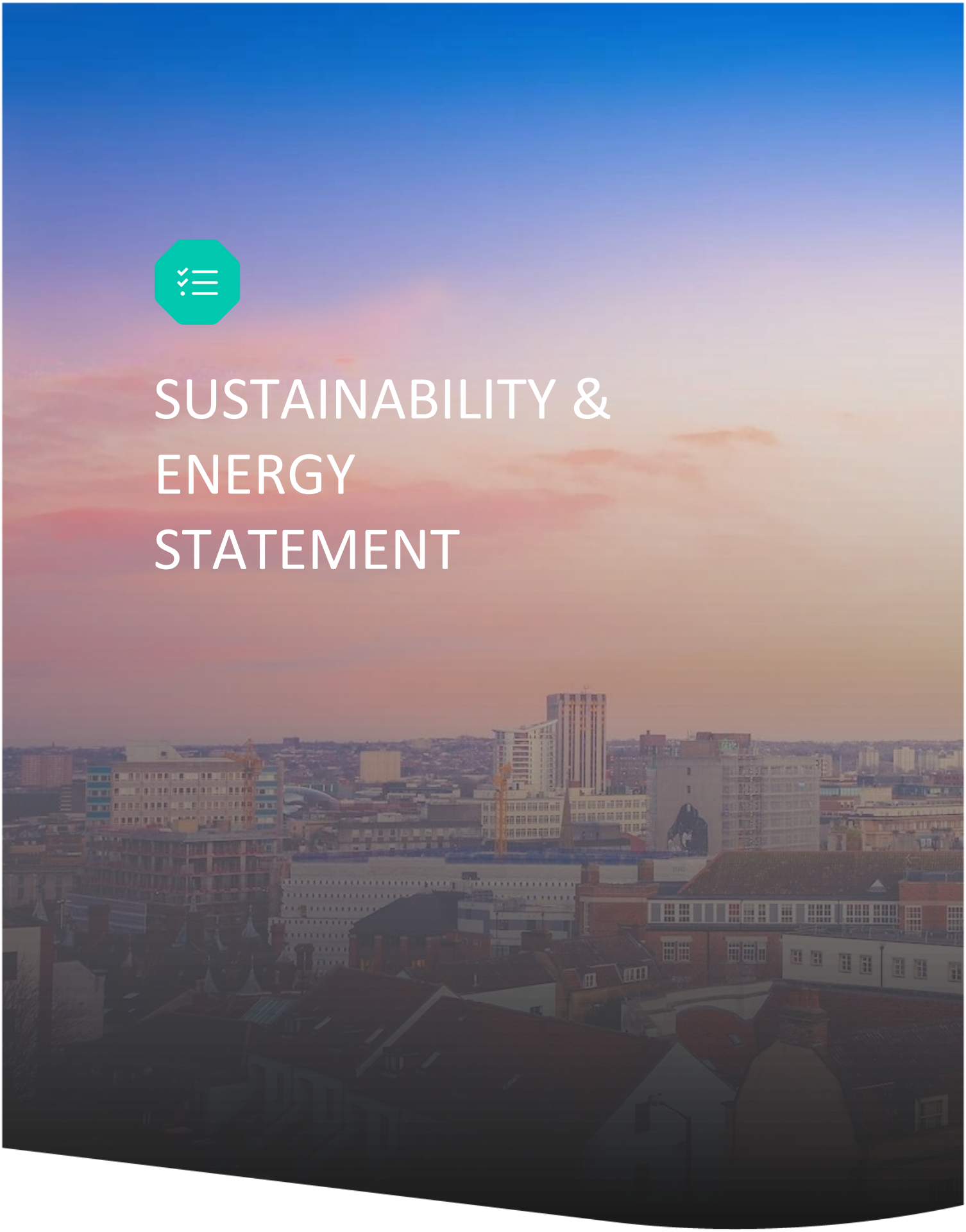


SUSTAINABILITY & ENERGY STATEMENT

BUILDING ENERGY EXPERTS

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Prepared for:	Cotswold Homes
Project:	Yatton Keynell
Report date:	14/03/2025
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Contents

Contents 1
1. Executive Summary 3
Summary of total reduction in carbon emissions 3
2. Planning Policy Context 4
National Policy Context 4
Regional & Local Policy Context 4
3. Design Principles to Reduce Energy Consumption and Carbon Emissions 5
Be “Lean” – Use less energy 5
Be “Clean” – Supply energy efficiently 6
Be “Green” – Renewable energy 6
4. Sustainable Design and Construction 7
Energy Efficiency 7
Decentralised, Renewable and Low-Carbon Energy Supply Systems 7
Avoiding Responses to Climate Impacts that Lead to Increases in Energy Use and CO2 Emissions 7
Encouraging Greener Transport Use 7
Waste and Recycling - During Construction 7
Waste and Recycling - In Operation 8
Building Materials - Type, Life Cycle and Source 8
Pollution 8
Summary 8
5. Water Management 9
Water Conservation Measures 9
Table 1 - Water Consumption 9
6. Selecting Renewables 10
Table 2 – Feasibility Matrix of Appropriate Renewables 10
Table 3 – Feasibility Matrix of Appropriate Renewables 11
Table 4 – Proposed Renewables 12
Feasibility of Appropriate Renewables – Conclusion 12
7. Baseline ‘Threshold Values’ & Proposed Fabric/Services Specification 13
Table 5 – Baseline Compliance & proposed building 13
8. Conclusion 14
Appendix A – Individual House Type Performance 16
Appendix B – SAP Outputs 18
..... 19

1. Executive Summary

This Sustainability and Energy Statement has been produced to demonstrate how the proposed development of 55 new build dwellings on land at Yatton Keynell, Wiltshire will comply with the following Wiltshire Council Policies:

- Core Policy 41 – Sustainable Construction and Low-Carbon Energy
- Core Policy 42 – Standalone Renewable Energy Installations

The statements contain the results of energy modelling, showing how the proposed development will meet policy requirements by Wiltshire Council in the core strategy to reduce carbon emissions for this development over the building regulation requirements. The energy strategy in this statement has been produced in line with the energy hierarchy:

- Be “Lean” - reduce energy demand.
- Be “Clean” – supply energy efficiently.
- Be “Green”– use renewable energy.

