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ENERGY STATEMENT

Proposed residential development, Land at South Worple Way, East Sheen, London SW14 8TN
Planning | July 2024

Report reference CG-11 (version 1)

Contents

Revision	Date	Revision Description	Prepared by
First Issue	*25/07/2024*		*CM*

1.0. Executive Summary

This Energy Report has been prepared by Therm Energy Ltd in support of a full planning. application for a residential scheme at land at South Worple Way, East Sheen, London SW14 8TN.

The Development comprises a block of 4no.Flats to be built over 2-storeys, and a small, detached house.

The Report includes an energy demand assessment demonstrating how various energy efficiency, low carbon and renewable measures have been considered and those that have been recommended for incorporation into the development.

SAP thermal calculations have been prepared for all of the dwellings and are based on the construction specification described within the report as well as the drawings provided by the Client.

The site is of relatively low density and does not have sufficient baseload to efficiency to justify communal heating.

It is proposed to meet the required reduction in carbon emissions by a very good standard of fabric performance combined with low carbon heat pumps to provide heating and hot water.

The reduction in carbon emissions is summarized as follows.

Dwelling	**Total CO_2 Emissions** (Total CO_2, kg/year)
Part L Target Emissions	3 977
Proposed Carbon Emissions	1874
% Reduction in Carbon Emissions	**52**

The Planning requirement calls for a minimum 35% reduction in carbon emissions against a Building Regulation Part L (2021) baseline. This requirement is met.

2.0. Introduction

This Energy Statement has been prepared by Therm Energy Ltd in support of a full planning. application for a residential scheme at land at South Worple Way, East Sheen, London SW14 8TN.

The Development comprises a block of 4no. flats to be built over 2-storeys, and a small, detached house.

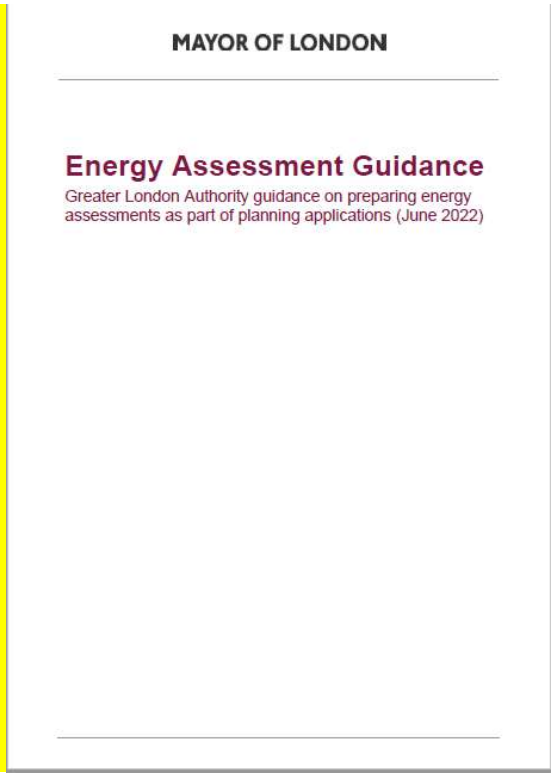
The local authority is the London Borough of Richmond upon Thames. .

The design has been developed to address the energy performance policy requirements of the London Borough of Richmond upon Thames. The relevant policies are.

- LP 20 Climate Change Adaption.
- LP 22 Sustainable Design and Construction.

This is a minor development of less han 9 dwellings. There is an expectactation that the development should achieve a 35 per cent reduction in carbon emissions beyond Part L (2021) Standards.

Energy reports are required to be developed in accorance with the guidance provided by the London Plan. It is assumed that the latest guidance published in June 2022 applies.


MAYOR OF LONDON

Energy Assessment Guidance

Greater London Authority guidance on preparing energy assessments as part of planning applications (June 2022)

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The proposed dwellings have been designed and will be built to reduce energy demand and carbon dioxide emissions. For energy efficiency, the approach is set out in London Plan, SI 2 Minimizing greenhouse gas emissions, SI 4 Managing heat risk. In addition to the requirements for zero-carbon in major new developments in London Plan policy SI 2.
The Development will consider the requirements of the Energy Hierarchy (Policy LP22 (B), namely.

1. Be-lean – use less energy
2. Be-clean – supply energy efficiently
3. Be-green – use renewable energy

3. The Development

The site is located at land South Worple Way, East Sheen, London SW14 8TN.

This residential development comprises a block of 4no. flats to be built over 2-storeys, and a small, detached house. There are five proposed dwellings in total.

The site plan is shown in Fig.1 and the habitable floor areas of each dwelling are shown in Table 1.

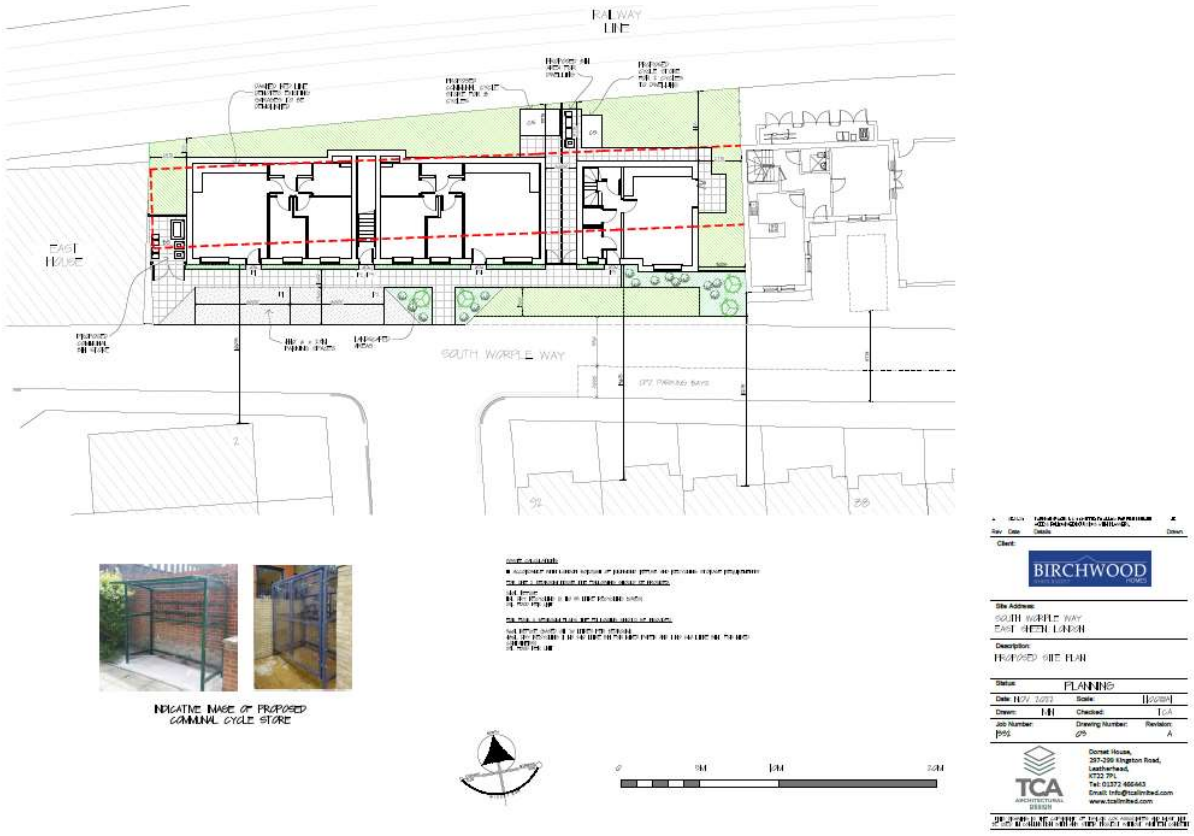

Fig 1 - Site Plan

Table 1 - Schedule of Accommodation

Description	Total Habitable Floor Area (m^2)
Flat A - Ground Floor	60
Flat B - Ground Floor	60
Flat C - First Floor	60
Flat C - First Floor	60
Detached House	82
Total Area	**322**

4. Policies and drivers

4.1. National and international policy

Over the past 25 years the need to reduce the growth in global greenhouse gas emissions has been gaining momentum on the international political agenda. Since the Kyoto Protocol was agreed upon in 1997, most countries have been setting targets for national carbon emissions reductions - the UK was the first to put this into legislation.

The Climate Change Act (2008) sets a legally binding target for reducing UK carbon dioxide (CO2) by at least 80% by 2050. It also provides for a Committee on Climate Change, which sets out carbon budgets binding on the Government for 5-year periods.

The Act is the driver behind a framework of strategies and policy documents developed at national and regional levels such as The Carbon Plan (DECC 2011) and zero carbon buildings policy (DCLG), which in turn have informed the development of local planning policy.

4.2. Regional Policy: London Plan

4.2.1. Policy S1 2 Minimising caron dioxide emissions

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

C. A minimum on-site reduction of at least 35 per cent beyond Building Regulations is required for major development. Residential development should achieve 10 per cent, and non-residential development should 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, in agreement with the borough, either:
1) through a cash in lieu contribution to the borough's carbon offset fund, or
2) off-site provided that an alternative proposal is identified and delivery is certain.

D. Boroughs must establish and administer a carbon offset fund. Offset fund payments must be ring-fenced to implement projects that deliver carbon reductions. The operation of offset funds should be monitored and reported on annually.

The Mayor is committed to London becoming a zero-carbon city. This will require reduction of all greenhouse gases, of which carbon dioxide is the most prominent. London's homes and workplaces are responsible for producing approximately 78 per cent of its greenhouse gas emissions. If London is to achieve its objective of becoming a zero-carbon city by 2050, new development needs to meet the requirements of this policy. Development involving major refurbishment should also aim to meet this policy.

The energy hierarchy (Fig. 2) should inform the design, construction and operation of new buildings. The priority is to minimise energy demand, and then address how energy will be supplied and renewable technologies incorporated. An important aspect of managing demand will be to reduce peak energy loadings.

Boroughs should ensure that all developments maximise opportunities for on-site electricity and heat production from solar technologies (photovoltaic and thermal) and use innovative building materials and smart technologies. This approach will reduce carbon emissions, reduce energy costs to occupants, improve London's energy resilience and support the growth of green jobs.

A zero-carbon target for major residential developments has been in place for London since October 2016 and applies to major non-residential developments.

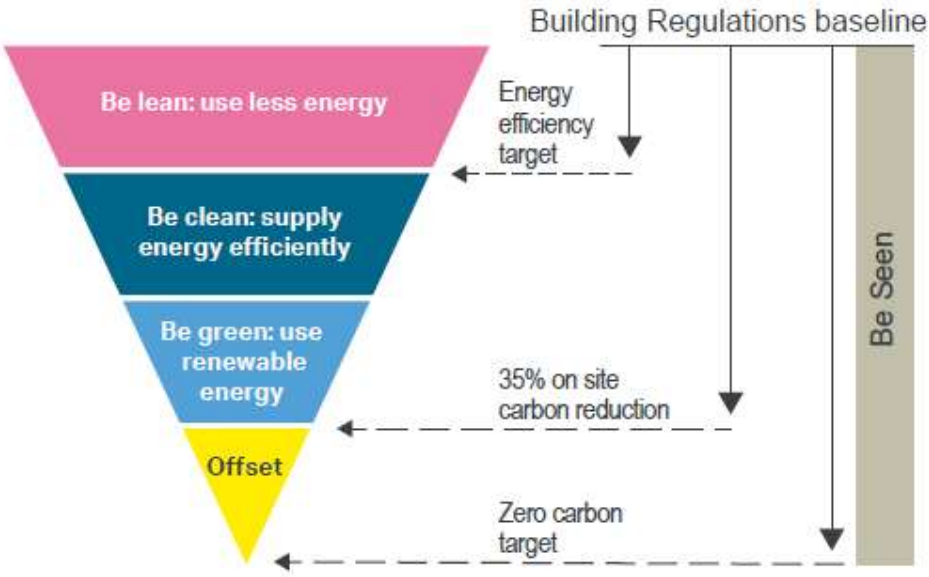

Fig. 2 - The energy hierarchy and associated targets

4.2.2. Decarbonizing the grid

The electricity grid has significantly decarbonised since the last update to the 2013 Part L (Thermal Standards) of the Building Regulations.
Latest amendments to the SAP methodology include updated carbon emission factors for the various fuels commonly used to provide heating and hot water.

4.2.3. Decentralised energy in development in development proposals

This policy requires development proposals to evaluate the feasibility of CHP systems and, where a new CHP system is appropriate, to examine opportunities to extend it beyond the site boundary to adjacent sites.

It requires major development proposals to select energy systems in accordance with the following hierarchy:
1. Connection to existing heating or cooling networks
2. Site-wide CHP network

3. Communal heating and cooling.

4.2.4 Renewable energy

The London Plan Policy S1 2 requires that all developments maximise opportunities for on-site electricity and heat production from solar technologies (photovoltaic and thermal) and use innovative building materials and smart technologies. This approach will reduce carbon emissions, reduce energy costs to occupants, improve London's energy resilience and support the growth of green jobs.

4.2.5 Overheating and cooling

The London Plan Policy S1 4 *Managing Heat Risk* Policy requires the following.

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.

4.3. London Borough of Richmond

The relevant policies are.

- LP 20 Climate Change Adaption.
- LP 22 Sustainable Design and Construction.

LP 20 Climate Change Adaption

A. The Council will promote and encourage development to be fully resilient to the future impacts of climate change in order to minimise vulnerability of people and property.

B. New development, in their layout, design, construction, materials, landscaping and operation, should minimise the effects of overheating as well as minimise energy consumption in accordance with the following cooling hierarchy:
1. minimise internal heat generation through energy efficient design
2. reduce the amount of heat entering a building in summer through shading, reducing solar reflectance, fenestration, insulation and green roofs and walls
3. manage the heat within the building through exposed internal thermal mass and high ceilings
4. passive ventilation
5. mechanical ventilation
6. active cooling systems (ensuring they are the lowest carbon options).

C. Opportunities to adapt existing buildings, places and spaces to the likely effects of climate change should be maximised and will be supported.

LP 22 Sustainable Design and Construction

A. Developments will be required to achieve the highest standards of sustainable design and construction to mitigate the likely effects of climate change. Applicants will be required to complete the following:
1. Development of 1 dwelling unit or more, or 100sqm or more of non-residential floor space (including extensions) will be required to complete the Sustainable Construction Checklist SPD. A completed Checklist has to be submitted as part of the planning application.
2. Development that results in a new residential dwelling, including conversions, change of use, and extensions that result in a new dwelling unit, will be required to incorporate water conservation measures to achieve maximum water consumption of 110 litres per person per day for homes (including an allowance of 5 litres or less per person per day for external water consumption).
3. New non-residential buildings over 100sqm will be required to meet BREEAM 'Excellent' standard.
4. Proposals for change of use to residential will be required to meet BREEAM Domestic Refurbishment 'Excellent' standard (where feasible).

Reducing Carbon Dioxide Emissions

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

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

Targets are expressed as a percentage improvement over the target emission rate (TER) based on Part L of the 2013 Building Regulations.

C. This should be achieved by following the Energy Hierarchy:
1. Be lean: use less energy
2. Be clean: supply energy efficiently
3. Be green: use renewable energy

Decentralised Energy Networks

D. The Council requires developments to contribute towards the Mayor of London target of 25% of heat and power to be generated through localised decentralised energy (DE) systems by 2025. The following will be required:
1. All new development will be required to connect to existing DE networks where feasible. This also applies where a DE network is planned and expected to be operational within 5 years of the development being completed.

2. Development proposals of 50 units or more, or new non-residential development of 1000sqm or more, will need to provide an assessment of the provision of on-site decentralised energy (DE) networks and combined heat and power (CHP).

3. Where feasible, new development of 50 units or more, or new non-residential development of 1000sqm or more, as well as schemes for the Proposal Sites identified in this Plan, will need to provide on-site DE and CHP; this is particularly necessary within the clusters identified for DE opportunities in the borough-wide Heat Mapping Study. Where on-site provision is not feasible, provision should be made for future connection to a local DE network should one become available. Applicants are required to consider the installation of low, or preferably ultra-low, NOx boilers to reduce the amount of NOx emitted in the borough.
Local opportunities to contribute towards decentralised energy supply from renewable and low-carbon technologies will be encouraged where appropriate.

Retrofitting

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

5. Assessment Methodology

The 5no. Dwellings have been modelled using the SAP 10 Assessment methodology.

This is the recommended method for assessing dwellings for compliance against Part L (2021) of the Building Regulations.

6. Energy hierarchy

In line with best practice the proposed energy strategy for this development will follow the principals of the energy hierarchy.
The energy hierarchy has three priorities, seeking to reduce energy use before meeting remaining demand by the cleanest means possible.

- ✓ **Be-Lean** – use less energy: Optimise the building fabric, glazing, and structure to minimise energy consumption in the first instance by using low U-values and good air tightness, and ensure that active systems run as energy efficiently as possible.

- ✓ **Be-Clean** – supply energy efficiently: Further reduce carbon emissions through the use of decentralised energy where feasible, such as combined heat and power (CHP).

- ✓ **Be-Green** – use renewable energy: When the above design elements have been reasonably exhausted, supply energy through renewable sources where practical.

7. Establishing the Baseline Performance

The regulated CO_2 emissions of the proposed dwelling has been modelled using Building Regulations compliance software (SAP) to determine a baseline Target Emission Rate (TER) against which CO_2 savings can be measured at each stage of the energy hierarchy.

The baseline calculations are based on buildings that are the same size and shape as the proposed building and have the same exposed facades. This should not be regarded as a compliant specification for the proposed dwelling but one the design is compared against for regulation compliance.

The baseline or target specification is shown in Table 2.

Table 2 – Baseline U-values & Services (Target Emission Rate)

Element	Baseline Specification
Ground floor U-value	0.11
External wall U-value	0.18
Roof U-value	0.11
New windows U-value	1.2
New door U-value	1..0
Air permeability	5.0 $m^2/h.m^3$
% Low energy lighting	100%
Heating – Gas	89.5%
Wastewater Heat Recovery	YES
Photovoltaic Panels	Houses – kWp equivalent to 40% of the ground floor area

8. Energy efficient design measures (“be lean”)

It is proposed to incorporate thermal insulation standards to at least the standards shown in Table 2. Adding renewable or low carbon technologies, will then yield the maximum carbon reductions with lower long-term running costs for the occupants of the proposed dwellings.

