr			**Assessor ID**	T355-0001
Client					

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	58.5700 (1b)	x	2.8500 (2b)	=	166.9245	(1b) - (3b)
First floor	50.5000 (1c)	x	2.8500 (2c)	=	143.9250	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	109.0700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	310.8495	(5)

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2. Ventilation rate

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		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	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) =	0.1287	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		4.0000	(17)
Infiltration rate		0.3287	(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) =	0.2794	(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	0.3562	0.3492	0.3422	0.3073	0.3003	0.2654	0.2654	0.2584	0.2794	0.3003	0.3143	0.3283	(22b)
Effective ac	0.5634	0.5610	0.5586	0.5472	0.5451	0.5352	0.5352	0.5334	0.5390	0.5451	0.5494	0.5539	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
DOOR			2.3500	1.0000	2.3500			(26)
G (Uw = 1.00)			27.2400	0.9615	26.1923			(27)
GF			58.5700	0.1200	7.0284	110.0000	6442.7000	(28a)
EW	149.6200	29.5900	120.0300	0.1500	18.0045	60.0000	7201.8000	(29a)
FR	59.5600		59.5600	0.1100	6.5516	9.0000	536.0400	(30)
Total net area of external elements Aum(A, m2)			267.7500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		60.1268			(33)
PW			44.9900	0.0000	0.0000	45.0000	2024.5500	(32)
IW			177.1000			9.0000	1593.9000	(32c)
IF			50.5000			18.0000	909.0000	(32d)
IF			50.5000			9.0000	454.5000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	19162.4900 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		175.6898 (35)
Thermal bridges (User defined value 0.030 * total exposed area)		8.0325 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	68.1593 (37)

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

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	57.7980	57.5453	57.2976	56.1342	55.9165	54.9031	54.9031	54.7155	55.2935	55.9165	56.3568	56.8172	(38)
Heat transfer coeff													
	125.9573	125.7046	125.4569	124.2935	124.0758	123.0624	123.0624	122.8748	123.4528	124.0758	124.5161	124.9765	(39)
Average = Sum(39)m / 12 =												124.2924	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1548	1.1525	1.1502	1.1396	1.1376	1.1283	1.1283	1.1266	1.1319	1.1376	1.1416	1.1458	(40)
HLP (average)												1.1396	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8091	(42)
Hot water usage for mixer showers													
	71.3196	70.2478	68.6860	65.6978	63.4925	61.0332	59.6354	61.1854	62.8845	65.5250	68.5774	71.0464	(42a)
Hot water usage for baths													
	30.7930	30.3357	29.6917	28.5043	27.6151	26.6292	26.0967	26.7362	27.4325	28.4874	29.6993	30.6889	(42b)
Hot water usage for other uses													
	43.3983	41.8201	40.2420	38.6639	37.0858	35.5077	35.5077	37.0858	38.6639	40.2420	41.8201	43.3983	(42c)
Average daily hot water use (litres/day)												133.7572	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	145.5109	142.4037	138.6197	132.8659	128.1934	123.1701	121.2397	125.0073	128.9808	134.2544	140.0969	145.1335	(44)
Energy conte	230.4537	202.7809	213.0534	181.8868	172.5730	151.4520	146.6290	154.7852	159.0463	182.1820	199.5937	227.2440	(45)
Energy content (annual)										Total = Sum(45)m =		2221.6800	
Distribution loss (46)m = 0.15 x (45)m													
	34.5681	30.4171	31.9580	27.2830	25.8859	22.7178	21.9943	23.2178	23.8569	27.3273	29.9391	34.0866	(46)
Water storage loss:													
Store volume												145.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.1800	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.6372	(55)
Total storage loss													
	19.7532	17.8416	19.7532	19.1160	19.7532	19.1160	19.7532	19.7532	19.1160	19.7532	19.1160	19.7532	(56)
If cylinder contains dedicated solar storage													
	19.7532	17.8416	19.7532	19.1160	19.7532	19.1160	19.7532	19.7532	19.1160	19.7532	19.1160	19.7532	(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													
	273.4693	241.6337	256.0690	223.5148	215.5886	193.0800	189.6446	197.8008	200.6743	225.1976	241.2217	270.2596	(62)
WWHRS	-63.5493	-56.2035	-58.8531	-48.7327	-45.4171	-38.8637	-36.4286	-38.7381	-40.2099	-47.4031	-53.7019	-62.3725	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h													
	209.9200	185.4302	197.2159	174.7821	170.1715	154.2163	153.2160	159.0627	160.4644	177.7945	187.5198	207.8872	(64)
										Total per year (kWh/year) = Sum(64)m =		2137.6805	(64)
12Total per year (kWh/year)												2138	(64)
Electric shower(s)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000	(64a)
Heat gains from water heating, kWh/month													
	111.0383	98.5069	105.2527	93.7798	91.7930	83.6602	83.1666	85.8786	86.1853	94.9880	99.6673	109.9711	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	140.4563	140.4563	140.4563	140.4563	140.4563	140.4563	140.4563	140.4563	140.4563	140.4563	140.4563	140.4563	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	136.3702	150.9813	136.3702	140.9159	136.3702	140.9159	136.3702	136.3702	140.9159	136.3702	140.9159	136.3702	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	270.2130	273.0170	265.9511	250.9086	231.9202	214.0738	202.1513	199.3473	206.4132	221.4557	240.4441	258.2905	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.0456	37.0456	37.0456	37.0456	37.0456	37.0456	37.0456	37.0456	37.0456	37.0456	37.0456	37.0456	(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)													
	-112.3651	-112.3651	-112.3651	-112.3651	-112.3651	-112.3651	-112.3651	-112.3651	-112.3651	-112.3651	-112.3651	-112.3651	(71)
Water heating gains (Table 5)													
	149.2451	146.5876	141.4687	130.2497	123.3777	116.1947	111.7831	115.4282	119.7018	127.6720	138.4268	147.8107	(72)
Total internal gains													
	620.9652	635.7228	608.9269	587.2111	556.8050	536.3213	515.4414	516.2826	532.1678	550.6348	584.9237	607.6083	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.3600	11.2829	0.5700	0.7000	0.7700	19.8420	(75)
Southeast	2.3500	36.7938	0.5700	0.7000	0.7700	23.9083	(77)
Southwest	18.5300	36.7938	0.5700	0.7000	0.7700	188.5196	(79)