SAP calculations have been completed in line with Part L (Volume 1, 2021) of the Building Regulations and the requirements of the energy hierarchy to support the energy statement and show how the proposed development reduces its emissions.

Firstly, SAP calculations to achieve compliance with Part L (Volume 1, 2021) were modelled using SAP10 with the notional values to provide 'baseline' energy demand, primary energy rate, and emissions for a dwelling with a gas boiler and no renewables. Then, additional measures were applied to provide residual energy demand, primary energy rate, and emissions using non-renewable approaches, including building fabric. Finally, appropriate decentralised renewables were included in the calculations to provide the final energy demand and emissions figures for comparison. More details are provided in the following sections.

The baseline calculation uses a Gas Combi Boiler for heating and hot water in the building. This is an appropriate selection for a baseline calculation as it represents a common heating method for domestic buildings in the area and is included in the notional building specification.

To summarise the results, the total reduction in carbon emissions for the proposed development is as follows:

Summary of total reduction in carbon emissions

	Before Renewables	After Renewables (PV)
Baseline Target Emission Rate (TER)	89,148.83	
Residual Building Emission Rate (DER)	87,593.74	18,873.23
Total CO_2 Saving on residual energy	1.74%	78.45%

2. Planning Policy Context

National Policy Context

The National Planning Policy Framework encourages the adoption of sustainable development through encouraging local authorities to adopt strategies, policies and targets that mitigate and adapt to climate change. It also recommends the move to low carbon technologies by planning new development in ways to reduce greenhouse gas emissions, and adhere to standards established in the Government's zero carbon buildings policy.

The Government Energy Policy sets targets for the UK to cut carbon dioxide emissions and become net zero by 2050, as well as setting national targets for the generation of electricity from clean and renewable sources.

Regional & Local Policy Context

Local Policy requirements are set out in the Wiltshire Core Strategy.

Core Policy 41: Sustainable Construction and Low-Carbon Energy
New development, building conversions, refurbishments and extensions will be encouraged to incorporate design measures to reduce energy demand. Development will be well insulated and designed to take advantage of natural light and heat from the sun and use natural air movement for ventilation, whilst maximising cooling in the summer.

Core Policy 42: Standalone Renewable Energy Installations
Proposals for standalone renewable energy schemes will be supported subject to satisfactory resolution of all site specific constraints. In particular, proposals will need to demonstrate how impacts on the following factors have been satisfactorily assessed.

3. Design Principles to Reduce Energy Consumption and Carbon Emissions

The energy strategy for the proposed development has been formulated in line with the energy hierarchy. It uses the following approaches to optimise energy usage, supply clean and renewable energy, and reduce embedded carbon emissions while meeting local requirements (figure 1).

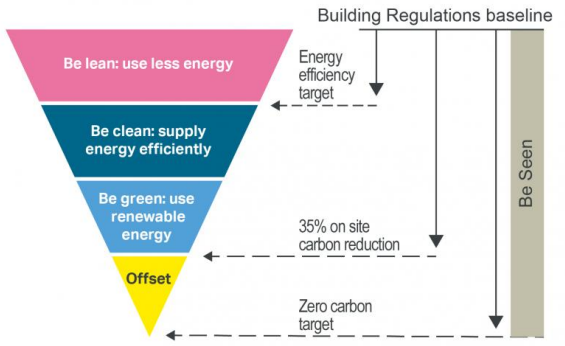


Figure 1: The Energy Hierarchy

Be "Lean" – Use less energy

The proposed development has been designed with the use of efficient fabric specifications, integrating efficiency into the thermal envelope of the dwellings. The proposed thermal elements meet or go beyond the minimum requirements set out in Approved Document L Volume 1 (2021) for new fabric elements.

Target U-values have been specified to achieve or go beyond the U-values found in the national dwelling specification. When possible, the national dwelling values are much lower than the limiting factors (maximum allowed U-values) to create the target rates used in the SAP calculation.

The fabric elements and fenestration have been specified using calculated U-values for the intended construction specification for the building. This includes:

- External walls that achieve a U-value of at least 0.18 W/m^{2}k.
- A ground floor that achieves a U-value of at least 0.12 W/m^{2}k.
- A pitched roof with insulation at the flat ceiling plane that achieves a U-value of at least 0.11 W/m^{2}k.

Careful consideration will be given to the fenestration. Double glazing with low window U-values of 1.2 W/m^{2}k will be utilised to limit heat loss through openings. The glazing design also allows for passive heating into the buildings. However, to minimise the risk of overheating, the glazing will be openable where practical as well as feature a low-e coating.

Good detailing will help to limit heat losses through the fabric of the proposed development. Where available, all non-repeating thermal bridges (e.g. between the external walls and the roofs) will be specified to enhanced construction details that represent the best practice for the proposed construction. Alternatively, some details will be calculated with target values for the thermal bridging set. This will ensure that heat losses through these junctions are minimised, and the psi values can be utilised in the SAP calculations.

The dwellings will be naturally ventilated, with intermittent extractor fans in the bathrooms, and a cooker hood in the kitchens. This will reduce the energy demand of active ventilation systems. The proposed building layout has been determined by several factors, such as ownership and site boundaries, relationship to adjacent

buildings and site access, as well as internal walls arrangements. The internal room layouts within the resultant footprint have been designed with consideration of recommended zoning and room orientations.

The dwellings will have designed air permeability of below 5 $m^3/hr/m^2$. This is below the requirements of the building regulations 8 $m^3/hr/m^2$ and the same as the notional value of 5 $m^3/hr/m^2$.