Having reduced energy demand through improvements to the fabric, this development shall seek to reduce energy consumption further through the specification of mechanical and electrical systems with efficiencies that surpass the requirements of the Domestic Building Services Compliance Guide:

Table 3 - Improvement to building services

Element	Proposed development
Low energy lighting	100%
Electric heating (if used) e.g. heat pumps	Typical efficiency of 250-300%
Heating controls	Improved heating controls beyond Part L minimum standards.

8.1 Passive Design Measure

The passive design measures proposed include the followingr.

Passive Solar Gain

Measures include the provision of natural ventilation coupled with high levels of thermal insulation, low air permeability and the control of solar gain.
Due to the proximity of a railway, the dwellings have been designed to provide orientations towards the west, south and east with very few openings on the north side.

This results in all dwellings with access to direct sunlight throughout the day and the benefit of soalr gain is maximized.

Natural Daylighting

The orientation and the size of the windows have been optimized to maximize the amount of natural daylight and therefore reduce the demand for artificial lighting.

Building Envelope

It is proposed to incorporate thermal insulation standards to at least the standards shown in Table 2.

Air Leakage

Unwarranted heat loss can occur through gaps in the construction. This can be due to poor detailing and workmanship. It is proposed to adopt recognised construction details to limit heat loss. The Building Regulations set a minimum standard for air permeability of 8.0m^3(h.m^2). However, to meet the carbon targets, a much lower figure will have to be achieved, The design will aim to achieve an air permeability of less than 5.0m^3(h.m^2).

Thermal Bridging

Heat losses through bridged areas of the construction have to be calculated using manufacturers or trade industry provided details. The SAP calculations have been modelled assuming a Y-value of 0.04WmK.
The Y-value is the total thermal bridging heat losses for a dwelling.
This is assessed by first multiplying the Psi-value for each junction (Ψ) by its corresponding length, and adding the resulting figures together. This is known as the HTB (heat loss due to thermal bridging).

Ventilation

Building Regulation Approved Document F was revised in 2021 to coincide with Part L improved thermal standards. The dwellings will be designed to meet Part F requirements.

Lighting

The requirements for efficient lighting are contained in Approved Document L to the Building Regulations, and require internal light fittings to have lamps with an minimum luminous efficacy of 75 light source lumens per circuit-watt.

Fixed external lighting to have automatic controls which switch luminaires off in response to daylight.

9. Energy efficient systems (“be clean”)

9.1. Combined heat and power

Combined heat and power (CHP) systems use relatively cheap and clean fuels (such as natural gas) to generate heat and electricity on site. A typical CHP system uses combustion of natural gas to drive a turbine that produces electricity. The heat generated is captured and used to produce hot water.
As losses are minimised, the carbon footprint of the energy generated is very low. However this is dependent on there being sufficient year-round local heat demand to fully utilise the heat generated by the CHP plant. An example would be developments of at least 500 dwellings, universities, or hospitals.

Due to its size, this development is deemed not suitable for combined heat and power.

9.2. District heating networks

In a district heating network heat is supplied from one or more central energy centres to multiple buildings within the network. Supply to multiple buildings guarantees high year-round local heat demand which in turn allows the use of low carbon technologies within the energy centre, such as combined heat and power systems. Large plant and aggregated demand allows systems within the energy centre to run more efficiently.
Hot water is distributed within the network via highly insulated pipes. To connect to the network individual boilers are replaced with separately metered heat exchangers.
London Plan Policy 5.6 requires new developments to connect to an existing district heating network if one is available. Where there is no existing network, but potential for a future network has been identified, major developments should incorporate the infrastructure required to connect to the network. This may include installing centralised heating plant connected to individual heat exchangers within each dwelling.

Having reviewed the London Heat Map (see Fig.3) , it is evident this proposed development is neither within the coverage of an existing district heating network, nor is it within an area designated as having potential for a future network. However, this is a minor development of five dwellings, and as such it will be neither practical or cost effective to connect to a district heating network.

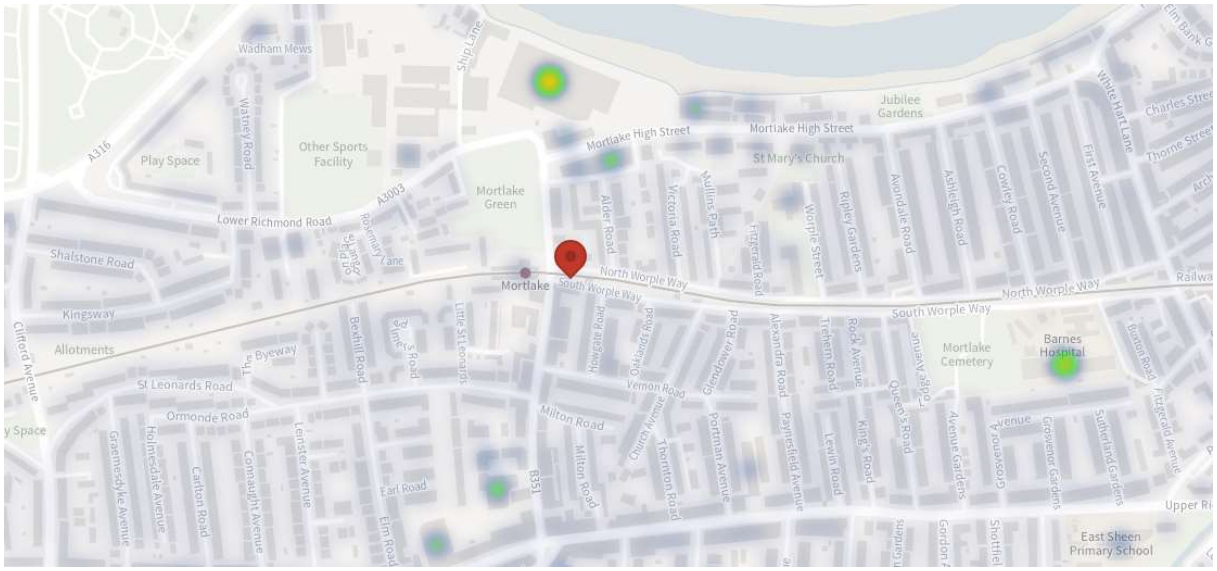

Fig 3 - London Heat Map – Richmond area

10. Low and zero carbon energy sources (“be green”)

10.1. Photovoltaics

Solar photovoltaics (PV) capture the sun's energy using photovoltaic cells. The cells convert sunlight into electricity, which can be utilised on site or transferred into the National Grid. PV cells are made from layers of semi-conducting material, usually silicon. When light shines on the cell it creates an electric field across the layers. The stronger the sunshine, the more electricity is produced. Groups of cells are mounted together in panels or modules that can be mounted on a roof.

The power of a PV cell is measured in kilowatts peak (kWp). This is the rate at which the cell generates energy at peak performance in full direct sunlight.

Photovoltaics offer high CO_2 savings, are simple to install and suitable for most buildings. The limiting factors for PV are the availability of suitable roof space and that the panels should be installed to face a favourable orientation, such as south, south-east or south-west. Overshadowing reduces the efficiency of the PV panels.

10.2. Heat pumps

The lowering of the fuel emission factor for electricity, as a result of decarbonizing of the national grid, make heat pumps an attractive choice for compliance with building regulations and planning requirements.
Heat pumps collect low temperature heat from renewable sources (such as the air or ground) and concentrate the heat to a usable temperature via a reverse refrigeration cycle. Useable heat is transferred to the dwelling via a heat exchanger and can be used for low temperature central heating and domestic hot water, though an immersion top-up may be required for DHW.

Heat pumps have some impact on the environment as they generally use grid supplied electricity to run the pumps. It is common for heat pumps to have a coefficient of performance of three, meaning that for every 1kWh of electricity used, over 3kWh of heat can be generated. The renewable component of the output is therefore taken as the difference between the output energy and the input energy, in this scenario the heat pump will be deemed to have delivered 2kWh of renewable energy.

Ground source heat pumps require external horizontal ground loops, or as is more likely in built-up environments, vertical loops fed into bore holes. The application of ground source heat pumps are therefore constrained by site ground conditions and available space.

Air source heat pumps have a slightly lower seasonal efficiency than ground source heat pumps, but require less space. Noise and space considerations should be assessed when determining an appropriate site for external condensing units.

Heat pumps are a very good option for sites not connected to the gas network, or as a replacement of existing electric or oil-fired heating systems. When assessed against a gas

central heating system on cost versus potential CO_2 savings, heat pumps will often perform less favourably.

Recent developments in heat pump technology have seen the introduction of domestic hot water heat pumps which deliver hot water very efficiently. These models are described as a 'Hot water heat pumps' and this solution is ideally suited to relatively small dwellings, such as Flats, and can provide a Part L compliant solution. Products are available from several manufacturers including Dimplex and Valliant.

Figure 4 - Hot Water Heat Pumps

10.3. Solar thermal

Solar thermal systems use free heat from the sun to warm domestic hot water. A conventional boiler or immersion heater can be used to make the water hotter, or to provide hot water when solar energy is unavailable.

Solar thermal systems are most appropriate for buildings with high year-round domestic hot water demand. For this development, the hot water demand is anticipated to be relatively low.

Although a typical solar thermal system will be able to meet half the annual domestic hot water demand for a dwelling, many will use electricity to run pumps within the system. This means the resultant CO_2 and cost savings in a home with a gas boiler will be relatively low. Solar hot water is insufficient to meet Building Regulation and Planning requirements without additional technologies and is not considered viable for this development

10.4. Wind turbines

Wind turbines use blades to catch the wind. When the wind blows, the blades are forced round, driving a turbine which generates electricity. The stronger the wind, the more electricity produced.

There are two types of domestic-sized wind turbine: Pole mounted and building mounted. Pole mounted turbines are free standing and are erected in a suitably exposed position, and are often about 5kW to 6kW in size. Building mounted turbines are smaller and can be installed on the roof of a home where there is a suitable wind resource. Often these are around 1kW to 2kW in size.

Large scale turbines, in exposed locations offer one of the best financial returns of all renewable energy systems as the payback of the system increases dramatically with the size of the turbine. However small- scale systems offer much lower levels of performance and recent studies have questioned the viability and output from such systems, particularly in urban environments. Solar thermal systems use free heat from the sun to warm domestic hot water. A conventional boiler or immersion heater can be used to make the water hotter, or to provide hot water when solar energy is unavailable.

10.5. Biomass

Biomass heating systems, burn wood pellets, chips or logs to provide warmth in a single room or to power central heating and hot water boilers. The carbon dioxide emitted when wood is burned is the same amount that was absorbed over the months and years that the plant was growing. The process is sustainable as long as new plants continue to grow in place of those used for fuel. There are some carbon emissions caused by the cultivation, manufacture and transportation of the fuel, but as long as the fuel is sourced locally, these are much lower than the emissions from fossil fuels.

When specifying biomass heating systems is important to consider the potential technical issues surrounding delivery and storage of fuel.

Although the CO_2 savings from biomass are substantial, the high levels of NOx emissions can make biomass systems unsuitable for urban environments.

Biomass is no longer considered to be a viable solution to meet Part L targets and beyond.

10.6. Proposed low and zero carbon energy sources

Based on the above findings, it is deemed that the most appropriate way to meet the reduction in carbon emissions against the TER or predicted energy usage, is using air source heat pumps (ASHP) to provide main heating and hot water.

ASHPs are a low carbon technology and will be expected to comfortably meet the carbon and energy targets for this development. This will be used in conjunction with a building fabric that will be built to a high standard of thermal insulation.

Fig. 4 - Typical air source heat pump

The detailed design of the heating system will determine the most appropriate model and capacity of the heating system. However, it can safely be assumed that the heating efficiency will be at least 250%, which the SAP calculations have taken account of.

Hot water heat pumps may provide a solution for the Flats. These heat pumps are located within the dwelling.

11. Establishing Carbon Dioxide Emissions

SAP calculations have been prepared for all of the dwellings AND THE RESULTS ARE SHOWN IN Table 3. The calculation worksheets are provided in Appendix A of this report.

Table 3 - Reduction in Carbon Emissions

Dwelling	Area (m^2)	TER (Total CO_2, kg/year/m^2)	DER (Total CO_2, kg/year/m^2)	% Reduction in CO_2 Emissions
Flat A	60	12.43	5.77	53.5
Flat B	60	12.43	5.77	53.5
Flat C	60	12.29	5.81	52.7
Flat D	60	12.29	5.81	52.7
House	82	12.35	5.92	52.0
Total	**322**			

Using the results from Table 3 and aggregating them across all five units, the total carbon emissions can be calculated and are shown in Table 4.

Table 4 – Site Wide Reduction in Carbon Emissions

Dwelling	Area (m^2)	TER (Total CO_2, kg/year)	DER (Total CO_2, kg/year)	% Reduction in CO_2 Emissions
All Dwellings	322	3 977	1 874	52
Total	322	3 977	1 874	52

The maximum regulated carbon emissions (based on the TER) are assessed as 3 977 CO_2, kg/year.

The proposed regulated carbon emissions (based on the DER) are assessed as 1 874 CO_2, kg/year.

The reduction in site CO_2 emissions as a result of the proposed energy efficiency measures incorporated into the dwellings are assessed as 2 103 CO_2, kg/year, which corresponds to a 52% reduction on carbon emissions.

The energy demand assessment shows that the carbon saving measures outlined give an overall reduction of **52%** compared to Building Regulations Part L (2021) through the use of lean and green carbon reduction measures, including use of an air source heat pump to provide heating and hot water.

12. Conclusions

The Development proposes 5 new dwellings. The energy performance of the dwellings has been considered against the requirements of:

- London Borough of Richmond upon Thames Policies LP20 and LP22.

The dwellings have been designed to achieve at least a 35% reduction in CO_2 emissions when compared to a baseline in accordance with Part L1 (2021) of the Building Regulations. The proposed fabric and mechanical services result in a carbon reduction of around 52%.This meets the required carbon reduction requirements

The findings of this Report are supported by;

- SAP thermal calculations as described in Appendix A.

Appendix A: SAP worksheets

The following SAP TER and DER worksheets are included to support the findings of this report.

Flats - Calculation ref. CG-11-01, CG-11-02, CG-11-03, CG-11-04

House - Calculation ref. CG-11-05

Full SAP Calculation Printout

Property Reference	CG-11-01 Flat	**Issued on Date**	25/07/2024
Assessment Reference	CG-11-01 SAP Design	**Prop Type Ref**	Flat 1 - Ground
Property	Flat 1 - Ground, South Worple Way, East Sheen		

SAP Rating	80 C	**DER**	5.77	**TER**	12.43
Environmental	96 A	**% DER < TER**			53.58
CO_2 Emissions (t/year)	0.28	**DFEE**	30.23	**TFEE**	34.60
Compliance Check	See BREL	**% DFEE < TFEE**			12.65
% DPER < TPER	8.93	**DPER**	59.50	**TPER**	65.33

Assessor Details	Mr. Colin Marshall	**Assessor ID**	AV43-0001
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		60.0000 (1b)	x	2.5000 (2b)	=	150.0000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	60.0000						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	150.0000	(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		1 * 10 =	10.0000 (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) =		10.0000 / (5) =	0.0667 (8)
Pressure test			Yes
Pressure Test Method			Blower Door
Measured/design AP50			5.0000 (17)
Infiltration rate			0.3167 (18)
Number of sides sheltered			1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.2929 (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	0.3735	0.3661	0.3588	0.3222	0.3149	0.2783	0.2783	0.2709	0.2929	0.3149	0.3295	0.3442	(22b)
Effective ac	0.5697	0.5670	0.5644	0.5519	0.5496	0.5387	0.5387	0.5367	0.5429	0.5496	0.5543	0.5592	(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	
solid D			1.8900	1.2000	2.2680			(26)
W or Glazed D (Uw = 1.30)			5.5100	1.2357	6.8089			(27)
ground			60.0000	0.1200	7.2000	75.0000	4500.0000	(28a)
cavity wall	65.0000	7.4000	57.6000	0.1800	10.3680	190.0000	10944.0000	(29a)
common wall	15.0000		15.0000	0.2000	3.0000	190.0000	2850.0000	(29a)
Total net area of external elements Aum(A, m2)			140.0000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		29.6449			(33)
Party Ceiling 1			60.0000			30.0000	1800.0000	(32b)
Internal Wall 1			105.0000			9.0000	945.0000	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 21039.0000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	350.6500 (35)

List of Thermal Bridges

		Length	Psi-value	Total
E1	Steel lintel with perforated steel base plate	6.0000	0.0950	0.5700
E3	Sill	5.0000	0.0630	0.3150
E4	Jamb	14.0000	0.0820	1.1480
E5	Ground floor (normal)	30.0000	0.0480	1.4400
E6	Intermediate floor within a dwelling	30.0000	0.0750	2.2500
E16	Corner (normal)	10.0000	0.0320	0.3200

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 6.0430 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 35.6879 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	28.2021	28.0681	27.9367	27.3195	27.2040	26.6665	26.6665	26.5670	26.8736	27.2040	27.4376	27.6818	(38)
Heat transfer coeff	63.8900	63.7560	63.6246	63.0074	62.8920	62.3544	62.3544	62.2549	62.5615	62.8920	63.1256	63.3698	(39)
Average = Sum(39)m / 12 =												63.0069	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0648	1.0626	1.0604	1.0501	1.0482	1.0392	1.0392	1.0376	1.0427	1.0482	1.0521	1.0562	(40)
HLP (average)												1.0501	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 1.9816 (42)

Hot water usage for mixer showers

69.9922	68.9206	67.3414	64.9120	62.7354	59.6902	57.2818	60.0974	61.5136	64.5296	67.6706	69.9290	(42a)

Hot water usage for baths

24.2730	23.9066	23.3854	22.6047	21.9012	20.9327	20.1980	21.0965	21.5680	22.5276	23.5253	24.2538	(42b)

Hot water usage for other uses

34.9239	33.6540	32.3840	31.1140	29.8441	28.5741	28.5741	29.8441	31.1140	32.3840	33.6540	34.9239	(42c)