Solar gains	232.2700	402.2324	567.8580	732.9465	847.7440	853.3945	817.8607	730.4155	624.7467	449.2726	279.4061	197.9980	(83)
Total gains	853.2352	1037.9552	1176.7849	1320.1576	1404.5490	1389.7157	1333.3021	1246.6980	1156.9145	999.9074	864.3298	805.6063	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	42.2597	42.3446	42.4282	42.8254	42.9005	43.2538	43.2538	43.3198	43.1170	42.9005	42.7488	42.5913	
alpha	3.8173	3.8230	3.8285	3.8550	3.8600	3.8836	3.8836	3.8880	3.8745	3.8600	3.8499	3.8394	
util living area													
	0.9808	0.9605	0.9241	0.8423	0.7100	0.5379	0.3987	0.4417	0.6598	0.8816	0.9642	0.9843	(86)

Living	19.7001	19.9304	20.2145	20.5414	20.7686	20.8817	20.9110	20.9065	20.8347	20.5249	20.0535	19.6594	
Non living	18.4461	18.7366	19.0897	19.4863	19.7373	19.8510	19.8720	19.8711	19.8114	19.4792	18.9019	18.4000	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	31	28	31	30	31	30	31	31	30	31	30	31	
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
MIT	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	(87)
Th 2	19.9563	19.9582	19.9600	19.9686	19.9703	19.9778	19.9778	19.9792	19.9749	19.9703	19.9670	19.9636	(88)
util rest of house	0.9764	0.9519	0.9078	0.8101	0.6557	0.4618	0.3094	0.3488	0.5842	0.8494	0.9549	0.9807	(89)
MIT 2	19.9563	19.9582	19.9600	19.9686	19.9703	19.9778	19.9778	19.9792	19.9749	19.9703	19.9670	19.9636	(90)
Living area fraction									fLA = Living area / (4) =			0.3754	(91)
MIT	20.3482	20.3493	20.3505	20.3559	20.3569	20.3616	20.3616	20.3625	20.3598	20.3569	20.3548	20.3527	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.3482	20.3493	20.3505	20.3559	20.3569	20.3616	20.3616	20.3625	20.3598	20.3569	20.3548	20.3527	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9782	0.9554	0.9144	0.8229	0.6770	0.4912	0.3434	0.3843	0.6140	0.8625	0.9587	0.9821	(94)
Useful gains	834.6187	991.6464	1076.0179	1086.3919	950.9232	682.5966	457.9144	479.1378	710.3099	862.4391	828.6588	791.2073	(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	2021.3831	1942.0518	1737.6376	1423.8889	1074.1084	709.0342	462.9093	486.8856	772.7855	1210.5917	1650.4404	2018.7079	(97)
Space heating kWh	882.9527	638.6724	492.2450	242.9979	91.6497	0.0000	0.0000	0.0000	0.0000	259.0256	591.6828	913.2605	(98a)
Space heating requirement - total per year (kWh/year)												4112.4866	
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	882.9527	638.6724	492.2450	242.9979	91.6497	0.0000	0.0000	0.0000	0.0000	259.0256	591.6828	913.2605	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4112.4866	
Space heating per m2											(98c) / (4) =	37.7050	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	320.7395	(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	882.9527	638.6724	492.2450	242.9979	91.6497	0.0000	0.0000	0.0000	0.0000	259.0256	591.6828	913.2605	(98)
Space heating efficiency (main heating system 1)	320.7395	320.7395	320.7395	320.7395	320.7395	0.0000	0.0000	0.0000	0.0000	320.7395	320.7395	320.7395	(210)
Space heating fuel (main heating system)	275.2866	199.1250	153.4719	75.7617	28.5745	0.0000	0.0000	0.0000	0.0000	80.7589	184.4746	284.7359	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating

Water heating requirement	209.9200	185.4302	197.2159	174.7821	170.1715	154.2163	153.2160	159.0627	160.4644	177.7945	187.5198	207.8872	(64)
Efficiency of water heater												112.5000	(216)