The design of the dwellings optimises the use of natural lighting, and it is proposed that only energy efficient lighting is installed at the properties. This means that all light fittings should have bulbs with a luminous efficacy of greater than 85 lamp lumens per circuit-watt.

The proposed dwellings have been designed to allow for cross ventilation where possible, in order to minimise the need for additional mechanical methods of cooling. Windows have been sized and positioned to allow for good internal natural light and allow for solar gains during winter months. Windows will also have a large free opening area to help ensure that the risk of summer overheating is reduced.

Be “Clean” – Supply energy efficiently

The energy that is used in the development has been considered for its efficiency. Local policy supports the connection of proposed developments to heat networks. Local heat and power sources minimise distribution losses and achieve greater efficiency when compared to separate localised energy systems.

This section shows the consideration given to the connection of the dwellings to any existing or planned district heating networks in the proximity of the site. There are no existing district heating systems near the development site. The development is not major (under 100 dwellings). This means the use of district heating networks, or a CHP system, would not be selected due to the unnecessary added complexity. This project is also aiming to use very efficient fabric in order to reduce the heating demand and use efficient services to reduce water demand. Therefore, the expected demand for heating and hot water would potentially not be significant enough for CHP systems.

Be “Green” – Renewable energy

Low carbon energy generation and renewable technologies have been assessed for the proposed development, with some considered appropriate. See section 6 for further details regarding the feasibility of each assessed technologies.

Based upon the feasibility matrix, an air source heat pump (ASHP) will be used for the hot water and heating requirements, and solar PV will be used to achieve a reduction of carbon emissions.

4. Sustainable Design and Construction

Energy Efficiency

The proposed building fabric makes use of high-performance insulation materials. The U-values of the building fabric have been calculated and used in the assessment of the dwelling. The achieved U-values are lower than the limiting factors permitted by Part L and are substantially less or equal to the U-values used in the notional building.

The proposed dwellings would have the potential to achieve a 78.83% total reduction in CO_2 over the baseline Building Regulation measures if low carbon technologies and energy efficiency improvements are used.

Decentralised, Renewable and Low-Carbon Energy Supply Systems

The proposal for the dwellings makes use of two low carbon systems, including an electric air source heat pump for heating and water heating. Solar PV is also proposed to be added to the building to provide onsite renewable generation. This reduces the associated carbon emissions of the development, with solar used to offset the increase in electricity consumption on site.

Avoiding Responses to Climate Impacts that Lead to Increases in Energy Use and CO2 Emissions

There are no proposals to include artificial cooling. The proposed dwellings have been designed to allow for cross ventilation where possible. Windows have been sized and positioned to allow for good internal natural light and allow for solar gains during winter months. The buildings will also include appropriate internal shading, such as blinds and curtains, will be used to mitigate overheating from the sun. The design of the dwellings also includes some external features to provide shading.

Dynamic Thermal Modelling would be used to access the scheme before construction to verify the overheating risk to the dwellings, however previous developments of the same types of houses have found that the overheating risk can be controlled by using site shading, window depth reveals, and G-values.

Encouraging Greener Transport Use

Public transport can be found on The St with the closest bus stops an eight minute walk away, with buses towards Chippenham, Burton and Acton Turville. The closest train station is Chippenham which connects to services on the Great Western Railway and provides services to Bristol Temple Meads, Swindon, and London. All plots will have electric charging points to enable the use of electric cars and encourage the use of sustainable and low-carbon transport by residents, as per the requirements of Approved Document S.

Many local services, shops and public houses can be found close by in village, in nearby in Chippenham.

Waste and Recycling - During Construction

A site waste management plan (SWMP) will be developed for this project. Waste groups to be monitored will be identified, and targets will be set to identify how waste can be reduced, reused, recycled, or diverted from landfills. Unavoidable waste will be disposed of responsibly.

Waste and Recycling - In Operation

Adequate waste and recycling storage will be provided within the curtilage of each dwelling to cater for the resident's waste and recycling needs. Both the internal and external provision will comply with the Wiltshire Council's recycling and waste collection requirements, ensuring that recyclables and waste can be separated before collection.

Building Materials - Type, Life Cycle and Source

Where feasible, the most local suppliers of materials will be selected to minimise the environmental impact of transportation. Materials used for the proposal will be purchased from sources that minimise carbon emissions and come from sustainable sources, in line with Cotswold Homes' environmental policy.

Only suppliers with a certified chain of custody from the Forest Stewardship Council (FSC) or the Programme for the Endorsement of Forest Certification (PEFC) will be used to supply materials. 100% of the timber used will be legally sourced. Material will be sourced from suppliers with an EMS certificate or equivalent.

Pollution

An appropriate construction management plan will be prepared to address issues regarding water, waste, noise, vibration, dust, emissions, odours, and ground contamination. The development makes use of natural building materials for the structure of the dwelling. It will also include renewable technologies and nontoxic paints, producing limited impact on air pollution in the local area. The development will also incorporate lighting measures to prevent light pollution.

Summary

The energy strategy demonstrates how the dwellings will achieve high fabric performance and proposes the installation of Solar PV, and ASHP to further offset the carbon dioxide emissions associated with the dwellings. There is minimal perceived flood risk, and the dwellings will be specified to achieve a water use target of less than 125 liters per person, per day.

The proposed development is therefore judged to comply with all the relevant sustainability and climate change requirements.

5. Water Management

Water Conservation Measures

Internal portable water will be conserved by installing flow restrictors to taps, showers and dual flush toilets. The following schedule provides a suggested specification which has been proven to exceed building regulations requirements for water conservation (Regulation 36 Compliance).

Table 1 - Water Consumption

Area	Flow Rate/Capacity
Toilet	Dual Flush 6 and 3 Liters
Basin Taps	6 Litres / Minute
Bath	180 Litres (Capacity to Overflow)
Shower	8 Litres / Minute
Kitchen Taps	8 Litres / Minute
Dishwasher	1.25 Litres / Place Setting
Washing Machine	8.17 Litres / KG dry load
Total Water Consumption Litres/person/day	113.3

6. Selecting Renewables

Table 2 – Feasibility Matrix of Appropriate Renewables

Showing the considerations in choosing a renewable technology for this site.