Average daily hot water use (litres/day) 118.7832 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	129.1891	126.4812	123.1107	118.6308	114.4807	109.1971	106.0538	111.0379	114.1956	119.4412	124.8498	129.1067	(44)
Energy conte	190.1887	167.3602	175.9227	154.9614	147.5199	126.2828	117.1926	130.6937	132.4612	153.9121	168.7387	189.6027	(45)
Energy content (annual)											Total = Sum(45)m =	1854.8367	
Distribution loss (46)m = 0.15 x (45)m	28.5283	25.1040	26.3884	23.2442	22.1280	18.9424	17.5789	19.6041	19.8692	23.0868	25.3108	28.4404	(46)
Water storage loss:													
Store volume												200.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6100	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8694	(55)
Total storage loss	26.9514	24.3432	26.9514	26.0820	26.9514	26.0820	26.9514	26.9514	26.0820	26.9514	26.0820	26.9514	(56)
If cylinder contains dedicated solar storage	26.9514	24.3432	26.9514	26.0820	26.9514	26.0820	26.9514	26.9514	26.0820	26.9514	26.0820	26.9514	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	217.1401	191.7034	202.8741	181.0434	174.4713	152.3648	144.1440	157.6451	158.5432	180.8635	194.8207	216.5541	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	217.1401	191.7034	202.8741	181.0434	174.4713	152.3648	144.1440	157.6451	158.5432	180.8635	194.8207	216.5541	(64)
										Total per year (kWh/year) = Sum(64)m =		2172.1677	(64)
12Total per year (kWh/year)												2172	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000	(64a)
Heat gains from water heating, kWh/month	63.2377	55.6473	58.4943	51.5247	49.0504	41.9890	38.9665	43.4557	44.0433	51.1758	56.1056	63.0429	(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	99.0817	99.0817	99.0817	99.0817	99.0817	99.0817	99.0817	99.0817	99.0817	99.0817	99.0817	99.0817	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	94.9293	105.1003	94.9293	98.0936	94.9293	98.0936	94.9293	94.9293	98.0936	94.9293	98.0936	94.9293	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	172.9469	174.7416	170.2191	160.5914	148.4380	137.0156	129.3847	127.5901	132.1125	141.7403	153.8936	165.3161	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.9082	32.9082	32.9082	32.9082	32.9082	32.9082	32.9082	32.9082	32.9082	32.9082	32.9082	32.9082	(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)	-79.2654	-79.2654	-79.2654	-79.2654	-79.2654	-79.2654	-79.2654	-79.2654	-79.2654	-79.2654	-79.2654	-79.2654	(71)
Water heating gains (Table 5)	84.9970	82.8084	78.6214	71.5621	65.9279	58.3181	52.3744	58.4081	61.1713	68.7846	77.9245	84.7351	(72)
Total internal gains	405.5977	415.3748	396.4943	382.9715	362.0197	346.1518	329.4129	333.6520	344.1019	358.1787	382.6362	397.7049	(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	
South	5.5100	46.7521	0.7200	1.0000	0.7700	128.5340	(78)

Solar gains	128.5340	210.5056	268.1468	303.0641	315.8116	303.9257	296.9539	288.3833	280.1110	227.0501	152.3567	111.0652	(83)
Total gains	534.1317	625.8804	664.6411	686.0356	677.8313	650.0775	626.3668	622.0353	624.2130	585.2288	534.9929	508.7702	(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	91.4723	91.6646	91.8539	92.7536	92.9239	93.7249	93.7249	93.8748	93.4148	92.9239	92.5800	92.2233	

alpha	7.0982	7.1110	7.1236	7.1836	7.1949	7.2483	7.2483	7.2583	7.2277	7.1949	7.1720	7.1482	
util living area	0.9963	0.9882	0.9709	0.9189	0.8045	0.6069	0.4374	0.4595	0.6760	0.9209	0.9886	0.9973	(86)
MIT	20.2666	20.4403	20.6196	20.8186	20.9456	20.9937	20.9995	20.9992	20.9866	20.8418	20.5211	20.2349	(87)
Th 2	20.0297	20.0315	20.0333	20.0418	20.0434	20.0508	20.0508	20.0521	20.0479	20.0434	20.0401	20.0368	(88)
util rest of house	0.9947	0.9833	0.9589	0.8877	0.7425	0.5206	0.3434	0.3654	0.5903	0.8843	0.9829	0.9961	(89)
MIT 2	19.1961	19.4166	19.6394	19.8777	20.0056	20.0481	20.0507	20.0520	20.0415	19.9087	19.5271	19.1615	(90)
Living area fraction										fLA = Living area / (4) =		0.4667	(91)
MIT	19.6957	19.8944	20.0968	20.3168	20.4443	20.4894	20.4934	20.4940	20.4826	20.3441	19.9910	19.6625	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.6957	19.8944	20.0968	20.3168	20.4443	20.4894	20.4934	20.4940	20.4826	20.3441	19.9910	19.6625	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9940	0.9824	0.9598	0.8976	0.7698	0.5610	0.3873	0.4094	0.6303	0.8972	0.9825	0.9955	(94)
Useful gains	530.9081	614.8957	637.9510	615.7649	521.8235	364.6625	242.6183	254.6412	393.4581	525.0765	525.6369	506.5009	(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	983.6287	955.9800	865.0901	719.3417	549.9438	367.2310	242.7728	254.8730	399.3024	612.8257	813.7501	979.8520	(97)
Space heating kWh	336.8241	229.2086	168.9915	74.5753	20.9215	0.0000	0.0000	0.0000	0.0000	65.2854	207.4415	352.1732	(98a)
Space heating requirement - total per year (kWh/year)												1455.4212	
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	336.8241	229.2086	168.9915	74.5753	20.9215	0.0000	0.0000	0.0000	0.0000	65.2854	207.4415	352.1732	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1455.4212	
Space heating per m2											(98c) / (4) =	24.2570	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Fraction of main heating from main system 2	0.0000	(203)
Fraction of total heating from main system 1	1.0000	(204)
Fraction of total heating from main system 2	0.0000	(205)
Efficiency of main space heating system 1 (in %)	100.0000	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	336.8241	229.2086	168.9915	74.5753	20.9215	0.0000	0.0000	0.0000	0.0000	65.2854	207.4415	352.1732	(98)
Space heating efficiency (main heating system 1)	100.0000	100.0000	100.0000	100.0000	100.0000	0.0000	0.0000	0.0000	0.0000	100.0000	100.0000	100.0000	(210)
Space heating fuel (main heating system)	336.8241	229.2086	168.9915	74.5753	20.9215	0.0000	0.0000	0.0000	0.0000	65.2854	207.4415	352.1732	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Space heating fuel used, main system 2												0.0000	(213)
Water heating													
Water heating requirement	217.1401	191.7034	202.8741	181.0434	174.4713	152.3648	144.1440	157.6451	158.5432	180.8635	194.8207	216.5541	(64)
Efficiency of water heater												324.5200	(216)
(217)m	324.5200	324.5200	324.5200	324.5200	324.5200	324.5200	324.5200	324.5200	324.5200	324.5200	324.5200	324.5200	(217)
Fuel for water heating, kWh/month	66.9112	59.0729	62.5151	55.7881	53.7629	46.9508	44.4176	48.5779	48.8547	55.7326	60.0335	66.7306	(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	20.1813	16.1902	14.5775	10.6801	8.2496	6.7400	7.5256	9.7820	12.7059	16.6708	18.8296	20.7422	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												1455.4212	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												324.5200	
Water heating fuel used												669.3479	(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)												162.8750	(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	2287.6440	(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	1455.4212	0.1570	228.4640	(261)
Space heating - main system 2	0.0000	0.0000	0.0000	(262)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	669.3479	0.1412	94.4846	(264)
Space and water heating			322.9487	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	162.8750	0.1443	23.5079	(268)
Total CO2, kg/year			346.4565	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			5.7700	(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	1455.4212	1.5811	2301.1797	(275)
Space heating - main system 2	0.0000	0.0000	0.0000	(276)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	669.3479	1.5220	1018.7256	(278)
Space and water heating			3319.9052	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	162.8750	1.5338	249.8231	(282)
Total Primary energy kWh/year			3569.7283	(286)
Dwelling Primary energy Rate (DPER)			59.5000	(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	60.0000	(1b) x	2.5000	(2b) =	150.0000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	60.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		150.0000	(5)

2. Ventilation rate

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

	Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1333 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.3833 (18)
Number of sides sheltered		1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3546 (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	0.4521	0.4432	0.4344	0.3900	0.3812	0.3369	0.3369	0.3280	0.3546	0.3812	0.3989	0.4166	(22b)
Effective ac	0.6022	0.5982	0.5943	0.5761	0.5726	0.5567	0.5567	0.5538	0.5629	0.5726	0.5796	0.5868	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			1.8900	1.0000	1.8900			(26)
TER Opening Type (Uw = 1.20)			5.5100	1.1450	6.3092			(27)
ground			60.0000	0.1300	7.8000			(28a)
cavity wall	65.0000	7.4000	57.6000	0.1800	10.3680			(29a)
common wall	15.0000		15.0000	0.1800	2.7000			(29a)
Total net area of external elements Aum(A, m2)			140.0000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		29.0672			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 360.6500 (35)
List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	6.0000	0.0500	0.3000
E3 Sill	5.0000	0.0500	0.2500
E4 Jamb	14.0000	0.0500	0.7000
E5 Ground floor (normal)	30.0000	0.1600	4.8000
E6 Intermediate floor within a dwelling	30.0000	0.0000	0.0000
E16 Corner (normal)	10.0000	0.0900	0.9000

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 6.9500 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 36.0172 (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	29.8086	29.6122	29.4196	28.5153	28.3461	27.5584	27.5584	27.4125	27.8618	28.3461	28.6884	29.0462	(38)
Heat transfer coeff	65.8258	65.6293	65.4368	64.5324	64.3632	63.5756	63.5756	63.4297	63.8790	64.3632	64.7055	65.0634	(39)
Average = Sum(39)m / 12 =												64.5316	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0971	1.0938	1.0906	1.0755	1.0727	1.0596	1.0596	1.0572	1.0646	1.0727	1.0784	1.0844	(40)
HLP (average)												1.0755	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 1.9816 (42)
Hot water usage for mixer showers

57.4451	56.5818	55.3238	52.9169	51.1406	49.1598	48.0339	49.2823	50.6509	52.7777	55.2363	57.2250	(42a)

Hot water usage for baths

24.8265	24.4578	23.9386	22.9812	22.2644	21.4695	21.0401	21.5557	22.1171	22.9676	23.9447	24.7426	(42b)

Hot water usage for other uses

34.9239	33.6540	32.3840	31.1140	29.8441	28.5741	28.5741	29.8441	31.1140	32.3840	33.6540	34.9239	(42c)

Average daily hot water use (litres/day) 107.7295 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	117.1955	114.6935	111.6463	107.0121	103.2491	99.2034	97.6481	100.6821	103.8820	108.1293	112.8350	116.8914	(44)
Energy conte	185.6090	163.3220	171.5963	146.4943	138.9931	121.9821	118.0969	124.6655	128.0969	146.7305	160.7541	183.0237	(45)
Energy content (annual)											Total = Sum(45)m =	1789.3645	
Distribution loss (46)m = 0.15 x (45)m	27.8413	24.4983	25.7394	21.9741	20.8490	18.2973	17.7145	18.6998	19.2145	22.0096	24.1131	27.4536	(46)
Water storage loss:													
Store volume												150.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3938	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7527	(55)
Total storage loss	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(56)
If cylinder contains dedicated solar storage	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	232.2039	205.4077	218.1912	191.5861	185.5880	167.0740	164.6918	171.2604	173.1888	193.3254	205.8460	229.6186	(62)
WWHRS	-26.2615	-23.2259	-24.3208	-20.1386	-18.7684	-16.0603	-15.0540	-16.0084	-16.6166	-19.5891	-22.1921	-25.7752	(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	205.9424	182.1819	193.8704	171.4475	166.8196	151.0137	149.6379	155.2520	156.5722	173.7363	183.6539	203.8435	(64)
										Total per year (kWh/year) = Sum(64)m =		2093.9712	(64)
12Total per year (kWh/year)												2094	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000	(64a)
Heat gains from water heating, kWh/month	98.9909	87.9731	94.3317	84.7828	83.4911	76.6325	76.5432	78.7272	78.6657	86.0638	89.5242	98.1313	(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	99.0817	99.0817	99.0817	99.0817	99.0817	99.0817	99.0817	99.0817	99.0817	99.0817	99.0817	99.0817	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	102.5141	113.4977	102.5141	105.9312	102.5141	105.9312	102.5141	102.5141	105.9312	102.5141	105.9312	102.5141	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	172.9469	174.7416	170.2191	160.5914	148.4380	137.0156	129.3847	127.5901	132.1125	141.7403	153.8936	165.3161	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.9082	32.9082	32.9082	32.9082	32.9082	32.9082	32.9082	32.9082	32.9082	32.9082	32.9082	32.9082	(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)	-79.2654	-79.2654	-79.2654	-79.2654	-79.2654	-79.2654	-79.2654	-79.2654	-79.2654	-79.2654	-79.2654	-79.2654	(71)
Water heating gains (Table 5)	133.0523	130.9124	126.7899	117.7539	112.2193	106.4341	102.8806	105.8161	109.2579	115.6772	124.3392	131.8969	(72)
Total internal gains	464.2378	474.8762	455.2476	440.0010	418.8959	402.1054	387.5039	388.6448	400.0262	415.6560	439.8885	455.4516	(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	
South	5.5100	46.7521	0.6300	0.7000	0.7700	78.7271	(78)

Solar gains	78.7271	128.9347	164.2399	185.6268	193.4346	186.1545	181.8842	176.6348	171.5680	139.0682	93.3185	68.0275	(83)
Total gains	542.9649	603.8109	619.4875	625.6277	612.3304	588.2599	569.3881	565.2796	571.5941	554.7242	533.2070	523.4790	(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	91.3143	91.5876	91.8571	93.1444	93.3892	94.5463	94.5463	94.7637	94.0972	93.3892	92.8952	92.3843	
alpha	7.0876	7.1058	7.1238	7.2096	7.2259	7.3031	7.3031	7.3176	7.2731	7.2259	7.1930	7.1590	
util living area	0.9966	0.9919	0.9828	0.9520	0.8682	0.6765	0.4899	0.5142	0.7410	0.9440	0.9904	0.9973	(86)
MIT	20.2559	20.3896	20.5464	20.7523	20.9105	20.9881	20.9989	20.9985	20.9769	20.8051	20.5038	20.2375	(87)
Th 2	20.0032	20.0059	20.0085	20.0209	20.0232	20.0340	20.0340	20.0360	20.0298	20.0232	20.0185	20.0136	(88)
util rest of house	0.9950	0.9883	0.9748	0.9295	0.8124	0.5822	0.3832	0.4076	0.6511	0.9139	0.9854	0.9961	(89)
MIT 2	19.1592	19.3305	19.5290	19.7873	19.9575	20.0289	20.0338	20.0356	20.0184	19.8523	19.4860	19.1441	(90)
Living area fraction										fLA = Living area / (4) =		0.4667	(91)
MIT	19.6710	19.8247	20.0038	20.2376	20.4022	20.4765	20.4842	20.4850	20.4657	20.2969	19.9610	19.6544	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.6710	19.8247	20.0038	20.2376	20.4022	20.4765	20.4842	20.4850	20.4657	20.2969	19.9610	19.6544	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9943	0.9874	0.9748	0.9352	0.8359	0.6265	0.4331	0.4575	0.6931	0.9236	0.9850	0.9955	(94)
Useful gains	539.8919	596.2172	603.8647	585.0881	511.8366	368.5335	246.6249	258.6421	396.1474	512.3315	525.2044	521.1227	(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	1011.8082	979.4996	883.6449	731.6449	560.1040	373.6015	246.9385	259.1085	406.6353	624.1262	832.1756	1005.5128	(97)
Space heating kWh	351.1058	257.5658	208.1565	105.5209	35.9110	0.0000	0.0000	0.0000	0.0000	83.1753	221.0193	360.3862	(98a)
Space heating requirement - total per year (kWh/year)												1622.8407	
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	351.1058	257.5658	208.1565	105.5209	35.9110	0.0000	0.0000	0.0000	0.0000	83.1753	221.0193	360.3862	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1622.8407	
Space heating per m2											(98c) / (4) =	27.0473	(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	351.1058	257.5658	208.1565	105.5209	35.9110	0.0000	0.0000	0.0000	0.0000	83.1753	221.0193	360.3862	(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)	380.3963	279.0528	225.5216	114.3239	38.9068	0.0000	0.0000	0.0000	0.0000	90.1141	239.4575	390.4509	(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	205.9424	182.1819	193.8704	171.4475	166.8196	151.0137	149.6379	155.2520	156.5722	173.7363	183.6539	203.8435	(64)
Efficiency of water heater												79.8000	(216)
(217)m	85.2456	84.8361	84.2195	83.0051	81.2588	79.8000	79.8000	79.8000	79.8000	82.5073	84.4762	85.3234	(217)
Fuel for water heating, kWh/month	241.5871	214.7457	230.1964	206.5506	205.2941	189.2402	187.5162	194.5514	196.2057	210.5709	217.4032	238.9068	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	21.3004	17.0880	15.3858	11.2723	8.7071	7.1137	7.9429	10.3244	13.4104	17.5952	19.8737	21.8924	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-28.4598	-40.3112	-58.2086	-65.7641	-71.2013	-66.5961	-65.8307	-62.0565	-55.3640	-46.3158	-31.3790	-24.5877	(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	-15.4661	-32.6201	-64.9831	-97.7968	-129.4790	-130.1238	-128.5359	-108.6969	-79.5335	-46.6445	-20.6517	-12.2187	(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 1758.2239 (211)

Space heating fuel - main system 2 0.0000 (213)

Space heating fuel - secondary 0.0000 (215)

Efficiency of water heater 79.8000

Water heating fuel used 2532.7682 (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) 171.9064 (232)

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

PV generation	-1482.8252	(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	3066.0734	(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	1758.2239	0.2100	369.2270	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2532.7682	0.2100	531.8813	(264)
Space and water heating			901.1083	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	171.9064	0.1443	24.8114	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-616.0750	0.1345	-82.8460	
PV Unit electricity exported	-866.7501	0.1258	-109.0770	
Total			-191.9230	(269)
Total CO2, kg/year			745.9260	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			12.4300	(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	1758.2239	1.1300	1986.7930	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2532.7682	1.1300	2862.0281	(278)
Space and water heating			4848.8211	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	171.9064	1.5338	263.6758	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-616.0750	1.4970	-922.2558	
PV Unit electricity exported	-866.7501	0.4619	-400.3862	
Total			-1322.6420	(283)
Total Primary energy kWh/year			3919.9556	(286)
Target Primary Energy Rate (TPER)			65.3300	(287)