(217)m	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	(217)
Fuel for water heating, kWh/month	186.5956	164.8268	175.3030	155.3619	151.2635	137.0812	136.1920	141.3891	142.6350	158.0396	166.6842	184.7886	(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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(231)
Lighting	31.9800	25.6555	23.0999	16.9240	13.0726	10.6804	11.9253	15.5009	20.1341	26.4171	29.8380	32.8688	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-53.9200	-80.9732	-122.6549	-140.5518	-150.9725	-138.0483	-136.1976	-127.3452	-110.2844	-92.2761	-60.3425	-45.9585	(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	-18.8145	-43.7156	-97.0771	-162.2935	-228.6987	-237.0657	-233.2148	-192.0577	-134.2805	-69.2662	-26.6191	-14.4246	(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	1282.1890	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	112.5000	
Water heating fuel used	1900.1605	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
Total electricity for the above, kWh/year	0.0000	(231)
Electricity for lighting (calculated in Appendix L)	258.0966	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-2717.0529	(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	723.3931	(238)

Full SAP Calculation Print out
Energy Efficiency Calculator

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	1282.1890	0.1560	200.0695	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1900.1605	0.1407	267.3796	(264)
Space and water heating			467.4491	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	258.0966	0.1443	37.2513	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1259.5249	0.1343	-169.0917	
PV Unit electricity exported	-1457.5280	0.1231	-179.4311	
Total			-348.5228	(269)
Total CO2, kg/year			156.1776	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			1.4300	(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	1282.1890	1.5777	2022.8539	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1900.1605	1.5203	2888.8149	(278)
Space and water heating			4911.6689	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	258.0966	1.5338	395.8771	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1259.5249	1.4962	-1884.4547	
PV Unit electricity exported	-1457.5280	0.4518	-658.4438	
Total			-2542.8985	(283)
Total Primary energy kWh/year			2764.6475	(286)
Dwelling Primary energy Rate (DPER)			25.3500	(287)

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	58.5700 (1b)	x	2.8500 (2b)	=	166.9245	(1b) - (3b)
First floor	50.5000 (1c)	x	2.8500 (2c)	=	143.9250	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	109.0700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	310.8495	(5)

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2. Ventilation rate

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		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	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) =	0.1287	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3787	(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) =	0.3219	(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	0.4104	0.4023	0.3943	0.3541	0.3460	0.3058	0.3058	0.2977	0.3219	0.3460	0.3621	0.3782	(22b)
Effective ac	0.5842	0.5809	0.5777	0.5627	0.5599	0.5468	0.5468	0.5443	0.5518	0.5599	0.5656	0.5715	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K