Solar PV	Water Source Heat Pump
The design of the dwellings allows for a large area of roof space that can incorporate a PV system with a sizable peak performance, this will help ensure that the inclusion of a PV system will be a benefit to the dwelling. The orientation and shading of the site have been assessed to be suitable for solar PV. Therefore, it has been judged as appropriate to include solar PV in the proposals for the site.	Water-source heat pumps require a suitable source of water that is not possible in this location. Alliteratively a water source heat pump can be used in conjunction with an ambient loop system away from water sources. However, this requires the use of large chillers in the form of a large air source heat pump unit; this type of system is more suited to large blocks of flats. Therefore, at this site, this would not be appropriate; individual heat pumps would be more efficient.
Solar Thermal	**Biomass**
The hot water demand and installation area would make it possible to use solar thermal. However, to reach the same reduction in carbon emissions as other options, a significant number of panels would be required. Therefore, it is more space efficient to use solar PV to maximise the reduction in carbon emissions.	The proximity of residential dwellings could have an impact on the local air quality. There is not a suitable area for storage to the building.
Air Source Heat Pump	**Combined Heat & Power (CHP)**
An air source heat pump has been deemed appropriate based on the requirement for fabric, noise, space, and the space heating demand.	CHP requires a significant electricity demand, which this development does not provide. This makes CHP unviable, unless a site-wide community heating system is proposed.
Ground Source Heat Pump	**Wind**
The energy demand of the proposed scheme would make it possible to use ground source heat pumps. However, further investigation into external work and the geological setting would be required. The amount of space in the garden is limited and would require bore holes that would be considerably expensive.	The development is within proximity to residential properties, so wind is not suitable for this site.
District Heating	
The property is not within an existing district heat network, or in proximity to any planned heat network.	

Table 3 – Feasibility Matrix of Appropriate Renewables

Showing the considerations in choosing a renewable technology for this site.

Technology	Requirements	Requirements Met?	Appropriate?
Photovoltaic panels	Roof facing east to west (through south)	Yes	Yes- Selected
	Little/no or modest over shading	Yes	
	Flat roof or pitched roof not greater than 45°	Yes	
	Any size development	Yes	
Solar thermal	All requirements for photovoltaic panels	Yes	No – Area used for solar PV
	Hot water tank	Yes	
Air source heat pumps	Suitable external wall or other location on-site for equipment	Yes	Yes – Selected
	Aesthetic considerations	Yes	
	Noise impact	Yes	
	Any size development	Yes	
Ground source heat pumps	External space for horizontal trench or vertical borehole	Yes	Would require further investigation
	Medium to large sized development	Yes	
	Archaeology	Unknown	
	Best suited to underfloor heating	No	
Biomass	Space needed for plant, fuel storage and deliveries	Yes	No - Air pollution, storage size and delivery location insufficient
	Medium to large sized development	No	
	Minimal impact on residents (air quality, deliveries)	No	
Combined heat and power	Space need for plant access and servicing	Yes	No (development intended to have low heat demand)
	Large sized development (large heat demand)	No	
District heating	Available network	No	No
	Very large sized development (Substantial heat demand)	No	

Table 4 – Proposed Renewables

Showing renewables added to the specification to further reduce carbon emissions. This includes the use of an air source heat pump and solar PV. The table below shows the array size of the proposed solar PV installation for the entire site.

Total Array Size	Direct/Landlord's Supply	Orientation	Inclination	Overshading
90.45 kWp	Direct Supply	Plot Specific	30	None or little

Individual Type PV Proposal				
Type	Total Array Size	Direct/Landlord's Supply	Inclination	Overshading
Type W	2.01 kWp	Direct Supply	30	None or little
Type P	2.01 kWp	Direct Supply	30	None or little
Type P+	2.01 kWp	Direct Supply	30	None or little
Type M	1.005 kWp	Direct Supply	30	None or little
Type M+	1.005 kWp	Direct Supply	30	None or little
Type KV1	1.34 kWp	Direct Supply	30	None or little
Type K	2.01 kWp	Direct Supply	30	None or little
Type F	2.01 kWp	Direct Supply	30	None or little
Type F+	2.01 kWp	Direct Supply	30	None or little
Type D	2.01 kWp	Direct Supply	30	None or little
Type DV1	2.01 kWp	Direct Supply	30	None or little
Type B	2.01 kWp	Direct Supply	30	None or little
Type A3	1.34 kWp	Direct Supply	30	None or little
Type A2	1.34 kWp	Direct Supply	30	None or little
Type A1	1.005 kWp	Direct Supply	30	None or little
Type A1 Bungalow	1.005 kWp	Direct Supply	30	None or little

Feasibility of Appropriate Renewables – Conclusion

The location, size and type of development makes most renewable technologies appropriate for this site. Air Source Heat Pumps (ASHP) are proposed for this development. Solar thermal hot water heating is feasible however the roof space will be required for the solar PV. The development is not in an area with a planned district heating system.

Photovoltaic panels offer an immediate and appropriate solution. The number of panels can be scaled to achieve a large reduction in CO2 emissions, as demonstrated in Table 11. This will need to be confirmed by survey before installation.