Full SAP Calculation Printout

Property Reference	CG-11-02 Flat	**Issued on Date**	25/07/2024
Assessment Reference	CG-11-02 SAP Design	**Prop Type Ref**	Flat 2 - Ground
Property	Flat 2 - Ground, South Worple Way, East Sheen		

SAP Rating	80 C	**DER**	5.77	**TER**	12.43
Environmental	96 A	**% DER < TER**			53.58
CO_2 Emissions (t/year)	0.28	**DFEE**	30.23	**TFEE**	34.60
Compliance Check	See BREL	**% DFEE < TFEE**			12.65
% DPER < TPER	8.93	**DPER**	59.50	**TPER**	65.33

Assessor Details	Mr. Colin Marshall	**Assessor ID**	AV43-0001
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		60.0000	(1b)	x 2.5000	(2b) =	150.0000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	60.0000						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		150.0000	(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		1 * 10 =	10.0000 (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) =		10.0000 / (5) =	0.0667 (8)
Pressure test			Yes
Pressure Test Method			Blower Door
Measured/design AP50			5.0000 (17)
Infiltration rate			0.3167 (18)
Number of sides sheltered			1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.2929 (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	0.3735	0.3661	0.3588	0.3222	0.3149	0.2783	0.2783	0.2709	0.2929	0.3149	0.3295	0.3442	(22b)
Effective ac	0.5697	0.5670	0.5644	0.5519	0.5496	0.5387	0.5387	0.5367	0.5429	0.5496	0.5543	0.5592	(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	
solid D			1.8900	1.2000	2.2680			(26)
W or Glazed D (Uw = 1.30)			5.5100	1.2357	6.8089			(27)
ground			60.0000	0.1200	7.2000	75.0000	4500.0000	(28a)
cavity wall	65.0000	7.4000	57.6000	0.1800	10.3680	190.0000	10944.0000	(29a)
common wall	15.0000		15.0000	0.2000	3.0000	190.0000	2850.0000	(29a)
Total net area of external elements Aum(A, m2)			140.0000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		29.6449			(33)
Party Ceiling 1			60.0000			30.0000	1800.0000	(32b)
Internal Wall 1			105.0000			9.0000	945.0000	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 21039.0000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	350.6500 (35)

List of Thermal Bridges

		Length	Psi-value	Total
E1	Steel lintel with perforated steel base plate	6.0000	0.0950	0.5700
E3	Sill	5.0000	0.0630	0.3150
E4	Jamb	14.0000	0.0820	1.1480
E5	Ground floor (normal)	30.0000	0.0480	1.4400
E6	Intermediate floor within a dwelling	30.0000	0.0750	2.2500
E16	Corner (normal)	10.0000	0.0320	0.3200

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 6.0430 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 35.6879 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	28.2021	28.0681	27.9367	27.3195	27.2040	26.6665	26.6665	26.5670	26.8736	27.2040	27.4376	27.6818	(38)
Heat transfer coeff	63.8900	63.7560	63.6246	63.0074	62.8920	62.3544	62.3544	62.2549	62.5615	62.8920	63.1256	63.3698	(39)
Average = Sum(39)m / 12 =												63.0069	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0648	1.0626	1.0604	1.0501	1.0482	1.0392	1.0392	1.0376	1.0427	1.0482	1.0521	1.0562	(40)
HLP (average)												1.0501	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 1.9816 (42)

Hot water usage for mixer showers

69.9922	68.9206	67.3414	64.9120	62.7354	59.6902	57.2818	60.0974	61.5136	64.5296	67.6706	69.9290	(42a)

Hot water usage for baths

24.2730	23.9066	23.3854	22.6047	21.9012	20.9327	20.1980	21.0965	21.5680	22.5276	23.5253	24.2538	(42b)

Hot water usage for other uses

34.9239	33.6540	32.3840	31.1140	29.8441	28.5741	28.5741	29.8441	31.1140	32.3840	33.6540	34.9239	(42c)

Average daily hot water use (litres/day) 118.7832 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	129.1891	126.4812	123.1107	118.6308	114.4807	109.1971	106.0538	111.0379	114.1956	119.4412	124.8498	129.1067	(44)
Energy conte	190.1887	167.3602	175.9227	154.9614	147.5199	126.2828	117.1926	130.6937	132.4612	153.9121	168.7387	189.6027	(45)
Energy content (annual)											Total = Sum(45)m =	1854.8367	
Distribution loss (46)m = 0.15 x (45)m	28.5283	25.1040	26.3884	23.2442	22.1280	18.9424	17.5789	19.6041	19.8692	23.0868	25.3108	28.4404	(46)
Water storage loss:													
Store volume												200.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6100	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8694	(55)
Total storage loss	26.9514	24.3432	26.9514	26.0820	26.9514	26.0820	26.9514	26.9514	26.0820	26.9514	26.0820	26.9514	(56)
If cylinder contains dedicated solar storage	26.9514	24.3432	26.9514	26.0820	26.9514	26.0820	26.9514	26.9514	26.0820	26.9514	26.0820	26.9514	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	217.1401	191.7034	202.8741	181.0434	174.4713	152.3648	144.1440	157.6451	158.5432	180.8635	194.8207	216.5541	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	217.1401	191.7034	202.8741	181.0434	174.4713	152.3648	144.1440	157.6451	158.5432	180.8635	194.8207	216.5541	(64)
										Total per year (kWh/year) = Sum(64)m =		2172.1677	(64)
12Total per year (kWh/year)												2172	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000	(64a)
Heat gains from water heating, kWh/month	63.2377	55.6473	58.4943	51.5247	49.0504	41.9890	38.9665	43.4557	44.0433	51.1758	56.1056	63.0429	(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	99.0817	99.0817	99.0817	99.0817	99.0817	99.0817	99.0817	99.0817	99.0817	99.0817	99.0817	99.0817	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	94.9293	105.1003	94.9293	98.0936	94.9293	98.0936	94.9293	94.9293	98.0936	94.9293	98.0936	94.9293	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	172.9469	174.7416	170.2191	160.5914	148.4380	137.0156	129.3847	127.5901	132.1125	141.7403	153.8936	165.3161	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.9082	32.9082	32.9082	32.9082	32.9082	32.9082	32.9082	32.9082	32.9082	32.9082	32.9082	32.9082	(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)	-79.2654	-79.2654	-79.2654	-79.2654	-79.2654	-79.2654	-79.2654	-79.2654	-79.2654	-79.2654	-79.2654	-79.2654	(71)
Water heating gains (Table 5)	84.9970	82.8084	78.6214	71.5621	65.9279	58.3181	52.3744	58.4081	61.1713	68.7846	77.9245	84.7351	(72)
Total internal gains	405.5977	415.3748	396.4943	382.9715	362.0197	346.1518	329.4129	333.6520	344.1019	358.1787	382.6362	397.7049	(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	
South	5.5100	46.7521	0.7200	1.0000	0.7700	128.5340	(78)

Solar gains	128.5340	210.5056	268.1468	303.0641	315.8116	303.9257	296.9539	288.3833	280.1110	227.0501	152.3567	111.0652	(83)
Total gains	534.1317	625.8804	664.6411	686.0356	677.8313	650.0775	626.3668	622.0353	624.2130	585.2288	534.9929	508.7702	(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	91.4723	91.6646	91.8539	92.7536	92.9239	93.7249	93.7249	93.8748	93.4148	92.9239	92.5800	92.2233	

alpha	7.0982	7.1110	7.1236	7.1836	7.1949	7.2483	7.2483	7.2583	7.2277	7.1949	7.1720	7.1482	
util living area	0.9963	0.9882	0.9709	0.9189	0.8045	0.6069	0.4374	0.4595	0.6760	0.9209	0.9886	0.9973	(86)
MIT	20.2666	20.4403	20.6196	20.8186	20.9456	20.9937	20.9995	20.9992	20.9866	20.8418	20.5211	20.2349	(87)
Th 2	20.0297	20.0315	20.0333	20.0418	20.0434	20.0508	20.0508	20.0521	20.0479	20.0434	20.0401	20.0368	(88)
util rest of house	0.9947	0.9833	0.9589	0.8877	0.7425	0.5206	0.3434	0.3654	0.5903	0.8843	0.9829	0.9961	(89)
MIT 2	19.1961	19.4166	19.6394	19.8777	20.0056	20.0481	20.0507	20.0520	20.0415	19.9087	19.5271	19.1615	(90)
Living area fraction										fLA = Living area / (4) =		0.4667	(91)
MIT	19.6957	19.8944	20.0968	20.3168	20.4443	20.4894	20.4934	20.4940	20.4826	20.3441	19.9910	19.6625	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.6957	19.8944	20.0968	20.3168	20.4443	20.4894	20.4934	20.4940	20.4826	20.3441	19.9910	19.6625	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9940	0.9824	0.9598	0.8976	0.7698	0.5610	0.3873	0.4094	0.6303	0.8972	0.9825	0.9955	(94)
Useful gains	530.9081	614.8957	637.9510	615.7649	521.8235	364.6625	242.6183	254.6412	393.4581	525.0765	525.6369	506.5009	(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	983.6287	955.9800	865.0901	719.3417	549.9438	367.2310	242.7728	254.8730	399.3024	612.8257	813.7501	979.8520	(97)
Space heating kWh	336.8241	229.2086	168.9915	74.5753	20.9215	0.0000	0.0000	0.0000	0.0000	65.2854	207.4415	352.1732	(98a)
Space heating requirement - total per year (kWh/year)												1455.4212	
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	336.8241	229.2086	168.9915	74.5753	20.9215	0.0000	0.0000	0.0000	0.0000	65.2854	207.4415	352.1732	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1455.4212	
Space heating per m2											(98c) / (4) =	24.2570	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Fraction of main heating from main system 2	0.0000	(203)
Fraction of total heating from main system 1	1.0000	(204)
Fraction of total heating from main system 2	0.0000	(205)
Efficiency of main space heating system 1 (in %)	100.0000	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	336.8241	229.2086	168.9915	74.5753	20.9215	0.0000	0.0000	0.0000	0.0000	65.2854	207.4415	352.1732	(98)
Space heating efficiency (main heating system 1)	100.0000	100.0000	100.0000	100.0000	100.0000	0.0000	0.0000	0.0000	0.0000	100.0000	100.0000	100.0000	(210)
Space heating fuel (main heating system)	336.8241	229.2086	168.9915	74.5753	20.9215	0.0000	0.0000	0.0000	0.0000	65.2854	207.4415	352.1732	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Space heating fuel used, main system 2												0.0000	(213)
Water heating													
Water heating requirement	217.1401	191.7034	202.8741	181.0434	174.4713	152.3648	144.1440	157.6451	158.5432	180.8635	194.8207	216.5541	(64)
Efficiency of water heater												324.5200	(216)
(217)m	324.5200	324.5200	324.5200	324.5200	324.5200	324.5200	324.5200	324.5200	324.5200	324.5200	324.5200	324.5200	(217)
Fuel for water heating, kWh/month	66.9112	59.0729	62.5151	55.7881	53.7629	46.9508	44.4176	48.5779	48.8547	55.7326	60.0335	66.7306	(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	20.1813	16.1902	14.5775	10.6801	8.2496	6.7400	7.5256	9.7820	12.7059	16.6708	18.8296	20.7422	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												1455.4212	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												324.5200	
Water heating fuel used												669.3479	(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)												162.8750	(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	2287.6440	(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	1455.4212	0.1570	228.4640	(261)
Space heating - main system 2	0.0000	0.0000	0.0000	(262)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	669.3479	0.1412	94.4846	(264)
Space and water heating			322.9487	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	162.8750	0.1443	23.5079	(268)
Total CO2, kg/year			346.4565	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			5.7700	(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	1455.4212	1.5811	2301.1797	(275)
Space heating - main system 2	0.0000	0.0000	0.0000	(276)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	669.3479	1.5220	1018.7256	(278)
Space and water heating			3319.9052	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	162.8750	1.5338	249.8231	(282)
Total Primary energy kWh/year			3569.7283	(286)
Dwelling Primary energy Rate (DPER)			59.5000	(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	60.0000	(1b) x	2.5000	(2b) =	150.0000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	60.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		150.0000	(5)

2. Ventilation rate

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

	Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1333 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.3833 (18)
Number of sides sheltered		1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3546 (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	0.4521	0.4432	0.4344	0.3900	0.3812	0.3369	0.3369	0.3280	0.3546	0.3812	0.3989	0.4166	(22b)
Effective ac	0.6022	0.5982	0.5943	0.5761	0.5726	0.5567	0.5567	0.5538	0.5629	0.5726	0.5796	0.5868	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			1.8900	1.0000	1.8900			(26)
TER Opening Type (Uw = 1.20)			5.5100	1.1450	6.3092			(27)
ground			60.0000	0.1300	7.8000			(28a)
cavity wall	65.0000	7.4000	57.6000	0.1800	10.3680			(29a)
common wall	15.0000		15.0000	0.1800	2.7000			(29a)
Total net area of external elements Aum(A, m2)			140.0000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		29.0672			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 360.6500 (35)
List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	6.0000	0.0500	0.3000
E3 Sill	5.0000	0.0500	0.2500
E4 Jamb	14.0000	0.0500	0.7000
E5 Ground floor (normal)	30.0000	0.1600	4.8000
E6 Intermediate floor within a dwelling	30.0000	0.0000	0.0000
E16 Corner (normal)	10.0000	0.0900	0.9000

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 6.9500 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 36.0172 (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	29.8086	29.6122	29.4196	28.5153	28.3461	27.5584	27.5584	27.4125	27.8618	28.3461	28.6884	29.0462	(38)
Heat transfer coeff	65.8258	65.6293	65.4368	64.5324	64.3632	63.5756	63.5756	63.4297	63.8790	64.3632	64.7055	65.0634	(39)
Average = Sum(39)m / 12 =												64.5316	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0971	1.0938	1.0906	1.0755	1.0727	1.0596	1.0596	1.0572	1.0646	1.0727	1.0784	1.0844	(40)
HLP (average)												1.0755	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 1.9816 (42)
Hot water usage for mixer showers

57.4451	56.5818	55.3238	52.9169	51.1406	49.1598	48.0339	49.2823	50.6509	52.7777	55.2363	57.2250	(42a)

Hot water usage for baths

24.8265	24.4578	23.9386	22.9812	22.2644	21.4695	21.0401	21.5557	22.1171	22.9676	23.9447	24.7426	(42b)

Hot water usage for other uses

34.9239	33.6540	32.3840	31.1140	29.8441	28.5741	28.5741	29.8441	31.1140	32.3840	33.6540	34.9239	(42c)

Average daily hot water use (litres/day) 107.7295 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	117.1955	114.6935	111.6463	107.0121	103.2491	99.2034	97.6481	100.6821	103.8820	108.1293	112.8350	116.8914	(44)
Energy conte	185.6090	163.3220	171.5963	146.4943	138.9931	121.9821	118.0969	124.6655	128.0969	146.7305	160.7541	183.0237	(45)
Energy content (annual)											Total = Sum(45)m =	1789.3645	
Distribution loss (46)m = 0.15 x (45)m	27.8413	24.4983	25.7394	21.9741	20.8490	18.2973	17.7145	18.6998	19.2145	22.0096	24.1131	27.4536	(46)
Water storage loss:													
Store volume												150.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3938	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7527	(55)
Total storage loss	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(56)
If cylinder contains dedicated solar storage	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	232.2039	205.4077	218.1912	191.5861	185.5880	167.0740	164.6918	171.2604	173.1888	193.3254	205.8460	229.6186	(62)
WWHRS	-26.2615	-23.2259	-24.3208	-20.1386	-18.7684	-16.0603	-15.0540	-16.0084	-16.6166	-19.5891	-22.1921	-25.7752	(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	205.9424	182.1819	193.8704	171.4475	166.8196	151.0137	149.6379	155.2520	156.5722	173.7363	183.6539	203.8435	(64)
										Total per year (kWh/year) = Sum(64)m =		2093.9712	(64)
12Total per year (kWh/year)												2094	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000	(64a)
Heat gains from water heating, kWh/month	98.9909	87.9731	94.3317	84.7828	83.4911	76.6325	76.5432	78.7272	78.6657	86.0638	89.5242	98.1313	(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	99.0817	99.0817	99.0817	99.0817	99.0817	99.0817	99.0817	99.0817	99.0817	99.0817	99.0817	99.0817	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	102.5141	113.4977	102.5141	105.9312	102.5141	105.9312	102.5141	102.5141	105.9312	102.5141	105.9312	102.5141	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	172.9469	174.7416	170.2191	160.5914	148.4380	137.0156	129.3847	127.5901	132.1125	141.7403	153.8936	165.3161	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.9082	32.9082	32.9082	32.9082	32.9082	32.9082	32.9082	32.9082	32.9082	32.9082	32.9082	32.9082	(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)	-79.2654	-79.2654	-79.2654	-79.2654	-79.2654	-79.2654	-79.2654	-79.2654	-79.2654	-79.2654	-79.2654	-79.2654	(71)
Water heating gains (Table 5)	133.0523	130.9124	126.7899	117.7539	112.2193	106.4341	102.8806	105.8161	109.2579	115.6772	124.3392	131.8969	(72)
Total internal gains	464.2378	474.8762	455.2476	440.0010	418.8959	402.1054	387.5039	388.6448	400.0262	415.6560	439.8885	455.4516	(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	
South	5.5100	46.7521	0.6300	0.7000	0.7700	78.7271	(78)