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TER Opaque door			2.3500	1.0000	2.3500		(26)
TER Opening Type (Uw = 1.20)			24.9200	1.1450	28.5344		(27)
GF			58.5700	0.1300	7.6141		(28a)
EW	149.6200	27.2700	122.3500	0.1800	22.0230		(29a)
FR	59.5600		59.5600	0.1100	6.5516		(30)
Total net area of external elements Aum(A, m2)			267.7500				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		67.0731		(33)
PW			44.9900	0.0000	0.0000		(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 175.6898 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	9.0500	0.0500	0.4525
E3 Sill	9.0500	0.0500	0.4525
E4 Jamb	19.0600	0.0500	0.9530
E5 Ground floor (normal)	27.8800	0.1600	4.4608
[illegible]	27.8800	0.0800	2.2304
E10 Corner (normal)	9.8000	0.0900	0.8820

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 9.4312 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 76.5043 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	59.9286	59.5932	59.2644	57.7200	57.4311	56.0860	56.0860	55.8369	56.6041	57.4311	58.0156	58.6267	(38)
Heat transfer coeff	136.4329	136.0974	135.7686	134.2243	133.9353	132.5902	132.5902	132.3412	133.1083	133.9353	134.5199	135.1310	(39)

Average = Sum(39)m / 12 = 134.2229

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2509	1.2478	1.2448	1.2306	1.2280	1.2156	1.2156	1.2134	1.2204	1.2280	1.2333	1.2389	(40)
HLP (average)												1.2306	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.8091 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	71.3196	70.2478	68.6860	65.6978	63.4925	61.0332	59.6354	61.1854	62.8845	65.5250	68.5774	71.0464	(42a)
Hot water usage for baths	30.7930	30.3357	29.6917	28.5043	27.6151	26.6292	26.0967	26.7362	27.4325	28.4874	29.6993	30.6889	(42b)
Hot water usage for other uses	43.3983	41.8201	40.2420	38.6639	37.0858	35.5077	35.5077	37.0858	38.6639	40.2420	41.8201	43.3983	(42c)

Average daily hot water use (litres/day) 133.7572 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	145.5109	142.4037	138.6197	132.8659	128.1934	123.1701	121.2397	125.0073	128.9808	134.2544	140.0969	145.1335	(44)
Energy conte	230.4537	202.7809	213.0534	181.8868	172.5730	151.4520	146.6290	154.7852	159.0463	182.1820	199.5937	227.2440	(45)
Energy content (annual)										Total = Sum(45)m =		2221.6800	
Distribution loss (46)m = 0.15 x (45)m	34.5681	30.4171	31.9580	27.2830	25.8859	22.7178	21.9943	23.2178	23.8569	27.3273	29.9391	34.0866	(46)
Water storage loss:													
Store volume												145.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3665	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7379	(55)
Total storage loss	22.8747	20.6610	22.8747	22.1368	22.8747	22.1368	22.8747	22.8747	22.1368	22.8747	22.1368	22.8747	(56)
If cylinder contains dedicated solar storage	22.8747	20.6610	22.8747	22.1368	22.8747	22.1368	22.8747	22.8747	22.1368	22.8747	22.1368	22.8747	(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	276.5908	244.4531	259.1904	226.5356	218.7101	196.1008	192.7660	200.9223	203.6951	228.3191	244.2425	273.3811	(62)
WWHRS	-32.6044	-28.8356	-30.1949	-25.0026	-23.3015	-19.9393	-18.6899	-19.8748	-20.6299	-24.3204	-27.5521	-32.0006	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	243.9864	215.6176	228.9955	201.5330	195.4085	176.1615	174.0761	181.0475	183.0651	203.9986	216.6904	241.3806	(64)
									Total per year (kWh/year) = Sum(64)m =			2461.9608	(64)
12Total per year (kWh/year)												2462	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												0.0000	(64a)
Heat gains from water heating, kWh/month	113.5355	100.7624	107.7499	96.1964	94.2902	86.0768	85.6638	88.3757	88.6019	97.4852	102.0839	112.4683	(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	140.4563	140.4563	140.4563	140.4563	140.4563	140.4563	140.4563	140.4563	140.4563	140.4563	140.4563	140.4563	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	136.2914	150.8941	136.2914	140.8345	136.2914	140.8345	136.2914	136.2914	140.8345	136.2914	140.8345	136.2914	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	270.2130	273.0170	265.9511	250.9086	231.9202	214.0738	202.1513	199.3473	206.4132	221.4557	240.4441	258.2905	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.0456	37.0456	37.0456	37.0456	37.0456	37.0456	37.0456	37.0456	37.0456	37.0456	37.0456	37.0456	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-112.3651	-112.3651	-112.3651	-112.3651	-112.3651	-112.3651	-112.3651	-112.3651	-112.3651	-112.3651	-112.3651	-112.3651	(71)
Water heating gains (Table 5)	152.6015	149.9441	144.8251	133.6061	126.7341	119.5512	115.1395	118.7846	123.0582	131.0285	141.7832	151.1671	(72)
Total internal gains	627.2429	641.9921	615.2046	593.4861	563.0827	539.5963	518.7191	519.5602	535.4428	556.9125	591.1987	613.8859	(73)