7. Baseline 'Threshold Values' & Proposed Fabric/Services Specification

Table 5 – Baseline Compliance & proposed building

Building Specification		
Category	Part L 2021 Limiting Factors	Proposed Building (Specified Values)
Building Fabric		
Air Permeability (m3/m2.h at 50Pa)	8	5
Wall U-value (W/m2K)	0.26	0.18
All Roof Types U-value (W/m2K)	0.16	0.11
Ground Floor U-value (W/m2K)	0.18	0.12
Fenestration		
Rooflights W/m2K)	2.2	1.2
Glazing U-value (W/m2K)	1.6	1.2
Doors U-value (W/m2K)	1.4	1.2
Thermal Bringing		
Thermal Bringing Details	Assumed	Enhanced
Building Services & Systems		
Ventilation	Natural Ventilation with intermittent extractor fans	
Heating	Gas Boiler	Air Source Heat Pump
Heating Controls	Time and Temperature Zonal Control	
Heating Systems	Gas Boiler	Air Source Heat Pump
Water Heating (From main heating)	From Main Heating	From Main Heating
Waste water heat recovery	Yes	No
Lighting	Efficacy of 75lm/W	15 Watts (Power) with Efficacy of 85lm/W
Renewables	Solar PV (40% of GA/6)	Solar PV

8. Conclusion

Table 8 – Energy Table

Regulated residual emissions	Regulated Energy Demand (kWh/yr)	Regulated CO2 emissions (kg/yr)	CO2 saved (kg/yr)	Percentage reduction in CO2 emissions (%)
Baseline Part L TER (calculated stead without renewables)	492,333.56	89,148.83		
Proposed scheme after energy efficiency measures	483,992.17	87,593.74	1,555.09	1.74%
Residual emissions Proposed scheme after energy efficiency measures and CHP if applicable.	483,992.17	87,593.74	0	0%
Proposed scheme after on-site renewables	236,652.52	18,873.23	68,720.51	78.45%
Total regulated CO2 reduction beyond Part L TER			70,275.60	78.83%

Table 9 – Table 2a Residential Energy Efficiency

Notional Building TER without PV (kg/CO2/m2)	Emissions for the proposed building with energy efficiency alone (kg/CO2/m2)
89,148.83	18,873.23

Table 10 – Table 2B Energy Efficiency Measures

Element or system	Dwellings Limiting values (W/m2.K)	Dwellings Notional values (W/m2.K)	Dwellings Proposed (W/m2.K)
Wall	0.26	0.18	0.18
Roof	0.16	0.11	0.11
Floor	0.18	0.13	0.12
Windows	1.6	1.2	1.2
Doors	1.6	1.0	1.2
Rooflights	2.2	1.7	
Air Permeability	8.0	5.0	5.0
Thermal Bridging		(9.78)	(4.16)

Summary

This report demonstrates that via a fabric first approach, the proposals will result in carbon emissions being reduced by up to 1.74% against the baseline results, prior to taking account of the use of renewable energy generation sources. With the renewable energy generation sources proposed within this development (air source heat pumps and photovoltaic panels on every plot), the carbon emissions will be reduced by up to a further 78.45%, culminating in a carbon emission reduction against building regulations of up to 78.83% across the site in total. As demonstrated, these proposals will achieve a significant reduction in carbon emissions in accordance with Wiltshire Councils' policy.

Appendix A – Individual House Type Performance

House Type	Baseline Dwelling Emission Rate Emissions (Kg/pa)	Proposed Dwelling Emission Rate (Kg/pa)	Proposed Dwelling Primary Energy Rate (kWh/pa)	Proposed Dwelling Fabric Energy Efficiency Rate (kWh/pa)
Type W	2392.603	509.777	8643.883	7546.188
Type P+	1892.172	382.8348	4494.275	5553.305
Type P	1861.369	416.5712	4712.828	5218.874
Type M+	1442.941	340.3256	3784.893	3519.321
Type M	1390.154	334.7204	3713.849	3302.704
Type Kv1	1591.442	361.7354	4109.043	3657.116
Type K	1490.583	308.3964	3698.817	3552.377
Type F+	2010.131	455.124	5111.9	6065.022
Type F	2023.039	444.1216	5002.899	5904.205
Type Dv1+	1846.656	370.944	5202.624	5213.376
Type Dv1	1841.659	366.4728	4332.611	5129.291
Type D+	1659.42	370.077	4372.44	5245.611
Type D	1802.909	351.216	4184.674	4892.309
Type B	1714.033	312.4968	3841.596	4554.7
Type A3 End	1246.986	256.23	3043.443	2658.149
Type A3 Mid	1379.846	315.068	3564.444	3222.804
Type A2 Mid	1171.13	231.6072	2797.291	2482.207
Type A2 End	1260.336	252.8856	3017.441	2865.218

Type A1G	947.6775	209.6325	2523.098	2102.678
Type A1F	1077.347	258.2182	2910.099	2243.644
Type A1 Bungalow	1069.382	244.9422	2778.667	2006.667

Appendix B – SAP Outputs

Building Regulations England Part L (BREL) Compliance Report

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

Date: Fri 14 Mar 2025 09:30:54

Project Information			
Assessed By	Richard Millard	Building Type	House, Detached
OCDEA Registration	EES/025661	Assessment Date	2025-03-14

Dwelling Details			
Assessment Type	As designed	Total Floor Area	132 m^2
Site Reference	D+	Plot Reference	Regulated (Baseline)
Address	25		

Client Details	
Name	Ian White
Company	Cotswold Homes Ltd
Address	West House, Yate, Bristol, BS37 5NG

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

1a Target emission rate and dwelling emission rate		
Fuel for main heating system	Mains gas	
Target carbon dioxide emission rate	*10.0 $kgCO_2/m^2$*	
Dwelling carbon dioxide emission rate	12.6 $kgCO_2/m^2$	**FAIL**
1b Target primary energy rate and dwelling primary energy		
Target primary energy	*52.28 kWh_{PE}/m^2*	
Dwelling primary energy	66.49 kWh_{PE}/m^2	**FAIL**
1c Target fabric energy efficiency and dwelling fabric energy efficiency		
Target fabric energy efficiency	*41.2 kWh/m^2*	
Dwelling fabric energy efficiency	41.2 kWh/m^2	**OK**