Solar gains	78.7271	128.9347	164.2399	185.6268	193.4346	186.1545	181.8842	176.6348	171.5680	139.0682	93.3185	68.0275	(83)
Total gains	542.9649	603.8109	619.4875	625.6277	612.3304	588.2599	569.3881	565.2796	571.5941	554.7242	533.2070	523.4790	(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	91.3143	91.5876	91.8571	93.1444	93.3892	94.5463	94.5463	94.7637	94.0972	93.3892	92.8952	92.3843	
alpha	7.0876	7.1058	7.1238	7.2096	7.2259	7.3031	7.3031	7.3176	7.2731	7.2259	7.1930	7.1590	
util living area	0.9966	0.9919	0.9828	0.9520	0.8682	0.6765	0.4899	0.5142	0.7410	0.9440	0.9904	0.9973	(86)
MIT	20.2559	20.3896	20.5464	20.7523	20.9105	20.9881	20.9989	20.9985	20.9769	20.8051	20.5038	20.2375	(87)
Th 2	20.0032	20.0059	20.0085	20.0209	20.0232	20.0340	20.0340	20.0360	20.0298	20.0232	20.0185	20.0136	(88)
util rest of house	0.9950	0.9883	0.9748	0.9295	0.8124	0.5822	0.3832	0.4076	0.6511	0.9139	0.9854	0.9961	(89)
MIT 2	19.1592	19.3305	19.5290	19.7873	19.9575	20.0289	20.0338	20.0356	20.0184	19.8523	19.4860	19.1441	(90)
Living area fraction										fLA = Living area / (4) =		0.4667	(91)
MIT	19.6710	19.8247	20.0038	20.2376	20.4022	20.4765	20.4842	20.4850	20.4657	20.2969	19.9610	19.6544	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.6710	19.8247	20.0038	20.2376	20.4022	20.4765	20.4842	20.4850	20.4657	20.2969	19.9610	19.6544	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9943	0.9874	0.9748	0.9352	0.8359	0.6265	0.4331	0.4575	0.6931	0.9236	0.9850	0.9955	(94)
Useful gains	539.8919	596.2172	603.8647	585.0881	511.8366	368.5335	246.6249	258.6421	396.1474	512.3315	525.2044	521.1227	(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	1011.8082	979.4996	883.6449	731.6449	560.1040	373.6015	246.9385	259.1085	406.6353	624.1262	832.1756	1005.5128	(97)
Space heating kWh	351.1058	257.5658	208.1565	105.5209	35.9110	0.0000	0.0000	0.0000	0.0000	83.1753	221.0193	360.3862	(98a)
Space heating requirement - total per year (kWh/year)												1622.8407	
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	351.1058	257.5658	208.1565	105.5209	35.9110	0.0000	0.0000	0.0000	0.0000	83.1753	221.0193	360.3862	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1622.8407	
Space heating per m2											(98c) / (4) =	27.0473	(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	351.1058	257.5658	208.1565	105.5209	35.9110	0.0000	0.0000	0.0000	0.0000	83.1753	221.0193	360.3862	(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)	380.3963	279.0528	225.5216	114.3239	38.9068	0.0000	0.0000	0.0000	0.0000	90.1141	239.4575	390.4509	(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	205.9424	182.1819	193.8704	171.4475	166.8196	151.0137	149.6379	155.2520	156.5722	173.7363	183.6539	203.8435	(64)
Efficiency of water heater												79.8000	(216)
(217)m	85.2456	84.8361	84.2195	83.0051	81.2588	79.8000	79.8000	79.8000	79.8000	82.5073	84.4762	85.3234	(217)
Fuel for water heating, kWh/month	241.5871	214.7457	230.1964	206.5506	205.2941	189.2402	187.5162	194.5514	196.2057	210.5709	217.4032	238.9068	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	21.3004	17.0880	15.3858	11.2723	8.7071	7.1137	7.9429	10.3244	13.4104	17.5952	19.8737	21.8924	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-28.4598	-40.3112	-58.2086	-65.7641	-71.2013	-66.5961	-65.8307	-62.0565	-55.3640	-46.3158	-31.3790	-24.5877	(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	-15.4661	-32.6201	-64.9831	-97.7968	-129.4790	-130.1238	-128.5359	-108.6969	-79.5335	-46.6445	-20.6517	-12.2187	(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 1758.2239 (211)

Space heating fuel - main system 2 0.0000 (213)

Space heating fuel - secondary 0.0000 (215)

Efficiency of water heater 79.8000

Water heating fuel used 2532.7682 (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) 171.9064 (232)

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

PV generation	-1482.8252	(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	3066.0734	(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	1758.2239	0.2100	369.2270	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2532.7682	0.2100	531.8813	(264)
Space and water heating			901.1083	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	171.9064	0.1443	24.8114	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-616.0750	0.1345	-82.8460	
PV Unit electricity exported	-866.7501	0.1258	-109.0770	
Total			-191.9230	(269)
Total CO2, kg/year			745.9260	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			12.4300	(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	1758.2239	1.1300	1986.7930	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2532.7682	1.1300	2862.0281	(278)
Space and water heating			4848.8211	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	171.9064	1.5338	263.6758	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-616.0750	1.4970	-922.2558	
PV Unit electricity exported	-866.7501	0.4619	-400.3862	
Total			-1322.6420	(283)
Total Primary energy kWh/year			3919.9556	(286)
Target Primary Energy Rate (TPER)			65.3300	(287)

Full SAP Calculation Printout

Property Reference	CG-11-03 Flat	**Issued on Date**	25/07/2024
Assessment Reference	CG-11-03 SAP Design	**Prop Type Ref**	Flat 3 - First
Property	Flat 3 - First, South Worple Way, East Sheen		

SAP Rating	80 C	**DER**	5.81	**TER**	12.29
Environmental	96 A	**% DER < TER**			52.73
CO_2 Emissions (t/year)	0.28	**DFEE**	30.73	**TFEE**	33.98
Compliance Check	See BREL	**% DFEE < TFEE**			9.58
% DPER < TPER	7.21	**DPER**	59.84	**TPER**	64.49

Assessor Details	Mr. Colin Marshall	**Assessor ID**	AV43-0001
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	60.0000	(1b)	x 2.5000	(2b) =	150.0000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	60.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		150.0000	(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	1 * 10 =	10.0000 (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) =	10.0000 / (5) =	0.0667 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.3167 (18)
Number of sides sheltered		1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2929 (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	0.3735	0.3661	0.3588	0.3222	0.3149	0.2783	0.2783	0.2709	0.2929	0.3149	0.3295	0.3442	(22b)
Effective ac	0.5697	0.5670	0.5644	0.5519	0.5496	0.5387	0.5387	0.5367	0.5429	0.5496	0.5543	0.5592	(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	
solid D			1.8900	1.2000	2.2680			(26)
W or Glazed D (Uw = 1.30)			6.4200	1.2357	7.9335			(27)
cavity wall	65.8000	6.4200	59.3800	0.1800	10.6884	190.0000	11282.2000	(29a)
common wall	15.0000	1.8900	13.1100	0.2000	2.6220	190.0000	2490.9000	(29a)
External Roof 1	60.0000		60.0000	0.1200	7.2000	9.0000	540.0000	(30)
Total net area of external elements Aum(A, m2)			140.8000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		30.7119			(33)
Party Floor 1			60.0000			40.0000	2400.0000	(32d)
Party Ceiling 1			60.0000			30.0000	1800.0000	(32b)
Internal Wall 1			105.0000			9.0000	945.0000	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	19458.1000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		324.3017 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	6.0000	0.0950	0.5700
E3 Sill	5.0000	0.0630	0.3150
E4 Jamb	14.0000	0.0820	1.1480
E5 Ground floor (normal)	30.0000	0.0480	1.4400
E6 Intermediate floor within a dwelling	30.0000	0.0750	2.2500

E16 Corner (normal)									10.0000	0.0320	0.3200		
Thermal bridges (Sum(L x Psi) calculated using Appendix K)												6.0430	(36)
Point Thermal bridges											(36a) =	0.0000	
Total fabric heat loss											(33) + (36) + (36a) =	36.7549	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	28.2021	28.0681	27.9367	27.3195	27.2040	26.6665	26.6665	26.5670	26.8736	27.2040	27.4376	27.6818	(38)
Heat transfer coeff	64.9570	64.8229	64.6915	64.0744	63.9589	63.4214	63.4214	63.3218	63.6284	63.9589	64.1925	64.4367	(39)
Average = Sum(39)m / 12 =												64.0738	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0826	1.0804	1.0782	1.0679	1.0660	1.0570	1.0570	1.0554	1.0605	1.0660	1.0699	1.0739	(40)
HLP (average)												1.0679	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.9816	(42)
Hot water usage for mixer showers	69.9922	68.9206	67.3414	64.9120	62.7354	59.6902	57.2818	60.0974	61.5136	64.5296	67.6706	69.9290	(42a)
Hot water usage for baths	24.2730	23.9066	23.3854	22.6047	21.9012	20.9327	20.1980	21.0965	21.5680	22.5276	23.5253	24.2538	(42b)
Hot water usage for other uses	34.9239	33.6540	32.3840	31.1140	29.8441	28.5741	28.5741	29.8441	31.1140	32.3840	33.6540	34.9239	(42c)
Average daily hot water use (litres/day)												118.7832	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	129.1891	126.4812	123.1107	118.6308	114.4807	109.1971	106.0538	111.0379	114.1956	119.4412	124.8498	129.1067	(44)
Energy conte	190.1887	167.3602	175.9227	154.9614	147.5199	126.2828	117.1926	130.6937	132.4612	153.9121	168.7387	189.6027	(45)
Energy content (annual)											Total = Sum(45)m =	1854.8367	
Distribution loss (46)m = 0.15 x (45)m	28.5283	25.1040	26.3884	23.2442	22.1280	18.9424	17.5789	19.6041	19.8692	23.0868	25.3108	28.4404	(46)
Water storage loss:													
Store volume												200.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6100	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8694	(55)
Total storage loss	26.9514	24.3432	26.9514	26.0820	26.9514	26.0820	26.9514	26.9514	26.0820	26.9514	26.0820	26.9514	(56)
If cylinder contains dedicated solar storage	26.9514	24.3432	26.9514	26.0820	26.9514	26.0820	26.9514	26.9514	26.0820	26.9514	26.0820	26.9514	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	217.1401	191.7034	202.8741	181.0434	174.4713	152.3648	144.1440	157.6451	158.5432	180.8635	194.8207	216.5541	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	217.1401	191.7034	202.8741	181.0434	174.4713	152.3648	144.1440	157.6451	158.5432	180.8635	194.8207	216.5541	(64)
										Total per year (kWh/year) = Sum(64)m =		2172.1677	(64)
12Total per year (kWh/year)												2172	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000	(64a)
Heat gains from water heating, kWh/month	63.2377	55.6473	58.4943	51.5247	49.0504	41.9890	38.9665	43.4557	44.0433	51.1758	56.1056	63.0429	(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	99.0817	99.0817	99.0817	99.0817	99.0817	99.0817	99.0817	99.0817	99.0817	99.0817	99.0817	99.0817	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	91.8512	101.6924	91.8512	94.9129	91.8512	94.9129	91.8512	91.8512	94.9129	91.8512	94.9129	91.8512	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	172.9469	174.7416	170.2191	160.5914	148.4380	137.0156	129.3847	127.5901	132.1125	141.7403	153.8936	165.3161	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.9082	32.9082	32.9082	32.9082	32.9082	32.9082	32.9082	32.9082	32.9082	32.9082	32.9082	32.9082	(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)	-79.2654	-79.2654	-79.2654	-79.2654	-79.2654	-79.2654	-79.2654	-79.2654	-79.2654	-79.2654	-79.2654	-79.2654	(71)
Water heating gains (Table 5)	84.9970	82.8084	78.6214	71.5621	65.9279	58.3181	52.3744	58.4081	61.1713	68.7846	77.9245	84.7351	(72)
Total internal gains	402.5196	411.9669	393.4162	379.7908	358.9416	342.9711	326.3348	330.5739	340.9213	355.1007	379.4555	394.6269	(73)

6. Solar gains

[Jan]

	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.6600	10.6334	0.7200	1.0000	0.7700	3.5017	(74)
South	5.7600	46.7521	0.7200	1.0000	0.7700	134.3659	(78)

Solar gains	137.8676	226.7487	291.6845	335.0800	354.7455	344.0557	335.0193	320.9785	306.4922	245.3177	163.5892	119.0237	(83)
Total gains	540.3872	638.7156	685.1007	714.8708	713.6871	687.0268	661.3541	651.5524	647.4135	600.4184	543.0448	513.6506	(84)

7. Mean internal temperature (heating season)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	83.2094	83.3814	83.5508	84.3555	84.5078	85.2241	85.2241	85.3581	84.9468	84.5078	84.2003	83.8812	
alpha	6.5473	6.5588	6.5701	6.6237	6.6339	6.6816	6.6816	6.6905	6.6631	6.6339	6.6134	6.5921	
util living area													
	0.9947	0.9841	0.9623	0.9013	0.7783	0.5835	0.4212	0.4459	0.6608	0.9090	0.9850	0.9961	(86)
MIT	20.2004	20.3933	20.5924	20.8082	20.9423	20.9926	20.9993	20.9989	20.9836	20.8251	20.4768	20.1647	(87)
Th 2	20.0151	20.0169	20.0187	20.0271	20.0287	20.0361	20.0361	20.0375	20.0332	20.0287	20.0255	20.0222	(88)
util rest of house													
	0.9926	0.9781	0.9483	0.8677	0.7159	0.4993	0.3294	0.3533	0.5763	0.8709	0.9782	0.9946	(89)
MIT 2	19.1068	19.3507	19.5968	19.8529	19.9879	20.0328	20.0359	20.0372	20.0250	19.8781	19.4647	19.0672	(90)
Living area fraction									fLA = Living area / (4) =			0.4667	(91)
MIT	19.6171	19.8372	20.0614	20.2987	20.4333	20.4807	20.4855	20.4860	20.4723	20.3200	19.9370	19.5794	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.6171	19.8372	20.0614	20.2987	20.4333	20.4807	20.4855	20.4860	20.4723	20.3200	19.9370	19.5794	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9915	0.9768	0.9490	0.8780	0.7431	0.5386	0.3723	0.3966	0.6156	0.8836	0.9774	0.9936	(94)
Useful gains	535.8039	623.8817	650.1626	627.6251	530.3330	370.0606	246.2111	258.4090	398.5660	530.5433	530.7883	510.3772	(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													
	994.9537	968.2746	877.3073	730.3656	558.5699	372.9649	246.4223	258.7325	405.4610	621.6822	824.0401	990.9955	(97)
Space heating kWh													
	341.6075	231.4320	168.9957	73.9731	21.0082	0.0000	0.0000	0.0000	0.0000	67.8073	211.1413	357.5800	(98a)
Space heating requirement - total per year (kWh/year)												1473.5452	
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													
	341.6075	231.4320	168.9957	73.9731	21.0082	0.0000	0.0000	0.0000	0.0000	67.8073	211.1413	357.5800	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1473.5452	
Space heating per m2											(98c) / (4) =	24.5591	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Fraction of main heating from main system 2	0.0000	(203)
Fraction of total heating from main system 1	1.0000	(204)
Fraction of total heating from main system 2	0.0000	(205)
Efficiency of main space heating system 1 (in %)	100.0000	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	341.6075	231.4320	168.9957	73.9731	21.0082	0.0000	0.0000	0.0000	0.0000	67.8073	211.1413	357.5800	(98)
Space heating efficiency (main heating system 1)													
	100.0000	100.0000	100.0000	100.0000	100.0000	0.0000	0.0000	0.0000	0.0000	100.0000	100.0000	100.0000	(210)
Space heating fuel (main heating system)													
	341.6075	231.4320	168.9957	73.9731	21.0082	0.0000	0.0000	0.0000	0.0000	67.8073	211.1413	357.5800	(211)
Space heating efficiency (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Space heating fuel used, main system 2												0.0000	(213)
Water heating													
Water heating requirement													
	217.1401	191.7034	202.8741	181.0434	174.4713	152.3648	144.1440	157.6451	158.5432	180.8635	194.8207	216.5541	(64)
Efficiency of water heater												324.5200	(216)
(217)m	324.5200	324.5200	324.5200	324.5200	324.5200	324.5200	324.5200	324.5200	324.5200	324.5200	324.5200	324.5200	(217)
Fuel for water heating, kWh/month													
	66.9112	59.0729	62.5151	55.7881	53.7629	46.9508	44.4176	48.5779	48.8547	55.7326	60.0335	66.7306	(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	19.5270	15.6653	14.1048	10.3338	7.9821	6.5215	7.2816	9.4648	12.2939	16.1303	18.2191	20.0697	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												1473.5452	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												324.5200	
Water heating fuel used												669.3479	(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)												157.5938	(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	2300.4868	(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	1473.5452	0.1570	231.3084	(261)
Space heating - main system 2	0.0000	0.0000	0.0000	(262)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	669.3479	0.1412	94.4846	(264)
Space and water heating			325.7930	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	157.5938	0.1443	22.7456	(268)
Total CO2, kg/year			348.5387	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			5.8100	(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	1473.5452	1.5811	2329.8285	(275)
Space heating - main system 2	0.0000	0.0000	0.0000	(276)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	669.3479	1.5220	1018.7256	(278)
Space and water heating			3348.5541	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	157.5938	1.5338	241.7226	(282)
Total Primary energy kWh/year			3590.2766	(286)
Dwelling Primary energy Rate (DPER)			59.8400	(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	60.0000	(1b)	x 2.5000	(2b) =	150.0000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	60.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		150.0000	(5)

2. Ventilation rate

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

	Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1333 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.3833 (18)
Number of sides sheltered		1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3546 (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	0.4521	0.4432	0.4344	0.3900	0.3812	0.3369	0.3369	0.3280	0.3546	0.3812	0.3989	0.4166	(22b)
Effective ac	0.6022	0.5982	0.5943	0.5761	0.5726	0.5567	0.5567	0.5538	0.5629	0.5726	0.5796	0.5868	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			1.8900	1.0000	1.8900			(26)
TER Opening Type (Uw = 1.20)			6.4200	1.1450	7.3511			(27)
cavity wall	65.8000	6.4200	59.3800	0.1800	10.6884			(29a)
common wall	15.0000	1.8900	13.1100	0.1800	2.3598			(29a)
External Roof 1	60.0000		60.0000	0.1100	6.6000			(30)

Total net area of external elements Aum(A, m2) 140.8000 (31)
Fabric heat loss, W/K = Sum (A x U) (26)...(30) + (32) = 28.8893 (33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 334.3017 (35)
List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	6.0000	0.0500	0.3000
E3 Sill	5.0000	0.0500	0.2500
E4 Jamb	14.0000	0.0500	0.7000
E5 Ground floor (normal)	30.0000	0.1600	4.8000
E6 Intermediate floor within a dwelling	30.0000	0.0000	0.0000
E16 Corner (normal)	10.0000	0.0900	0.9000

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 6.9500 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 35.8393 (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	29.8086	29.6122	29.4196	28.5153	28.3461	27.5584	27.5584	27.4125	27.8618	28.3461	28.6884	29.0462	(38)
Heat transfer coeff	65.6480	65.4515	65.2590	64.3546	64.1854	63.3977	63.3977	63.2519	63.7011	64.1854	64.5277	64.8856	(39)
Average = Sum(39)m / 12 =												64.3538	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0941	1.0909	1.0876	1.0726	1.0698	1.0566	1.0566	1.0542	1.0617	1.0698	1.0755	1.0814	(40)
HLP (average)												1.0726	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 1.9816 (42)
Hot water usage for mixer showers