6. Solar gains

[Jan]	Area	Solar flux	g	FF	Access	Gains

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		m2	Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c	factor Table 6d	W	
Northeast		5.8200	11.2829	0.6300	0.7000	0.7700	20.0686	(75)
Southeast		2.1500	36.7938	0.6300	0.7000	0.7700	24.1760	(77)
Southwest		16.9500	36.7938	0.6300	0.7000	0.7700	190.5972	(79)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	234.8419	406.6886	574.1551	741.0840	857.1645	862.8814	826.9511	738.5281	631.6779	454.2515	282.5004	200.1902	(83)
Total gains	862.0847	1048.6806	1189.3596	1334.5701	1420.2472	1402.4777	1345.6702	1258.0884	1167.1207	1011.1640	873.6991	814.0761	(84)

7. Mean internal temperature (heating season)

ods 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	39.0149	39.1111	39.2058	39.6569	39.7424	40.1456	40.1456	40.2212	39.9893	39.7424	39.5697	39.3908	
alpha	3.6010	3.6074	3.6137	3.6438	3.6495	3.6764	3.6764	3.6814	3.6660	3.6495	3.6380	3.6261	
util living area													
	0.9810	0.9622	0.9290	0.8543	0.7307	0.5634	0.4219	0.4660	0.6834	0.8900	0.9655	0.9843	(86)
MIT	19.2025	19.5159	19.9148	20.3899	20.7379	20.9261	20.9802	20.9716	20.8474	20.3783	19.7072	19.1520	(87)
Th 2	19.8795	19.8820	19.8843	19.8956	19.8977	19.9075	19.9075	19.9093	19.9037	19.8977	19.8934	19.8890	(88)
util rest of house													
	0.9766	0.9537	0.9130	0.8223	0.6748	0.4811	0.3223	0.3632	0.6042	0.8583	0.9563	0.9806	(89)
MIT 2	17.8130	18.2083	18.7054	19.2834	19.6718	19.8605	19.8997	19.8971	19.7945	19.2868	18.4622	17.7552	(90)
Living area fraction									fLA = Living area / (4) =			0.3754	(91)
MIT	18.3347	18.6992	19.1595	19.6988	20.0721	20.2606	20.3054	20.3005	20.1898	19.6966	18.9296	18.2796	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3347	18.6992	19.1595	19.6988	20.0721	20.2606	20.3054	20.3005	20.1898	19.6966	18.9296	18.2796	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9681	0.9421	0.9004	0.8158	0.6843	0.5088	0.3593	0.4011	0.6263	0.8514	0.9457	0.9731	(94)
Useful gains	834.6108	987.9398	1070.8442	1088.7657	971.8938	713.5190	483.5487	504.5577	730.9951	860.9119	826.2775	792.2016	(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													
	1914.7940	1878.0419	1718.7617	1449.4643	1121.3162	750.5407	491.2971	516.1957	810.6028	1218.3535	1591.3189	1902.5929	(97)
Space heating kWh													
	803.6563	598.1486	482.0506	259.7030	111.1703	0.0000	0.0000	0.0000	0.0000	265.9365	550.8298	826.1312	(98a)
Space heating requirement - total per year (kWh/year)												3897.6263	
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													
	803.6563	598.1486	482.0506	259.7030	111.1703	0.0000	0.0000	0.0000	0.0000	265.9365	550.8298	826.1312	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3897.6263	
Space heating per m2											(98c) / (4) =	35.7351	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												92.3000	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	803.6563	598.1486	482.0506	259.7030	111.1703	0.0000	0.0000	0.0000	0.0000	265.9365	550.8298	826.1312	(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)													
	870.7002	648.0484	522.2650	281.3683	120.4445	0.0000	0.0000	0.0000	0.0000	288.1219	596.7820	895.0500	(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													
	243.9864	215.6176	228.9955	201.5330	195.4085	176.1615	174.0761	181.0475	183.0651	203.9986	216.6904	241.3806	(64)
Efficiency of water heater												79.8000	(216)
(217)m	86.5273	86.2234	85.6877	84.6295	82.8447	79.8000	79.8000	79.8000	79.8000	84.6554	86.0598	86.5918	(217)
Fuel for water heating, kWh/month													
	281.9763	250.0685	267.2444	238.1355	235.8734	220.7538	218.1405	226.8765	229.4049	240.9754	251.7906	278.7569	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	28.3187	22.7183	20.4553	14.9864	11.5759	9.4576	10.5600	13.7262	17.8290	23.3927	26.4220	29.1057	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-52.1351	-72.1815	-101.9048	-112.4470	-119.4492	-110.7943	-109.3419	-104.0389	-94.5052	-81.4368	-56.8112	-45.2232	(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	-33.6229	-70.2048	-138.6065	-206.8784	-272.3458	-273.2686	-270.1266	-229.3287	-168.8598	-100.0526	-44.7700	-26.6351	(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												4222.7804	(211)
Space heating fuel - main system 2												0.0000	(213)