2a Fabric U-values				
Element	***Maximum permitted average U-Value [W/m^2K]***	**Dwelling average U-Value [W/m^2K]**	**Element with highest individual U-Value**	
External walls	*0.26*	0.18	Walls (1) (0.18)	**OK**
Party walls	*0.2*	N/A	N/A	**N/A**
Curtain walls	*1.6*	N/A	N/A	**N/A**
Floors	*0.18*	0.13	Heatloss Floor 1 (0.13)	**OK**
Roofs	*0.16*	0.11	Roof (1) (0.11)	**OK**
Windows, doors, and roof windows	*1.6*	1.2	WG01 (1.2)	**OK**
Rooflights	*2.2*	N/A	N/A	**N/A**

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))		
Name	**Net area [m^2]**	**U-Value [W/m^2K]**
Exposed wall: Walls (1)	140.15	0.18
Ground floor: Heatloss Floor 1, Heatloss Floor 1	66.66	0.13
Exposed roof: Roof (1)	65.04	0.11
Exposed roof: Roof (2)	1.62	0.11

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	**Area [m^2]**	**Orientation**	**Frame factor**	**U-Value [W/m^2K]**
WG01, Windows	2.1	South East	0.7	1.2
WG02, Windows	2.05	South East	0.7	1.2
WG03, Windows	1.64	North West	0.7	1.2
FG01, Windows	2.13	South East	0.7	1.2
FG02, Windows	0.67	South East	0.7	1.2
FG03, Windows	2.15	South East	0.7	1.2
FG04, Windows	1.44	North West	0.7	1.2
FG05, Windows	0.66	North West	0.7	1.2
FG06, Windows	1.45	North West	0.7	1.2
ED01, Doors	3.39	South East	N/A	1.2
ED02, Doors	2	North West	N/A	1.2
ED03, Glazed Doors	5.02	North West	0.7	1.2
WG04, Windows	1.33	South East	0.7	1.2

Name	Area [m^2]	Orientation	Frame factor	U-Value [W/m^2K]
WG05, Windows	2.62	North East	0.7	1.2
WG06, Windows	1.33	North West	0.7	1.2

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))

Building part **1**: Thermal bridging calculated from linear thermal transmittances for each junction

Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E2: Other lintels (including other steel lintels)	Calculated by person with suitable expertise	0.05	mpf125e2-04
External wall	E3: Sill	Calculated by person with suitable expertise	0.05	mpf125e3-01
External wall	E4: Jamb	Calculated by person with suitable expertise	0.022 **(!)**	mpf125e4-01
External wall	E5: Ground floor (normal)	Calculated by person with suitable expertise	0.16	mpf125e5-04
External wall	E6: Intermediate floor within a dwelling	Calculated by person with suitable expertise	0.003 **(!)**	mpf125e6-01
External wall	E10: Eaves (insulation at ceiling level)	Calculated by person with suitable expertise	0.06	mpf125e10-01
External wall	E12: Gable (insulation at ceiling level)	Calculated by person with suitable expertise	0.06	mpf125e12-01
External wall	E16: Corner (normal)	Calculated by person with suitable expertise	0.09	mpf125e16-01
External wall	E17: Corner (inverted - internal area greater than external area)	Calculated by person with suitable expertise	-0.085	mpf125e17-01

3 Air permeability (better than typically expected values are flagged with a subsequent (!))

Maximum permitted air permeability at 50Pa	*8 m^3/hm^2*	
Dwelling air permeability at 50Pa	5 m^3/hm^2, Design value	OK
Air permeability test certificate reference		

4 Space heating

Main heating system 1: Boiler with radiators or underfloor heating - Mains gas	
Efficiency	88.6%
Emitter type	Radiators
Flow temperature	45°C
System type	Regular boiler
Manufacturer	Bosch Thermotechnology
Model	Greenstar 8000 Life
Commissioning	
Secondary heating system: N/A	
Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water

Cylinder/store - type: Cylinder	
Capacity	200 litres
Declared heat loss	2.09 kWh/day
Primary pipework insulated	Yes
Manufacturer	
Model	
Commissioning	
Waste water heat recovery system 1 - type: N/A	
Efficiency	
Manufacturer	
Model	

6 Controls

Main heating 1 - type: Time and temperature zone control by arrangement of plumbing and electrical services	
Function	
Ecodesign class	
Manufacturer	
Model	

Water heating - type: Cylinder thermostat and HW separately timed	
Manufacturer	
Model	

7 Lighting		
Minimum permitted light source efficacy	*75 lm/W*	
Lowest light source efficacy	85 lm/W	**OK**
External lights control	N/A	

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

9 Local generation	
Technology type: **Photovoltaic system (1)**	
Peak power	2.01 kWp
Orientation	South East
Pitch	30°
Overshading	None or very little
Manufacturer	
MCS certificate	

10 Heat networks
N/A

11 Supporting documentary evidence
N/A

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

Full SAP Calculation Printout

Property Reference	D+	**Issued on Date**	14/03/2025
Assessment Reference	Regulated (Baseline)	**Prop Type Ref**	Proposed 25
Property	25		

SAP Rating	91 B	**DER**	12.60	**TER**	10.00
Environmental	88 B	**% DER < TER**			-26.00
CO_2 Emissions (t/year)	1.52	**DFEE**	41.23	**TFEE**	41.16
Compliance Check	See BREL	**% DFEE < TFEE**			-0.18
% DPER < TPER	-27.19	**DPER**	66.49	**TPER**	52.28