57.4451	56.5818	55.3238	52.9169	51.1406	49.1598	48.0339	49.2823	50.6509	52.7777	55.2363	57.2250	(42a)

Hot water usage for baths

24.8265	24.4578	23.9386	22.9812	22.2644	21.4695	21.0401	21.5557	22.1171	22.9676	23.9447	24.7426	(42b)

Hot water usage for other uses

34.9239	33.6540	32.3840	31.1140	29.8441	28.5741	28.5741	29.8441	31.1140	32.3840	33.6540	34.9239	(42c)

Average daily hot water use (litres/day) 107.7295 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	117.1955	114.6935	111.6463	107.0121	103.2491	99.2034	97.6481	100.6821	103.8820	108.1293	112.8350	116.8914	(44)
Energy conte	185.6090	163.3220	171.5963	146.4943	138.9931	121.9821	118.0969	124.6655	128.0969	146.7305	160.7541	183.0237	(45)
Energy content (annual)										Total = Sum(45)m =		1789.3645	
Distribution loss (46)m = 0.15 x (45)m	27.8413	24.4983	25.7394	21.9741	20.8490	18.2973	17.7145	18.6998	19.2145	22.0096	24.1131	27.4536	(46)

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

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

If cylinder contains dedicated solar storage

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

Total heat required for water heating calculated for each month

232.2039	205.4077	218.1912	191.5861	185.5880	167.0740	164.6918	171.2604	173.1888	193.3254	205.8460	229.6186	(62)
WWHRS -26.2615	-23.2259	-24.3208	-20.1386	-18.7684	-16.0603	-15.0540	-16.0084	-16.6166	-19.5891	-22.1921	-25.7752	(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

205.9424	182.1819	193.8704	171.4475	166.8196	151.0137	149.6379	155.2520	156.5722	173.7363	183.6539	203.8435	(64)

Total per year (kWh/year) = Sum(64)m = 2093.9712 (64)
12Total per year (kWh/year) 2094 (64)
Electric shower(s)

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

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

98.9909	87.9731	94.3317	84.7828	83.4911	76.6325	76.5432	78.7272	78.6657	86.0638	89.5242	98.1313	(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	99.0817	99.0817	99.0817	99.0817	99.0817	99.0817	99.0817	99.0817	99.0817	99.0817	99.0817	99.0817	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	99.2867	109.9245	99.2867	102.5962	99.2867	102.5962	99.2867	99.2867	102.5962	99.2867	102.5962	99.2867	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	172.9469	174.7416	170.2191	160.5914	148.4380	137.0156	129.3847	127.5901	132.1125	141.7403	153.8936	165.3161	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.9082	32.9082	32.9082	32.9082	32.9082	32.9082	32.9082	32.9082	32.9082	32.9082	32.9082	32.9082	(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)	-79.2654	-79.2654	-79.2654	-79.2654	-79.2654	-79.2654	-79.2654	-79.2654	-79.2654	-79.2654	-79.2654	-79.2654	(71)
Water heating gains (Table 5)	133.0523	130.9124	126.7899	117.7539	112.2193	106.4341	102.8806	105.8161	109.2579	115.6772	124.3392	131.8969	(72)
Total internal gains	461.0104	471.3030	452.0202	436.6660	415.6685	398.7704	384.2765	385.4174	396.6912	412.4286	436.5536	452.2242	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.6600	10.6334	0.6300	0.7000	0.7700	2.1448	(74)
South	5.7600	46.7521	0.6300	0.7000	0.7700	82.2991	(78)

Solar gains	84.4439	138.8836	178.6567	205.2365	217.2816	210.7341	205.1993	196.5993	187.7265	150.2571	100.1984	72.9020	(83)
Total gains	545.4543	610.1866	630.6769	641.9025	632.9501	609.5045	589.4758	582.0167	584.4176	562.6857	536.7520	525.1262	(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	84.8723	85.1270	85.3782	86.5780	86.8062	87.8847	87.8847	88.0874	87.4662	86.8062	86.3458	85.8695	
alpha	6.6582	6.6751	6.6919	6.7719	6.7871	6.8590	6.8590	6.8725	6.8311	6.7871	6.7564	6.7246	
util living area	0.9952	0.9889	0.9769	0.9389	0.8447	0.6515	0.4717	0.4978	0.7223	0.9330	0.9873	0.9962	(86)
MIT	20.2129	20.3592	20.5301	20.7489	20.9111	20.9876	20.9988	20.9982	20.9751	20.7966	20.4767	20.1923	(87)
Th 2	20.0056	20.0083	20.0109	20.0233	20.0256	20.0364	20.0364	20.0384	20.0322	20.0256	20.0209	20.0160	(88)
util rest of house	0.9932	0.9844	0.9673	0.9136	0.7874	0.5605	0.3693	0.3950	0.6346	0.9009	0.9812	0.9946	(89)
MIT 2	19.1128	19.2996	19.5147	19.7865	19.9597	20.0308	20.0361	20.0380	20.0194	19.8460	19.4590	19.0948	(90)
Living area fraction										fLA = Living area / (4) =		0.4667	(91)
MIT	19.6262	19.7941	19.9886	20.2356	20.4037	20.4773	20.4854	20.4861	20.4654	20.2896	19.9339	19.6069	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.6262	19.7941	19.9886	20.2356	20.4037	20.4773	20.4854	20.4861	20.4654	20.2896	19.9339	19.6069	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9922	0.9831	0.9670	0.9198	0.8112	0.6030	0.4173	0.4431	0.6753	0.9108	0.9805	0.9937	(94)
Useful gains	541.1773	599.8994	609.8706	590.4518	513.4591	367.5500	245.9618	257.9094	394.6411	512.4993	526.3048	521.8187	(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	1006.1314	974.8411	880.2503	729.4989	558.6481	372.6092	246.3230	258.4529	405.4814	621.9333	828.1448	999.6881	(97)
Space heating kWh	345.9258	251.9608	201.1625	100.1140	33.6206	0.0000	0.0000	0.0000	0.0000	81.4189	217.3247	355.5348	(98a)
Space heating requirement - total per year (kWh/year)												1587.0622	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	345.9258	251.9608	201.1625	100.1140	33.6206	0.0000	0.0000	0.0000	0.0000	81.4189	217.3247	355.5348	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1587.0622	
Space heating per m2											(98c) / (4) =	26.4510	(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	345.9258	251.9608	201.1625	100.1140	33.6206	0.0000	0.0000	0.0000	0.0000	81.4189	217.3247	355.5348	(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)	374.7842	272.9803	217.9442	108.4658	36.4254	0.0000	0.0000	0.0000	0.0000	88.2111	235.4548	385.1948	(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	205.9424	182.1819	193.8704	171.4475	166.8196	151.0137	149.6379	155.2520	156.5722	173.7363	183.6539	203.8435	(64)
Efficiency of water heater												79.8000	(216)
(217)m	85.2136	84.7872	84.1427	82.8974	81.1801	79.8000	79.8000	79.8000	79.8000	82.4670	84.4383	85.2945	(217)
Fuel for water heating, kWh/month	241.6778	214.8694	230.4067	206.8189	205.4933	189.2402	187.5162	194.5514	196.2057	210.6736	217.5007	238.9879	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	20.6298	16.5500	14.9014	10.9174	8.4329	6.8898	7.6928	9.9994	12.9882	17.0413	19.2481	21.2032	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-28.4419	-40.2805	-58.1612	-65.7115	-71.1489	-66.5495	-65.7787	-61.9971	-55.3043	-46.2698	-31.3546	-24.5725	(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	-15.4840	-32.6509	-65.0305	-97.8494	-129.5315	-130.1704	-128.5879	-108.7563	-79.5932	-46.6905	-20.6761	-12.2339	(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	1719.4607	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	79.8000	
Water heating fuel used	2533.9419	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
Total electricity for the above, kWh/year	86.0000	(231)

Electricity for lighting (calculated in Appendix L)	166.4944	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-1482.8252	(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	3023.0718	(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	1719.4607	0.2100	361.0867	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2533.9419	0.2100	532.1278	(264)
Space and water heating			893.2145	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	166.4944	0.1443	24.0303	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-615.5706	0.1345	-82.7787	
PV Unit electricity exported	-867.2546	0.1259	-109.1448	
Total			-191.9235	(269)
Total CO2, kg/year			737.2506	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			12.2900	(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	1719.4607	1.1300	1942.9905	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2533.9419	1.1300	2863.3544	(278)
Space and water heating			4806.3449	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	166.4944	1.5338	255.3746	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-615.5706	1.4970	-921.5028	
PV Unit electricity exported	-867.2546	0.4620	-400.6351	
Total			-1322.1379	(283)
Total Primary energy kWh/year			3869.6824	(286)
Target Primary Energy Rate (TPER)			64.4900	(287)

Full SAP Calculation Printout

Property Reference	CG-11-04 Flat	**Issued on Date**	25/07/2024
Assessment Reference	CG-11-04 SAP Design	**Prop Type Ref**	Flat 4 - First
Property	Flat 4 - First, South Worple Way, East Sheen		

SAP Rating	80 C	**DER**	5.81	**TER**	12.29
Environmental	96 A	**% DER < TER**			52.73
CO_2 Emissions (t/year)	0.28	**DFEE**	30.73	**TFEE**	33.98
Compliance Check	See BREL	**% DFEE < TFEE**			9.58
% DPER < TPER	7.21	**DPER**	59.84	**TPER**	64.49

Assessor Details	Mr. Colin Marshall	**Assessor ID**	AV43-0001
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	60.0000	(1b)	x 2.5000	(2b) =	150.0000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	60.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		150.0000	(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	1 * 10 =	10.0000 (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) =	10.0000 / (5) =	0.0667 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.3167 (18)
Number of sides sheltered		1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2929 (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	0.3735	0.3661	0.3588	0.3222	0.3149	0.2783	0.2783	0.2709	0.2929	0.3149	0.3295	0.3442	(22b)
Effective ac	0.5697	0.5670	0.5644	0.5519	0.5496	0.5387	0.5387	0.5367	0.5429	0.5496	0.5543	0.5592	(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	
solid D			1.8900	1.2000	2.2680			(26)
W or Glazed D (Uw = 1.30)			6.4200	1.2357	7.9335			(27)
cavity wall	65.8000	6.4200	59.3800	0.1800	10.6884	190.0000	11282.2000	(29a)
common wall	15.0000	1.8900	13.1100	0.2000	2.6220	190.0000	2490.9000	(29a)
External Roof 1	60.0000		60.0000	0.1200	7.2000	9.0000	540.0000	(30)
Total net area of external elements Aum(A, m2)			140.8000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		30.7119			(33)
Party Floor 1			60.0000			40.0000	2400.0000	(32d)
Party Ceiling 1			60.0000			30.0000	1800.0000	(32b)
Internal Wall 1			105.0000			9.0000	945.0000	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	19458.1000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		324.3017 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	6.0000	0.0950	0.5700
E3 Sill	5.0000	0.0630	0.3150
E4 Jamb	14.0000	0.0820	1.1480
E5 Ground floor (normal)	30.0000	0.0480	1.4400
E6 Intermediate floor within a dwelling	30.0000	0.0750	2.2500

E16 Corner (normal)									10.0000	0.0320	0.3200		
Thermal bridges (Sum(L x Psi) calculated using Appendix K)												6.0430	(36)
Point Thermal bridges											(36a) =	0.0000	
Total fabric heat loss											(33) + (36) + (36a) =	36.7549	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	28.2021	28.0681	27.9367	27.3195	27.2040	26.6665	26.6665	26.5670	26.8736	27.2040	27.4376	27.6818	(38)
Heat transfer coeff	64.9570	64.8229	64.6915	64.0744	63.9589	63.4214	63.4214	63.3218	63.6284	63.9589	64.1925	64.4367	(39)
Average = Sum(39)m / 12 =												64.0738	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0826	1.0804	1.0782	1.0679	1.0660	1.0570	1.0570	1.0554	1.0605	1.0660	1.0699	1.0739	(40)
HLP (average)												1.0679	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.9816	(42)
Hot water usage for mixer showers	69.9922	68.9206	67.3414	64.9120	62.7354	59.6902	57.2818	60.0974	61.5136	64.5296	67.6706	69.9290	(42a)
Hot water usage for baths	24.2730	23.9066	23.3854	22.6047	21.9012	20.9327	20.1980	21.0965	21.5680	22.5276	23.5253	24.2538	(42b)
Hot water usage for other uses	34.9239	33.6540	32.3840	31.1140	29.8441	28.5741	28.5741	29.8441	31.1140	32.3840	33.6540	34.9239	(42c)
Average daily hot water use (litres/day)												118.7832	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	129.1891	126.4812	123.1107	118.6308	114.4807	109.1971	106.0538	111.0379	114.1956	119.4412	124.8498	129.1067	(44)
Energy conte	190.1887	167.3602	175.9227	154.9614	147.5199	126.2828	117.1926	130.6937	132.4612	153.9121	168.7387	189.6027	(45)
Energy content (annual)											Total = Sum(45)m =	1854.8367	
Distribution loss (46)m = 0.15 x (45)m	28.5283	25.1040	26.3884	23.2442	22.1280	18.9424	17.5789	19.6041	19.8692	23.0868	25.3108	28.4404	(46)
Water storage loss:													
Store volume												200.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6100	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8694	(55)
Total storage loss	26.9514	24.3432	26.9514	26.0820	26.9514	26.0820	26.9514	26.9514	26.0820	26.9514	26.0820	26.9514	(56)
If cylinder contains dedicated solar storage	26.9514	24.3432	26.9514	26.0820	26.9514	26.0820	26.9514	26.9514	26.0820	26.9514	26.0820	26.9514	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	217.1401	191.7034	202.8741	181.0434	174.4713	152.3648	144.1440	157.6451	158.5432	180.8635	194.8207	216.5541	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	217.1401	191.7034	202.8741	181.0434	174.4713	152.3648	144.1440	157.6451	158.5432	180.8635	194.8207	216.5541	(64)
										Total per year (kWh/year) = Sum(64)m =		2172.1677	(64)
12Total per year (kWh/year)												2172	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000	(64a)
Heat gains from water heating, kWh/month	63.2377	55.6473	58.4943	51.5247	49.0504	41.9890	38.9665	43.4557	44.0433	51.1758	56.1056	63.0429	(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	99.0817	99.0817	99.0817	99.0817	99.0817	99.0817	99.0817	99.0817	99.0817	99.0817	99.0817	99.0817	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	91.8512	101.6924	91.8512	94.9129	91.8512	94.9129	91.8512	91.8512	94.9129	91.8512	94.9129	91.8512	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	172.9469	174.7416	170.2191	160.5914	148.4380	137.0156	129.3847	127.5901	132.1125	141.7403	153.8936	165.3161	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.9082	32.9082	32.9082	32.9082	32.9082	32.9082	32.9082	32.9082	32.9082	32.9082	32.9082	32.9082	(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)	-79.2654	-79.2654	-79.2654	-79.2654	-79.2654	-79.2654	-79.2654	-79.2654	-79.2654	-79.2654	-79.2654	-79.2654	(71)
Water heating gains (Table 5)	84.9970	82.8084	78.6214	71.5621	65.9279	58.3181	52.3744	58.4081	61.1713	68.7846	77.9245	84.7351	(72)
Total internal gains	402.5196	411.9669	393.4162	379.7908	358.9416	342.9711	326.3348	330.5739	340.9213	355.1007	379.4555	394.6269	(73)

6. Solar gains

[Jan]

	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.6600	10.6334	0.7200	1.0000	0.7700	3.5017	(74)
South	5.7600	46.7521	0.7200	1.0000	0.7700	134.3659	(78)

Solar gains	137.8676	226.7487	291.6845	335.0800	354.7455	344.0557	335.0193	320.9785	306.4922	245.3177	163.5892	119.0237	(83)
Total gains	540.3872	638.7156	685.1007	714.8708	713.6871	687.0268	661.3541	651.5524	647.4135	600.4184	543.0448	513.6506	(84)

7. Mean internal temperature (heating season)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	83.2094	83.3814	83.5508	84.3555	84.5078	85.2241	85.2241	85.3581	84.9468	84.5078	84.2003	83.8812	
alpha	6.5473	6.5588	6.5701	6.6237	6.6339	6.6816	6.6816	6.6905	6.6631	6.6339	6.6134	6.5921	
util living area													
	0.9947	0.9841	0.9623	0.9013	0.7783	0.5835	0.4212	0.4459	0.6608	0.9090	0.9850	0.9961	(86)
MIT	20.2004	20.3933	20.5924	20.8082	20.9423	20.9926	20.9993	20.9989	20.9836	20.8251	20.4768	20.1647	(87)
Th 2	20.0151	20.0169	20.0187	20.0271	20.0287	20.0361	20.0361	20.0375	20.0332	20.0287	20.0255	20.0222	(88)
util rest of house													
	0.9926	0.9781	0.9483	0.8677	0.7159	0.4993	0.3294	0.3533	0.5763	0.8709	0.9782	0.9946	(89)
MIT 2	19.1068	19.3507	19.5968	19.8529	19.9879	20.0328	20.0359	20.0372	20.0250	19.8781	19.4647	19.0672	(90)
Living area fraction									fLA = Living area / (4) =			0.4667	(91)
MIT	19.6171	19.8372	20.0614	20.2987	20.4333	20.4807	20.4855	20.4860	20.4723	20.3200	19.9370	19.5794	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.6171	19.8372	20.0614	20.2987	20.4333	20.4807	20.4855	20.4860	20.4723	20.3200	19.9370	19.5794	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9915	0.9768	0.9490	0.8780	0.7431	0.5386	0.3723	0.3966	0.6156	0.8836	0.9774	0.9936	(94)
Useful gains	535.8039	623.8817	650.1626	627.6251	530.3330	370.0606	246.2111	258.4090	398.5660	530.5433	530.7883	510.3772	(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													
	994.9537	968.2746	877.3073	730.3656	558.5699	372.9649	246.4223	258.7325	405.4610	621.6822	824.0401	990.9955	(97)
Space heating kWh													
	341.6075	231.4320	168.9957	73.9731	21.0082	0.0000	0.0000	0.0000	0.0000	67.8073	211.1413	357.5800	(98a)
Space heating requirement - total per year (kWh/year)												1473.5452	
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													
	341.6075	231.4320	168.9957	73.9731	21.0082	0.0000	0.0000	0.0000	0.0000	67.8073	211.1413	357.5800	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1473.5452	
Space heating per m2											(98c) / (4) =	24.5591	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Fraction of main heating from main system 2	0.0000	(203)
Fraction of total heating from main system 1	1.0000	(204)
Fraction of total heating from main system 2	0.0000	(205)
Efficiency of main space heating system 1 (in %)	100.0000	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	341.6075	231.4320	168.9957	73.9731	21.0082	0.0000	0.0000	0.0000	0.0000	67.8073	211.1413	357.5800	(98)
Space heating efficiency (main heating system 1)													
	100.0000	100.0000	100.0000	100.0000	100.0000	0.0000	0.0000	0.0000	0.0000	100.0000	100.0000	100.0000	(210)
Space heating fuel (main heating system)													
	341.6075	231.4320	168.9957	73.9731	21.0082	0.0000	0.0000	0.0000	0.0000	67.8073	211.1413	357.5800	(211)
Space heating efficiency (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Space heating fuel used, main system 2												0.0000	(213)
Water heating													
Water heating requirement													
	217.1401	191.7034	202.8741	181.0434	174.4713	152.3648	144.1440	157.6451	158.5432	180.8635	194.8207	216.5541	(64)
Efficiency of water heater												324.5200	(216)
(217)m	324.5200	324.5200	324.5200	324.5200	324.5200	324.5200	324.5200	324.5200	324.5200	324.5200	324.5200	324.5200	(217)
Fuel for water heating, kWh/month													
	66.9112	59.0729	62.5151	55.7881	53.7629	46.9508	44.4176	48.5779	48.8547	55.7326	60.0335	66.7306	(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	19.5270	15.6653	14.1048	10.3338	7.9821	6.5215	7.2816	9.4648	12.2939	16.1303	18.2191	20.0697	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												1473.5452	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												324.5200	
Water heating fuel used												669.3479	(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)												157.5938	(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	2300.4868	(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	1473.5452	0.1570	231.3084	(261)
Space heating - main system 2	0.0000	0.0000	0.0000	(262)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	669.3479	0.1412	94.4846	(264)
Space and water heating			325.7930	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	157.5938	0.1443	22.7456	(268)
Total CO2, kg/year			348.5387	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			5.8100	(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	1473.5452	1.5811	2329.8285	(275)
Space heating - main system 2	0.0000	0.0000	0.0000	(276)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	669.3479	1.5220	1018.7256	(278)
Space and water heating			3348.5541	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	157.5938	1.5338	241.7226	(282)
Total Primary energy kWh/year			3590.2766	(286)
Dwelling Primary energy Rate (DPER)			59.8400	(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	60.0000	(1b)	x 2.5000	(2b) =	150.0000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	60.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		150.0000	(5)