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Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	79.8000	
Water heating fuel used	2939.9968	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
Total electricity for the above, kWh/year	86.0000	(231)
Electricity for lighting (calculated in Appendix L)	228.5479	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-2894.9690	(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)
	0.0000	(237)
Total delivered energy for all uses	4582.3561	(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	4222.7804	0.2100	886.7839	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2939.9968	0.2100	617.3993	(264)
Space and water heating			1504.1832	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	228.5479	0.1443	32.9865	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1060.2691	0.1350	-143.1252	
PV Unit electricity exported	-1834.6999	0.1261	-231.3109	
Total			-374.4362	(269)
Total CO2, kg/year			1174.6628	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			10.7700	(273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	4222.7804	1.1300	4771.7419	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2939.9968	1.1300	3322.1964	(278)
Space and water heating			8093.9382	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	228.5479	1.5338	350.5544	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1060.2691	1.4989	-1589.2596	
PV Unit electricity exported	-1834.6999	0.4628	-849.0844	
Total			-2438.3439	(283)
Total Primary energy kWh/year			6136.2495	(286)
Target Primary Energy Rate (TPER)			56.2600	(287)

Appendix D

GLA Part L 2021 Reporting Spreadsheet

Part L 2021 Performance

Residential

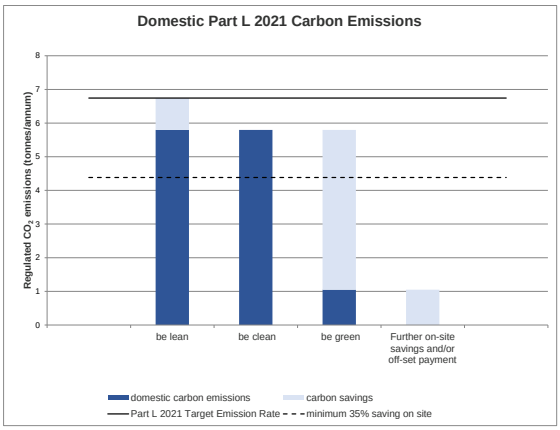
Table 1: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for residential buildings

	Carbon Dioxide Emissions for residential buildings (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2021 of the Building Regulations Compliant Development	6.7	1.6
After energy demand reduction (be lean)	5.8	1.6
After heat network connection (be clean)	5.8	1.6
After renewable energy (be green)	1.0	1.6

Table 2: Regulated Carbon Dioxide savings from each stage of the Energy Hierarchy for residential buildings