Assessor Details	Mr. Richard Millard	**Assessor ID**	U367-0001
Client			

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Main dwelling						
Ground floor	66.6600 (1b)	x	2.4000 (2b)	=	159.9840	(1b) - (3b)
First floor	65.0400 (1c)	x	2.6000 (2c)	=	169.1040	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	131.7000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	329.0880	(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	5 * 10 =	50.0000	(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) =	50.0000 / (5) =	0.1519	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.4019	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3416	(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	0.4356	0.4271	0.4185	0.3758	0.3673	0.3246	0.3246	0.3160	0.3416	0.3673	0.3844	0.4014	(22b)
Effective ac	0.5949	0.5912	0.5876	0.5706	0.5674	0.5527	0.5527	0.5499	0.5584	0.5674	0.5739	0.5806	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Main dwelling								
Windows			19.5700	1.1450	22.4084			(27)
Glazed Doors			5.0200	1.1450	5.7481			(27)
Doors			5.3900	1.2000	6.4680			(26a)
Heatloss Floor 1			66.6600	0.1300	8.6658	75.0000	4999.5000	(28a)
Cavity Wall	170.1300	29.9800	140.1500	0.1800	25.2270	60.0000	8409.0000	(29a)
External Roof 1	65.0400		65.0400	0.1100	7.1544	9.0000	585.3600	(30)
External Roof 2	1.6200		1.6200	0.1100	0.1782	9.0000	14.5800	(30)
Total net area of external elements Aum(A, m2)			303.4500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		75.8499			(33)
Main dwelling								
Internal Wall 1 - Block			51.6000			75.0000	3870.0000	(32c)
Internal Wall 2 - Stud			46.4700			9.0000	418.2300	(32c)
Internal Wall 3 - Up			206.0900			9.0000	1854.8100	(32c)
Internal Floor 1			65.0400			18.0000	1170.7200	(32d)
Internal Ceiling 1			66.6600			9.0000	599.9400	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		21922.1400	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							166.4551	(35)
List of Thermal Bridges								

	Length	Psi-value	Total	
K1 Element				
E2 Other lintels (including other steel lintels)	19.8300	0.0500	0.9915	
E3 Sill	14.3900	0.0500	0.7195	
E4 Jamb	37.0200	0.0220	0.8144	
E5 Ground floor (normal)	34.9900	0.1600	5.5984	
E6 Intermediate floor within a dwelling	33.1800	0.0030	0.0995	
E10 Eaves (insulation at ceiling level)	18.0400	0.0600	1.0824	
E12 Gable (insulation at ceiling level)	18.8300	0.0600	1.1298	
E16 Corner (normal)	29.8000	0.0900	2.6820	
E17 Corner (inverted - internal area greater than external area)	9.8000	-0.0850	-0.8330	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			12.2846	(36)
Point Thermal bridges		(36a) =	0.0000	
Total fabric heat loss		(33) + (36) + (36a) =	88.1345	(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	64.6026	64.2025	63.8103	61.9684	61.6238	60.0195	60.0195	59.7224	60.6374	61.6238	62.3209	63.0498	(38)
Heat transfer coeff	152.7370	152.3370	151.9448	150.1029	149.7582	148.1539	148.1539	147.8569	148.7719	149.7582	150.4554	151.1843	(39)
Average = Sum(39)m / 12 =												150.1012	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1597	1.1567	1.1537	1.1397	1.1371	1.1249	1.1249	1.1227	1.1296	1.1371	1.1424	1.1479	(40)
HLP (average)												1.1397	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.8993 (42)

Hot water usage for mixer showers

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
72.8310	71.7365	70.1416	67.0900	64.8380	62.3266	60.8991	62.4820	64.2171	66.9135	70.0307	72.5519	(42a)

Hot water usage for baths

31.4429	30.9760	30.3184	29.1059	28.1980	27.1913	26.6475	27.3005	28.0115	29.0887	30.3262	31.3366	(42b)

Hot water usage for other uses

44.3214	42.7097	41.0980	39.4863	37.8746	36.2629	36.2629	37.8746	39.4863	41.0980	42.7097	44.3214	(42c)

Average daily hot water use (litres/day) 136.5924 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	148.5953	145.4221	141.5579	135.6822	130.9106	125.7808	123.8096	127.6571	131.7149	137.1002	143.0665	148.2099	(44)
Energy conte	235.3386	207.0792	217.5693	185.7421	176.2308	154.6622	149.7369	158.0661	162.4176	186.0437	203.8245	232.0610	(45)
Energy content (annual)										Total = Sum(45)m =		2268.7720	
Distribution loss (46)m = 0.15 x (45)m	35.3008	31.0619	32.6354	27.8613	26.4346	23.1993	22.4605	23.7099	24.3626	27.9066	30.5737	34.8091	(46)
Water storage loss:													
Store volume												200.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												2.0900	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.1286	(55)
Total storage loss	34.9866	31.6008	34.9866	33.8580	34.9866	33.8580	34.9866	34.9866	33.8580	34.9866	33.8580	34.9866	(56)
If cylinder contains dedicated solar storage	34.9866	31.6008	34.9866	33.8580	34.9866	33.8580	34.9866	34.9866	33.8580	34.9866	33.8580	34.9866	(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	293.5876	259.6912	275.8183	242.1121	234.4798	211.0322	207.9859	216.3151	218.7876	244.2927	260.1945	290.3100	(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	293.5876	259.6912	275.8183	242.1121	234.4798	211.0322	207.9859	216.3151	218.7876	244.2927	260.1945	290.3100	(64)
										Total per year (kWh/year) = Sum(64)m =		2954.6070	(64)
12Total per year (kWh/year)												2955	(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	124.8493	110.9434	118.9410	106.8553	105.1960	96.5212	96.3867	99.1562	99.0998	108.4587	112.8676	123.7595	(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	144.9633	144.9633	144.9633	144.9633	144.9633	144.9633	144.9633	144.9633	144.9633	144.9633	144.9633	144.9633	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	153.5678	170.0215	153.5678	158.6868	153.5678	158.6868	153.5678	153.5678	158.6868	153.5678	158.6868	153.5678	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	299.7580	302.8685	295.0301	278.3428	257.2782	237.4805	224.2544	221.1438	228.9823	245.6695	266.7341	286.5319	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.4963	37.4963	37.4963	37.4963	37.4963	37.4963	37.4963	37.4963	37.4963	37.4963	37.4963	37.4963	(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)	-115.9706	-115.9706	-115.9706	-115.9706	-115.9706	-115.9706	-115.9706	-115.9706	-115.9706	-115.9706	-115.9706	-115.9706	(71)
Water heating gains (Table 5)	167.8082	165.0944	159.8669	148.4101	141.3924	134.0572	129.5521	133.2745	137.6387	145.7779	156.7606	166.3434	(72)
Total internal gains	690.6230	707.4734	677.9538	654.9287	621.7275	596.7134	573.8632	574.4751	591.7967	614.5042	651.6705	675.9321	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	2.6200	11.2829	0.6300	0.7000	0.7700	9.0343	(75)
Southeast	10.4300	36.7938	0.6300	0.7000	0.7700	117.2819	(77)
Northwest	6.5200	11.2829	0.6300	0.7000	0.7700	22.4824	(81)
Northwest	5.0200	11.2829	0.6300	0.7000	0.7700	17.3100	(81)