2. Ventilation rate

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

	Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1333 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.3833 (18)
Number of sides sheltered		1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3546 (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	0.4521	0.4432	0.4344	0.3900	0.3812	0.3369	0.3369	0.3280	0.3546	0.3812	0.3989	0.4166	(22b)
Effective ac	0.6022	0.5982	0.5943	0.5761	0.5726	0.5567	0.5567	0.5538	0.5629	0.5726	0.5796	0.5868	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			1.8900	1.0000	1.8900			(26)
TER Opening Type (Uw = 1.20)			6.4200	1.1450	7.3511			(27)
cavity wall	65.8000	6.4200	59.3800	0.1800	10.6884			(29a)
common wall	15.0000	1.8900	13.1100	0.1800	2.3598			(29a)
External Roof 1	60.0000		60.0000	0.1100	6.6000			(30)

Total net area of external elements Aum(A, m2) 140.8000 (31)
Fabric heat loss, W/K = Sum (A x U) (26)...(30) + (32) = 28.8893 (33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 334.3017 (35)
List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	6.0000	0.0500	0.3000
E3 Sill	5.0000	0.0500	0.2500
E4 Jamb	14.0000	0.0500	0.7000
E5 Ground floor (normal)	30.0000	0.1600	4.8000
E6 Intermediate floor within a dwelling	30.0000	0.0000	0.0000
E16 Corner (normal)	10.0000	0.0900	0.9000

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 6.9500 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 35.8393 (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	29.8086	29.6122	29.4196	28.5153	28.3461	27.5584	27.5584	27.4125	27.8618	28.3461	28.6884	29.0462	(38)
Heat transfer coeff	65.6480	65.4515	65.2590	64.3546	64.1854	63.3977	63.3977	63.2519	63.7011	64.1854	64.5277	64.8856	(39)
Average = Sum(39)m / 12 =												64.3538	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0941	1.0909	1.0876	1.0726	1.0698	1.0566	1.0566	1.0542	1.0617	1.0698	1.0755	1.0814	(40)
HLP (average)												1.0726	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 1.9816 (42)
Hot water usage for mixer showers

57.4451	56.5818	55.3238	52.9169	51.1406	49.1598	48.0339	49.2823	50.6509	52.7777	55.2363	57.2250	(42a)

Hot water usage for baths

24.8265	24.4578	23.9386	22.9812	22.2644	21.4695	21.0401	21.5557	22.1171	22.9676	23.9447	24.7426	(42b)

Hot water usage for other uses

34.9239	33.6540	32.3840	31.1140	29.8441	28.5741	28.5741	29.8441	31.1140	32.3840	33.6540	34.9239	(42c)

Average daily hot water use (litres/day) 107.7295 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	117.1955	114.6935	111.6463	107.0121	103.2491	99.2034	97.6481	100.6821	103.8820	108.1293	112.8350	116.8914	(44)
Energy conte	185.6090	163.3220	171.5963	146.4943	138.9931	121.9821	118.0969	124.6655	128.0969	146.7305	160.7541	183.0237	(45)
Energy content (annual)										Total = Sum(45)m =		1789.3645	
Distribution loss (46)m = 0.15 x (45)m	27.8413	24.4983	25.7394	21.9741	20.8490	18.2973	17.7145	18.6998	19.2145	22.0096	24.1131	27.4536	(46)

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

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

If cylinder contains dedicated solar storage

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

Total heat required for water heating calculated for each month

232.2039	205.4077	218.1912	191.5861	185.5880	167.0740	164.6918	171.2604	173.1888	193.3254	205.8460	229.6186	(62)
WWHRS -26.2615	-23.2259	-24.3208	-20.1386	-18.7684	-16.0603	-15.0540	-16.0084	-16.6166	-19.5891	-22.1921	-25.7752	(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

205.9424	182.1819	193.8704	171.4475	166.8196	151.0137	149.6379	155.2520	156.5722	173.7363	183.6539	203.8435	(64)

Total per year (kWh/year) = Sum(64)m = 2093.9712 (64)
12Total per year (kWh/year) 2094 (64)
Electric shower(s)

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

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

98.9909	87.9731	94.3317	84.7828	83.4911	76.6325	76.5432	78.7272	78.6657	86.0638	89.5242	98.1313	(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	99.0817	99.0817	99.0817	99.0817	99.0817	99.0817	99.0817	99.0817	99.0817	99.0817	99.0817	99.0817	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	99.2867	109.9245	99.2867	102.5962	99.2867	102.5962	99.2867	99.2867	102.5962	99.2867	102.5962	99.2867	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	172.9469	174.7416	170.2191	160.5914	148.4380	137.0156	129.3847	127.5901	132.1125	141.7403	153.8936	165.3161	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.9082	32.9082	32.9082	32.9082	32.9082	32.9082	32.9082	32.9082	32.9082	32.9082	32.9082	32.9082	(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)	-79.2654	-79.2654	-79.2654	-79.2654	-79.2654	-79.2654	-79.2654	-79.2654	-79.2654	-79.2654	-79.2654	-79.2654	(71)
Water heating gains (Table 5)	133.0523	130.9124	126.7899	117.7539	112.2193	106.4341	102.8806	105.8161	109.2579	115.6772	124.3392	131.8969	(72)
Total internal gains	461.0104	471.3030	452.0202	436.6660	415.6685	398.7704	384.2765	385.4174	396.6912	412.4286	436.5536	452.2242	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.6600	10.6334	0.6300	0.7000	0.7700	2.1448	(74)
South	5.7600	46.7521	0.6300	0.7000	0.7700	82.2991	(78)

Solar gains	84.4439	138.8836	178.6567	205.2365	217.2816	210.7341	205.1993	196.5993	187.7265	150.2571	100.1984	72.9020	(83)
Total gains	545.4543	610.1866	630.6769	641.9025	632.9501	609.5045	589.4758	582.0167	584.4176	562.6857	536.7520	525.1262	(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	84.8723	85.1270	85.3782	86.5780	86.8062	87.8847	87.8847	88.0874	87.4662	86.8062	86.3458	85.8695	
alpha	6.6582	6.6751	6.6919	6.7719	6.7871	6.8590	6.8590	6.8725	6.8311	6.7871	6.7564	6.7246	
util living area	0.9952	0.9889	0.9769	0.9389	0.8447	0.6515	0.4717	0.4978	0.7223	0.9330	0.9873	0.9962	(86)
MIT	20.2129	20.3592	20.5301	20.7489	20.9111	20.9876	20.9988	20.9982	20.9751	20.7966	20.4767	20.1923	(87)
Th 2	20.0056	20.0083	20.0109	20.0233	20.0256	20.0364	20.0364	20.0384	20.0322	20.0256	20.0209	20.0160	(88)
util rest of house	0.9932	0.9844	0.9673	0.9136	0.7874	0.5605	0.3693	0.3950	0.6346	0.9009	0.9812	0.9946	(89)
MIT 2	19.1128	19.2996	19.5147	19.7865	19.9597	20.0308	20.0361	20.0380	20.0194	19.8460	19.4590	19.0948	(90)
Living area fraction										fLA = Living area / (4) =		0.4667	(91)
MIT	19.6262	19.7941	19.9886	20.2356	20.4037	20.4773	20.4854	20.4861	20.4654	20.2896	19.9339	19.6069	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.6262	19.7941	19.9886	20.2356	20.4037	20.4773	20.4854	20.4861	20.4654	20.2896	19.9339	19.6069	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9922	0.9831	0.9670	0.9198	0.8112	0.6030	0.4173	0.4431	0.6753	0.9108	0.9805	0.9937	(94)
Useful gains	541.1773	599.8994	609.8706	590.4518	513.4591	367.5500	245.9618	257.9094	394.6411	512.4993	526.3048	521.8187	(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	1006.1314	974.8411	880.2503	729.4989	558.6481	372.6092	246.3230	258.4529	405.4814	621.9333	828.1448	999.6881	(97)
Space heating kWh	345.9258	251.9608	201.1625	100.1140	33.6206	0.0000	0.0000	0.0000	0.0000	81.4189	217.3247	355.5348	(98a)
Space heating requirement - total per year (kWh/year)												1587.0622	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	345.9258	251.9608	201.1625	100.1140	33.6206	0.0000	0.0000	0.0000	0.0000	81.4189	217.3247	355.5348	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1587.0622	
Space heating per m2											(98c) / (4) =	26.4510	(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	345.9258	251.9608	201.1625	100.1140	33.6206	0.0000	0.0000	0.0000	0.0000	81.4189	217.3247	355.5348	(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)	374.7842	272.9803	217.9442	108.4658	36.4254	0.0000	0.0000	0.0000	0.0000	88.2111	235.4548	385.1948	(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	205.9424	182.1819	193.8704	171.4475	166.8196	151.0137	149.6379	155.2520	156.5722	173.7363	183.6539	203.8435	(64)
Efficiency of water heater												79.8000	(216)
(217)m	85.2136	84.7872	84.1427	82.8974	81.1801	79.8000	79.8000	79.8000	79.8000	82.4670	84.4383	85.2945	(217)
Fuel for water heating, kWh/month	241.6778	214.8694	230.4067	206.8189	205.4933	189.2402	187.5162	194.5514	196.2057	210.6736	217.5007	238.9879	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	20.6298	16.5500	14.9014	10.9174	8.4329	6.8898	7.6928	9.9994	12.9882	17.0413	19.2481	21.2032	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-28.4419	-40.2805	-58.1612	-65.7115	-71.1489	-66.5495	-65.7787	-61.9971	-55.3043	-46.2698	-31.3546	-24.5725	(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	-15.4840	-32.6509	-65.0305	-97.8494	-129.5315	-130.1704	-128.5879	-108.7563	-79.5932	-46.6905	-20.6761	-12.2339	(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	1719.4607	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	79.8000	
Water heating fuel used	2533.9419	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
Total electricity for the above, kWh/year	86.0000	(231)

Electricity for lighting (calculated in Appendix L)	166.4944	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-1482.8252	(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	3023.0718	(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	1719.4607	0.2100	361.0867	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2533.9419	0.2100	532.1278	(264)
Space and water heating			893.2145	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	166.4944	0.1443	24.0303	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-615.5706	0.1345	-82.7787	
PV Unit electricity exported	-867.2546	0.1259	-109.1448	
Total			-191.9235	(269)
Total CO2, kg/year			737.2506	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			12.2900	(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	1719.4607	1.1300	1942.9905	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2533.9419	1.1300	2863.3544	(278)
Space and water heating			4806.3449	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	166.4944	1.5338	255.3746	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-615.5706	1.4970	-921.5028	
PV Unit electricity exported	-867.2546	0.4620	-400.6351	
Total			-1322.1379	(283)
Total Primary energy kWh/year			3869.6824	(286)
Target Primary Energy Rate (TPER)			64.4900	(287)

Full SAP Calculation Printout

Property Reference	CG-11-05 House	**Issued on Date**	25/07/2024
Assessment Reference	CG-11-05 SAP Design	**Prop Type Ref**	House
Property	House, South Worple Way, East Sheen		

SAP Rating	76 C	**DER**	5.92	**TER**	12.35
Environmental	95 A	**% DER < TER**			52.06
CO_2 Emissions (t/year)	0.42	**DFEE**	37.17	**TFEE**	40.86
Compliance Check	See BREL	**% DFEE < TFEE**			9.03
% DPER < TPER	4.33	**DPER**	61.85	**TPER**	64.65

Assessor Details	Mr. Colin Marshall	**Assessor ID**	AV43-0001
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	41.0000 (1b)	x	2.5000 (2b)	=	102.5000	(1b) - (3b)
First floor	41.0000 (1c)	x	2.6600 (2c)	=	109.0600	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	82.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	211.5600	(5)

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2. Ventilation rate

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			m3 per hour	
Number of open chimneys		0 * 80 =	0.0000	(6a)
Number of open flues		0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire		0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler		0 * 20 =	0.0000	(6d)
Number of flues attached to other heater		0 * 35 =	0.0000	(6e)
Number of blocked chimneys		0 * 20 =	0.0000	(6f)
Number of intermittent extract fans		2 * 10 =	20.0000	(7a)
Number of passive vents		0 * 10 =	0.0000	(7b)
Number of flueless gas fires		0 * 40 =	0.0000	(7c)
		Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =		20.0000 / (5) =	0.0945	(8)
Pressure test			Yes	
Pressure Test Method			Blower Door	
Measured/design AP50			5.0000	(17)
Infiltration rate			0.3445	(18)
Number of sides sheltered			0	(19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor		(21) = (18) x (20) =	0.3445	(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	0.4393	0.4307	0.4221	0.3790	0.3704	0.3273	0.3273	0.3187	0.3445	0.3704	0.3876	0.4048	(22b)
Effective ac	0.5965	0.5927	0.5891	0.5718	0.5686	0.5536	0.5536	0.5508	0.5594	0.5686	0.5751	0.5819	(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	
solid D			1.8900	1.2000	2.2680			(26)
W or Glazed D (Uw = 1.30)			11.3800	1.2357	14.0627			(27)
Heatloss Floor 1			41.0000	0.1200	4.9200	75.0000	3075.0000	(28a)
cavity wall	134.7000	13.2700	121.4300	0.1800	21.8574	190.0000	23071.7000	(29a)
External Roof 1	41.0000		41.0000	0.1200	4.9200	9.0000	369.0000	(30)
Total net area of external elements Aum(A, m2)			216.7000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		48.0281			(33)
Internal Wall 1			130.0000			9.0000	1170.0000	(32c)
Internal Floor 1			41.0000			18.0000	738.0000	(32d)
Internal Ceiling 1			41.0000			9.0000	369.0000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	28792.7000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		351.1305 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	33.0000	0.0950	3.1350
E3 Sill	5.0000	0.0630	0.3150
E4 Jamb	14.0000	0.0820	1.1480
E5 Ground floor (normal)	30.0000	0.0480	1.4400