	Regulated residential carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Be lean: savings from energy demand reduction	0.9	14%
Be clean: savings from heat network	0.0	0%
Be green: savings from renewable energy	4.7	70%
Cumulative on site savings	**5.7**	**84%**
Annual savings from off-set payment	1.0	-
	(Tonnes CO_2)	
Cumulative savings for off-set payment	**31**	-
Cash in-lieu contribution (£)	**2,992**	

*carbon price is based on GLA recommended price of £95 per tonne of carbon dioxide unless Local Planning Authority price is inputted in the 'Development Information' tab



Non-residential

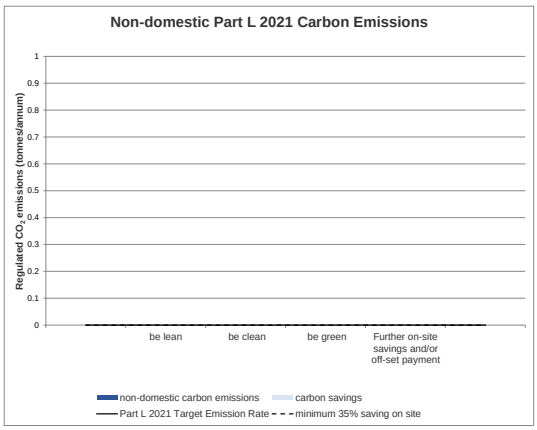
Table 3: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for non-residential buildings

	Carbon Dioxide Emissions for non-residential buildings (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2021 of the Building Regulations Compliant Development	0.0	
After energy demand reduction (be lean)	0.0	
After heat network connection (be clean)	0.0	
After renewable energy (be green)	0.0	

Table 4: Regulated Carbon Dioxide savings from each stage of the Energy Hierarchy for non-residential buildings

	Regulated non-residential carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Be lean: savings from energy demand reduction	0.0	0%
Be clean: savings from heat network	0.0	0%
Be green: savings from renewable energy	0.0	0%
Total Cumulative Savings	**0.0**	**0%**
Annual savings from off-set payment	0.0	-
	(Tonnes CO_2)	
Cumulative savings for off-set payment	**0**	-
Cash in-lieu contribution (£)	**0**	

*carbon price is based on GLA recommended price of £95 per tonne of carbon dioxide unless Local Planning Authority price is inputted in the 'Development Information' tab



SITE-WIDE

	Total regulated emissions (Tonnes CO_2 / year)	CO_2 savings (Tonnes CO_2 / year)	Percentage savings (%)
Part L 2021 baseline	6.7		
Be lean	5.8	0.9	14%
Be clean	5.8	0.0	0%
Be green	1.0	4.7	70%
Total Savings	-	5.7	84%
	-	CO_2 savings off-set (Tonnes CO_2)	-
Off-set	-	**31.5**	-

	Target Fabric Energy Efficiency (kWh/m²)	Dwelling Fabric Energy Efficiency (kWh/m²)	Improvement (%)
Development total	43.54	39.41	9%

	Area weighted non-residential cooling demand (MJ/m^2)	Total non-residential cooling demand (MJ/year)
Actual		
Notional		

EUI & space heating demand (predicted energy use)

Residential

Building type	EUI (kWh/m²/year) (excluding renewable energy)	Space heating demand (kWh/m²/year) (excluding renewable energy)	EUI value from Table 4 of the guidance (kWh/m²/year) (excluding renewable energy)	Space heating demand from Table 4 of the guidance(kWh/m²/year) (excluding renewable energy)	Methodology used (e.g. 'be seen' methodology or an alternative predictive energy modelling methodology)	Explanatory notes (if expected performance differs from the Table 4 values in the guidance)
Residential	48.71186441	40.32511556	35	15	Part L1 - SAP 10.2 & none dwellings / & Landlord Circulation	

Non-residential

Building type	EUI (kWh/m²/year) (excluding renewable energy)	Space heating demand (kWh/m²/year) (excluding renewable energy)	EUI value from Table 4 of the guidance (kWh/m²/year) (excluding renewable energy)	Space heating demand from Table 4 of the guidance(kWh/m²/year) (excluding renewable energy)	Methodology used (e.g. 'be seen' methodology or an alternative predictive energy modelling methodology)	Explanatory notes (if expected performance differs from the Table 4 values in the guidance)

Appendix E

Part G – Sample Internal Water Use Calculation

Job no:	23396
Date:	Oct-23
Assessor name:	Neil Ingham
Registration no:	STRO010583
Development name:	Belmopnt Close, Enfield
Issue Date:	24/10/2023

Rainwater | Greywater | Results

WATER EFFICIENCY CALCULATOR FOR NEW DWELLINGS

(for use with the Code for Sustainable Homes issues Wat 1 for the May 2009 and subsequent versions)

Dwelling Description	Typical 1 Bed Flat

1st step - Select from options below:

Is a Rain and/or Greywater system specified?	**No**
Is a shower AND bath present?	**Yes**
Has a washing machine been specified?	**No**
Has a dishwasher been specified?	**No**

2nd step - Build spreadsheet (click button below)

BUILD SPREADSHEET

As soon as this button is pressed the spreadsheet will change according to the options selected previously in the 1st step. Scroll down to see the changes.

3rd step - Enter consumption details for the specified fittings

TAPS (excluding kitchen taps)		Fitting type	Flow rate (litres/min)	Number of fittings
	1	Basins	5.00	1
	2			
	3			
	4			
		Proportionate flow rate (litres/min)		3.50

		Consumption / person / day (Litres)	**9.48**

BATHS		**Fitting type**	**Capacity to overflow (litres)**	**Number of fittings**
	1	Bath	165.00	1
	2			
	3			
	4			
		Proportionate capacity to overflow (litres)		115.50
		Consumption / person / day (Litres)		**18.15**

SHOWERS		**Fitting type**	**Flow rate (litres/min)**	**Number of fittings**
	1	Shower	7.50	1
	2			
	3			
	4			
		Proportionate flow rate (litres/min)		5.25
		Consumption / person / day (Litres)		**32.78**

DISHWASHER		
Where no dishwasher is specified, a default consumption figure of 1.25 litres per place setting is used.		
	Consumption / person / day (Litres)	**4.50**

WASHING MACHINES		**Number of fittings**
Where no washing		

machine is specified, a default consumption figure of 8.17 litres per kilogram of dry load is used.			
Where no washing machines have been specified but plumbing for future supply of grey/rainwater was installed, please enter details:			
		Consumption / person / day (Litres)	**17.16**

WC's	**Fitting Type**	**Flush Type**	**Volume****	**Number of fittings**
1	**Toilet**	**Full Flush**	4.50	1
		Part Flush	3.80	
2		**Full Flush**		
		Part Flush		
3		**Full Flush**		
		Part Flush		
4		**Full Flush**		
		Part Flush		
		Average effective flushing volume (litres)		4.03
		Consumption / person / day (Litres)		**17.81**

KITCHEN SINK TAPS	**Fitting Type**	**Flow rate (litres/minute)**	**Number of fittings**
1	Kitchen	6.50	1
2			
3			
4			
	Proportionate flow rate (litres/min)		4.55
	Consumption / person / day (Litres)		**13.22**

WASTE DISPOSAL UNIT	
Is a waste disposal unit specified for the dwelling?	No
Consumption / person / day (Litres)	**0.00**

WATER SOFTENER	
Water Softener in use?	No
Total capacity used per regeneration (%)	
Water consumed per regeneration (litres)	
Average number of regeneration cycles per day (No.)	
Number of occupants served by the system (No.)	

Water consumed beyond 4% person / day (Litres)	**0.00**

4th step - Analyse Results

Go to Start

INTERNAL WATER CONSUMPTION		
NET INTERNAL WATER CONSUMPTION	(litres/person/day)	**113.10**
RAINWATER ONLY COLLECTION SAVING	(litres/person/day)	**0.00**
GREYWATER ONLY RECYCLING SAVING	(litres/person/day)	**0.00**
RAIN/GREYWATER COLLECTION SAVING (combined system)	(litres/person/day)	**0.00**
NORMALISATION FACTOR	(litres/person/day)	**0.91**
TOTAL WATER CONSUMPTION	(litres/person/day)	**102.9**
CSH CREDITS ACHIEVED		**3**
CSH MANDATORY LEVEL:		**Level 3/4**

17. K COMPLIANCE		
EXTERNAL WATER USE	(litres / person / day)	5.00
TOTAL WATER CONSUMPTION	(litres / person / day)	**107.9**
17. K COMPLIANCE?		**Yes**

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