E6 Intermediate floor within a dwelling									30.0000	0.0750	2.2500		
E16 Corner (normal)									10.0000	0.0320	0.3200		
Thermal bridges (Sum(L x Psi) calculated using Appendix K)												8.6080	(36)
Point Thermal bridges											(36a) =	0.0000	
Total fabric heat loss										(33) + (36) + (36a) =		56.6361	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.6435	41.3819	41.1255	39.9213	39.6959	38.6471	38.6471	38.4528	39.0511	39.6959	40.1517	40.6283	(38)
Heat transfer coeff	98.2796	98.0180	97.7616	96.5574	96.3321	95.2832	95.2832	95.0890	95.6872	96.3321	96.7879	97.2644	(39)
Average = Sum(39)m / 12 =												96.5563	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1985	1.1953	1.1922	1.1775	1.1748	1.1620	1.1620	1.1596	1.1669	1.1748	1.1803	1.1862	(40)
HLP (average)												1.1775	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.4997	(42)
Hot water usage for mixer showers	80.5761	79.3425	77.5245	74.7278	72.2220	68.7164	65.9437	69.1851	70.8155	74.2876	77.9035	80.5035	(42a)
Hot water usage for baths	27.9253	27.5038	26.9041	26.0060	25.1966	24.0824	23.2371	24.2707	24.8132	25.9172	27.0651	27.9032	(42b)
Hot water usage for other uses	40.2296	38.7667	37.3038	35.8409	34.3780	32.9151	32.9151	34.3780	35.8409	37.3038	38.7667	40.2296	(42c)
Average daily hot water use (litres/day)												136.7507	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	148.7310	145.6130	141.7324	136.5746	131.7966	125.7139	122.0959	127.8339	131.4696	137.5086	143.7352	148.6362	(44)
Energy conte	218.9577	192.6754	202.5326	178.4006	169.8332	145.3839	134.9196	150.4628	152.4981	177.1937	194.2630	218.2832	(45)
Energy content (annual)										Total = Sum(45)m =		2135.4040	
Distribution loss (46)m = 0.15 x (45)m	32.8437	28.9013	30.3799	26.7601	25.4750	21.8076	20.2379	22.5694	22.8747	26.5791	29.1394	32.7425	(46)
Water storage loss:													
Store volume												200.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6100	(48)
Temperature factor from Table 2b												0.6000	(49)
Enter (49) or (54) in (55)												0.9660	(55)
Total storage loss	29.9460	27.0480	29.9460	28.9800	29.9460	28.9800	29.9460	29.9460	28.9800	29.9460	28.9800	29.9460	(56)
If cylinder contains dedicated solar storage	29.9460	27.0480	29.9460	28.9800	29.9460	28.9800	29.9460	29.9460	28.9800	29.9460	28.9800	29.9460	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	272.1661	240.7346	255.7410	229.8926	223.0416	196.8759	188.1280	203.6712	203.9901	230.4021	245.7550	271.4916	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	272.1661	240.7346	255.7410	229.8926	223.0416	196.8759	188.1280	203.6712	203.9901	230.4021	245.7550	271.4916	(64)
										Total per year (kWh/year) = Sum(64)m =		2761.8900	(64)
12Total per year (kWh/year)												2762	(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	91.4134	80.8735	85.9520	77.3278	75.0795	66.3498	63.4707	68.6388	68.7152	77.5268	82.6020	91.1891	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	124.9857	124.9857	124.9857	124.9857	124.9857	124.9857	124.9857	124.9857	124.9857	124.9857	124.9857	124.9857	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	113.6660	125.8445	113.6660	117.4549	113.6660	117.4549	113.6660	113.6660	117.4549	113.6660	117.4549	113.6660	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	223.5697	225.8896	220.0434	207.5975	191.8868	177.1210	167.2565	164.9365	170.7828	183.2286	198.9393	213.7052	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.4986	35.4986	35.4986	35.4986	35.4986	35.4986	35.4986	35.4986	35.4986	35.4986	35.4986	35.4986	(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)	-99.9886	-99.9886	-99.9886	-99.9886	-99.9886	-99.9886	-99.9886	-99.9886	-99.9886	-99.9886	-99.9886	-99.9886	(71)
Water heating gains (Table 5)	122.8674	120.3475	115.5269	107.3997	100.9133	92.1524	85.3100	92.2565	95.4378	104.2027	114.7251	122.5660	(72)
Total internal gains	523.5988	535.5773	512.7320	495.9478	469.9618	447.2240	426.7283	431.3547	444.1712	464.5931	494.6150	513.4328	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	1.3200	10.6334	0.7200	1.0000	0.7700	7.0034	(74)
East	3.4600	19.6403	0.7200	1.0000	0.7700	33.9070	(76)
South	6.6000	46.7521	0.7200	1.0000	0.7700	153.9609	(78)

Solar gains	194.8713	331.8615	453.1696	558.8598	622.7393	616.5958	595.1629	547.9017	489.9117	366.6027	233.4138	166.7583	(83)
Total gains	718.4701	867.4388	965.9016	1054.8076	1092.7011	1063.8198	1021.8912	979.2565	934.0829	831.1958	728.0288	680.1911	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	81.3798	81.5969	81.8109	82.8313	83.0250	83.9389	83.9389	84.1104	83.5845	83.0250	82.6340	82.2292	
alpha	6.4253	6.4398	6.4541	6.5221	6.5350	6.5959	6.5959	6.6074	6.5723	6.5350	6.5089	6.4819	
util living area													
	0.9972	0.9903	0.9716	0.9070	0.7679	0.5669	0.4096	0.4455	0.6840	0.9334	0.9915	0.9980	(86)
MIT	20.2692	20.4209	20.5980	20.7957	20.9104	20.9479	20.9524	20.9521	20.9369	20.7851	20.4910	20.2460	(87)
Th 2	19.9212	19.9237	19.9262	19.9380	19.9402	19.9505	19.9505	19.9524	19.9466	19.9402	19.9358	19.9311	(88)
util rest of house													
	0.9959	0.9861	0.9594	0.8715	0.6994	0.4773	0.3123	0.3448	0.5905	0.8990	0.9870	0.9971	(89)
MIT 2	19.0829	19.2771	19.4987	19.7377	19.8511	19.8881	19.8900	19.8919	19.8784	19.7344	19.3773	19.0616	(90)
Living area fraction										fLA = Living area / (4) =		0.3171	(91)
MIT	19.4591	19.6398	19.8473	20.0732	20.1870	20.2241	20.2268	20.2281	20.2140	20.0675	19.7304	19.4371	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.4591	19.6398	19.8473	20.0732	20.1870	20.2241	20.2268	20.2281	20.2140	20.0675	19.7304	19.4371	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9952	0.9847	0.9583	0.8766	0.7163	0.5010	0.3380	0.3714	0.6152	0.9039	0.9859	0.9965	(94)
Useful gains	715.0235	854.1667	925.6111	924.6713	782.7294	532.9816	345.3971	363.6754	574.6364	751.3470	717.7277	677.8209	(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	1489.8278	1444.7660	1304.8520	1078.8553	817.5705	535.8851	345.5764	364.0063	585.0333	912.0271	1222.4702	1482.0286	(97)
Space heating kWh	576.4544	396.8827	282.1552	111.0125	25.9218	0.0000	0.0000	0.0000	0.0000	119.5460	363.4147	598.3305	(98a)
Space heating requirement - total per year (kWh/year)												2473.7178	
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	576.4544	396.8827	282.1552	111.0125	25.9218	0.0000	0.0000	0.0000	0.0000	119.5460	363.4147	598.3305	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2473.7178	
Space heating per m2											(98c) / (4) =	30.1673	(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 %)												170.0000	(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	576.4544	396.8827	282.1552	111.0125	25.9218	0.0000	0.0000	0.0000	0.0000	119.5460	363.4147	598.3305	(98)
Space heating efficiency (main heating system 1)	170.0000	170.0000	170.0000	170.0000	170.0000	0.0000	0.0000	0.0000	0.0000	170.0000	170.0000	170.0000	(210)
Space heating fuel (main heating system)	339.0908	233.4604	165.9737	65.3015	15.2481	0.0000	0.0000	0.0000	0.0000	70.3212	213.7733	351.9591	(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	272.1661	240.7346	255.7410	229.8926	223.0416	196.8759	188.1280	203.6712	203.9901	230.4021	245.7550	271.4916	(64)
Efficiency of water heater												170.0000	(216)
(217)m	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	(217)
Fuel for water heating, kWh/month	160.0977	141.6086	150.4359	135.2310	131.2010	115.8094	110.6635	119.8066	119.9942	135.5307	144.5617	159.7009	(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	24.1646	19.3858	17.4547	12.7881	9.8779	8.0703	9.0109	11.7128	15.2137	19.9612	22.5462	24.8363	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												1455.1281	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												170.0000	
Water heating fuel used												1624.6412	(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)												195.0225	(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	3274.7918	(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	1455.1281	0.1571	228.5831	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1624.6412	0.1409	228.9572	(264)
Space and water heating			457.5403	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	195.0225	0.1443	28.1478	(268)
Total CO2, kg/year			485.6881	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			5.9200	(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	1455.1281	1.5815	2301.3222	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1624.6412	1.5211	2471.2425	(278)
Space and water heating			4772.5647	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	195.0225	1.5338	299.1321	(282)
Total Primary energy kWh/year			5071.6968	(286)
Dwelling Primary energy Rate (DPER)			61.8500	(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	41.0000 (1b)	x	2.5000 (2b)	=	102.5000	(1b) - (3b)
First floor	41.0000 (1c)	x	2.6600 (2c)	=	109.0600	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 82.0000						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	211.5600	(5)

2. Ventilation rate

	m3 per hour	
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	3 * 10 =	30.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)
	Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1418 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.3918 (18)
Number of sides sheltered		0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3918 (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	0.4995	0.4898	0.4800	0.4310	0.4212	0.3722	0.3722	0.3624	0.3918	0.4212	0.4408	0.4604	(22b)
Effective ac	0.6248	0.6199	0.6152	0.5929	0.5887	0.5693	0.5693	0.5657	0.5768	0.5887	0.5971	0.6060	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			1.8900	1.0000	1.8900			(26)
TER Opening Type (Uw = 1.20)			11.3800	1.1450	13.0305			(27)
Heatloss Floor 1			41.0000	0.1300	5.3300			(28a)
cavity wall	134.7000	13.2700	121.4300	0.1800	21.8574			(29a)
External Roof 1	41.0000		41.0000	0.1100	4.5100			(30)
Total net area of external elements Aum(A, m2)			216.7000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		46.6179			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 351.1305 (35)
List of Thermal Bridges

	K1 Element	Length	Psi-value	Total	
E1	Steel lintel with perforated steel base plate	33.0000	0.0500	1.6500	
E3	Sill	5.0000	0.0500	0.2500	
E4	Jamb	14.0000	0.0500	0.7000	
E5	Ground floor (normal)	30.0000	0.1600	4.8000	
E6	Intermediate floor within a dwelling	30.0000	0.0000	0.0000	
E16	Corner (normal)	10.0000	0.0900	0.9000	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 8.3000 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 54.9179 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	43.6185	43.2803	42.9487	41.3914	41.1000	39.7436	39.7436	39.4924	40.2660	41.1000	41.6894	42.3057	(38)
Heat transfer coeff	98.5365	98.1982	97.8666	96.3093	96.0179	94.6615	94.6615	94.4103	95.1840	96.0179	96.6074	97.2236	(39)

Average = Sum(39)m / 12 = 96.3079

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2017	1.1975	1.1935	1.1745	1.1710	1.1544	1.1544	1.1513	1.1608	1.1710	1.1781	1.1857	(40)
HLP (average)												1.1745	
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 2.4997 (42)
Hot water usage for mixer showers

66.1317	65.1379	63.6897	60.9188	58.8739	56.5936	55.2974	56.7346	58.3101	60.7586	63.5890	65.8783	(42a)

Hot water usage for baths

28.5620	28.1378	27.5405	26.4391	25.6144	24.6999	24.2060	24.7991	25.4450	26.4235	27.5476	28.4655	(42b)

Hot water usage for other uses

40.2296	38.7667	37.3038	35.8409	34.3780	32.9151	32.9151	34.3780	35.8409	37.3038	38.7667	40.2296	(42c)

Average daily hot water use (litres/day) 124.0251 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	134.9233	132.0424	128.5340	123.1988	118.8663	114.2086	112.4185	115.9118	119.5960	124.4859	129.9032	134.5734	(44)
Energy conte	213.6855	188.0266	197.5519	168.6530	160.0169	140.4328	135.9604	143.5230	147.4738	168.9261	185.0710	210.7094	(45)
Energy content (annual)										Total = Sum(45)m =		2060.0305	
Distribution loss (46)m = 0.15 x (45)m	32.0528	28.2040	29.6328	25.2979	24.0025	21.0649	20.3941	21.5284	22.1211	25.3389	27.7606	31.6064	(46)

Water storage loss:
Store volume 200.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.6525 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 0.8924 (55)
Total storage loss

27.6637	24.9865	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	26.7713	27.6637	26.7713	27.6637	(56)

If cylinder contains dedicated solar storage

27.6637	24.9865	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	26.7713	27.6637	26.7713	27.6637	(57)
23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)

Primary loss
Combi loss
Total heat required for water heating calculated for each month

264.6116	234.0244	248.4780	217.9363	210.9430	189.7161	186.8865	194.4491	196.7571	219.8522	234.3543	261.6355	(62)
-30.2327	-26.7380	-27.9985	-23.1839	-21.6065	-18.4889	-17.3304	-18.4291	-19.1293	-22.5513	-25.5479	-29.6728	(63a)
-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)

WWHRS
PV diverter
Solar input
FGHRS
Output from w/h

234.3790	207.2864	220.4795	194.7524	189.3365	171.2272	169.5561	176.0200	177.6278	197.3009	208.8063	231.9627	(64)

Total per year (kWh/year) = Sum(64)m = 2378.7347 (64)
12Total per year (kWh/year) 2379 (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

111.7913	99.3170	106.4269	95.5038	93.9465	86.1205	85.9477	88.4622	88.4617	96.9088	100.9627	110.8017	(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	124.9857	124.9857	124.9857	124.9857	124.9857	124.9857	124.9857	124.9857	124.9857	124.9857	124.9857	124.9857	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	121.2072	134.1937	121.2072	125.2474	121.2072	125.2474	121.2072	121.2072	125.2474	121.2072	125.2474	121.2072	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	223.5697	225.8896	220.0434	207.5975	191.8868	177.1210	167.2565	164.9365	170.7828	183.2286	198.9393	213.7052	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.4986	35.4986	35.4986	35.4986	35.4986	35.4986	35.4986	35.4986	35.4986	35.4986	35.4986	35.4986	(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)	-99.9886	-99.9886	-99.9886	-99.9886	-99.9886	-99.9886	-99.9886	-99.9886	-99.9886	-99.9886	-99.9886	-99.9886	(71)
Water heating gains (Table 5)	150.2571	147.7932	143.0469	132.6441	126.2722	119.6119	115.5211	118.9009	122.8634	130.2538	140.2260	148.9271	(72)
Total internal gains	558.5297	571.3722	547.7932	528.9848	502.8619	482.4760	464.4805	465.5403	479.3893	498.1853	527.9085	547.3351	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	1.3200	10.6334	0.6300	0.7000	0.7700	4.2896	(74)
East	3.4600	19.6403	0.6300	0.7000	0.7700	20.7680	(76)
South	6.6000	46.7521	0.6300	0.7000	0.7700	94.3011	(78)

Solar gains	119.3587	203.2652	277.5664	342.3016	381.4278	377.6649	364.5373	335.5898	300.0709	224.5441	142.9660	102.1394	(83)

Total gains	677.8884	774.6374	825.3595	871.2864	884.2897	860.1409	829.0178	801.1301	779.4603	722.7294	670.8745	649.4746	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	81.1676	81.4472	81.7232	83.0447	83.2967	84.4902	84.4902	84.7150	84.0265	83.2967	82.7884	82.2637	
alpha	6.4112	6.4298	6.4482	6.5363	6.5531	6.6327	6.6327	6.6477	6.6018	6.5531	6.5192	6.4842	
util living area													
	0.9980	0.9948	0.9871	0.9575	0.8718	0.6825	0.4998	0.5378	0.7838	0.9636	0.9945	0.9985	(86)
MIT	20.0470	20.2025	20.4049	20.6732	20.8795	20.9814	20.9979	20.9966	20.9547	20.7016	20.3334	20.0292	(87)
Th 2	19.9187	19.9220	19.9252	19.9405	19.9433	19.9566	19.9566	19.9591	19.9515	19.9433	19.9375	19.9315	(88)
util rest of house													
	0.9971	0.9924	0.9808	0.9368	0.8150	0.5821	0.3829	0.4187	0.6905	0.9414	0.9916	0.9978	(89)
MIT 2	18.8294	19.0300	19.2880	19.6274	19.8535	19.9486	19.9562	19.9584	19.9277	19.6686	19.2095	18.8166	(90)
Living area fraction										fLA = Living area / (4) =		0.3171	(91)
MIT	19.2155	19.4018	19.6422	19.9590	20.1788	20.2760	20.2865	20.2876	20.2533	19.9961	19.5659	19.2011	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.2155	19.4018	19.6422	19.9590	20.1788	20.2760	20.2865	20.2876	20.2533	19.9961	19.5659	19.2011	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9962	0.9908	0.9787	0.9372	0.8292	0.6140	0.4202	0.4567	0.7195	0.9428	0.9901	0.9971	(94)
Useful gains	675.3220	767.5151	807.7874	816.5877	733.2098	528.1532	348.3177	365.9133	560.7958	681.3796	664.2391	647.5713	(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													
	1469.7170	1424.0470	1286.1791	1065.0869	814.1202	537.3022	348.9688	367.0252	585.6986	902.1977	1204.2946	1458.4632	(97)
Space heating kWh													
	591.0299	441.1894	355.9234	178.9194	60.1974	0.0000	0.0000	0.0000	0.0000	164.2887	388.8400	603.3036	(98a)
Space heating requirement - total per year (kWh/year)												2783.6918	
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													
	591.0299	441.1894	355.9234	178.9194	60.1974	0.0000	0.0000	0.0000	0.0000	164.2887	388.8400	603.3036	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2783.6918	
Space heating per m2											(98c) / (4) =	33.9475	(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													
	591.0299	441.1894	355.9234	178.9194	60.1974	0.0000	0.0000	0.0000	0.0000	164.2887	388.8400	603.3036	(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)													
	640.3358	477.9951	385.6158	193.8455	65.2192	0.0000	0.0000	0.0000	0.0000	177.9942	421.2784	653.6333	(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													
	234.3790	207.2864	220.4795	194.7524	189.3365	171.2272	169.5561	176.0200	177.6278	197.3009	208.8063	231.9627	(64)
Efficiency of water heater												79.8000	(216)
(217)m	86.0444	85.7101	85.1276	83.8701	81.8000	79.8000	79.8000	79.8000	79.8000	83.6521	85.4336	86.1032	(217)
Fuel for water heating, kWh/month													
	272.3930	241.8460	258.9989	232.2072	231.4627	214.5705	212.4763	220.5764	222.5913	235.8588	244.4078	269.4008	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	25.1845	20.2039	18.1914	13.3278	10.2948	8.4109	9.3912	12.2071	15.8558	20.8036	23.4977	25.8844	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-38.1766	-53.7208	-77.0679	-86.4700	-93.0793	-86.8133	-85.7394	-81.0282	-72.6786	-61.3501	-41.9354	-33.0177	(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	-21.8555	-45.9520	-91.2941	-137.0633	-181.1838	-182.0374	-179.8950	-152.3348	-111.6813	-65.6956	-29.1732	-17.2844	(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												3015.9175	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												79.8000	
Water heating fuel used												2856.7896	(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)												203.2530	(232)

Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-2026.5277	(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	4135.4323	(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	3015.9175	0.2100	633.3427	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2856.7896	0.2100	599.9258	(264)
Space and water heating			1233.2685	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	203.2530	0.1443	29.3357	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-811.0775	0.1346	-109.1956	
PV Unit electricity exported	-1215.4502	0.1259	-153.0341	
Total			-262.2296	(269)
Total CO2, kg/year			1012.3038	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			12.3500	(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	3015.9175	1.1300	3407.9867	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2856.7896	1.1300	3228.1722	(278)
Space and water heating			6636.1589	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	203.2530	1.5338	311.7562	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-811.0775	1.4976	-1214.6479	
PV Unit electricity exported	-1215.4502	0.4622	-561.7408	
Total			-1776.3887	(283)
Total Primary energy kWh/year			5301.6273	(286)
Target Primary Energy Rate (TPER)			64.6500	(287)