Solar gains	166.1086	299.1627	452.4061	632.7594	774.6498	798.0381	757.3295	647.0408	514.1642	342.2536	201.9134	140.2432	(83)
Total gains	856.7316	1006.6361	1130.3599	1287.6881	1396.3773	1394.7515	1331.1928	1221.5159	1105.9610	956.7578	853.5838	816.1753	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	39.8691	39.9738	40.0769	40.5687	40.6621	41.1024	41.1024	41.1850	40.9317	40.6621	40.4737	40.2786	
alpha	3.6579	3.6649	3.6718	3.7046	3.7108	3.7402	3.7402	3.7457	3.7288	3.7108	3.6982	3.6852	
util living area	0.9876	0.9771	0.9561	0.8985	0.7867	0.6186	0.4718	0.5275	0.7582	0.9297	0.9782	0.9896	(86)
MIT	19.1190	19.3777	19.7594	20.2688	20.6735	20.9050	20.9735	20.9601	20.7910	20.2587	19.6076	19.0829	(87)
Th 2	19.9523	19.9548	19.9572	19.9685	19.9706	19.9805	19.9805	19.9824	19.9767	19.9706	19.9663	19.9619	(88)
util rest of house	0.9848	0.9720	0.9459	0.8747	0.7382	0.5390	0.3701	0.4227	0.6878	0.9081	0.9724	0.9872	(89)
MIT 2	17.7618	18.0913	18.5737	19.2071	19.6747	19.9158	19.9689	19.9632	19.8146	19.2095	18.3937	17.7220	(90)
Living area fraction									fLA = Living area / (4) =			0.1475	(91)
MIT	17.9621	18.2811	18.7486	19.3637	19.8220	20.0617	20.1171	20.1103	19.9587	19.3643	18.5728	17.9228	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8121	18.1311	18.5986	19.2137	19.6720	19.9117	19.9671	19.9603	19.8087	19.2143	18.4228	17.7728	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9761	0.9591	0.9280	0.8533	0.7222	0.5333	0.3687	0.4203	0.6746	0.8872	0.9597	0.9796	(94)
Useful gains	836.2896	965.4612	1048.9716	1098.7897	1008.4188	743.7562	490.8336	513.3772	746.0386	848.8190	819.1782	799.5090	(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	2063.7908	2015.5867	1838.3259	1548.1182	1193.8785	786.9488	498.8479	526.4162	849.2892	1290.0572	1703.5796	2051.9915	(97)
Space heating kWh	913.2609	705.6843	587.2796	323.5165	137.9820	0.0000	0.0000	0.0000	0.0000	328.2812	636.7690	931.8470	(98a)
Space heating requirement - total per year (kWh/year)												4564.6206	
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	913.2609	705.6843	587.2796	323.5165	137.9820	0.0000	0.0000	0.0000	0.0000	328.2812	636.7690	931.8470	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4564.6206	
Space heating per m2											(98c) / (4) =	34.6592	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												88.6000	(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													
	913.2609	705.6843	587.2796	323.5165	137.9820	0.0000	0.0000	0.0000	0.0000	328.2812	636.7690	931.8470	(98)
Space heating efficiency (main heating system 1)													
	88.6000	88.6000	88.6000	88.6000	88.6000	0.0000	0.0000	0.0000	0.0000	88.6000	88.6000	88.6000	(210)
Space heating fuel (main heating system)													
	1030.7685	796.4834	662.8437	365.1428	155.7359	0.0000	0.0000	0.0000	0.0000	370.5206	718.7009	1051.7461	(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													
	293.5876	259.6912	275.8183	242.1121	234.4798	211.0322	207.9859	216.3151	218.7876	244.2927	260.1945	290.3100	(64)
Efficiency of water heater												79.6000	(216)
(217)m	86.2283	85.9848	85.5103	84.5100	82.7126	79.6000	79.6000	79.6000	79.6000	84.5226	85.7863	86.2827	(217)
Fuel for water heating, kWh/month													
	340.4772	302.0200	322.5555	286.4893	283.4875	265.1158	261.2889	271.7527	274.8588	289.0264	303.3052	336.4638	(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	31.2562	25.0749	22.5771	16.5410	12.7767	10.4387	11.6554	15.1501	19.6784	25.8192	29.1627	32.1249	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-31.5960	-47.5160	-73.0252	-87.0733	-97.4618	-92.1343	-90.7767	-83.7661	-71.8048	-56.3043	-35.6228	-26.8931	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-12.7059	-28.4308	-60.8116	-97.3870	-133.7925	-136.3442	-134.2290	-110.7793	-77.1575	-42.0896	-17.3447	-9.8857	(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												5151.9420	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												79.6000	
Water heating fuel used												3536.8411	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
central heating pump												41.0000	(230c)

main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	86.0000	(231)
Electricity for lighting (calculated in Appendix L)	252.2552	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-1654.9322	(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	7372.1060	(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	5151.9420	0.2100	1081.9078	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3536.8411	0.2100	742.7366	(264)
Space and water heating			1824.6444	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	252.2552	0.1443	36.4082	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-793.9744	0.1334	-105.9363	
PV Unit electricity exported	-860.9579	0.1242	-106.9722	
Total			-212.9085	(269)
Total CO2, kg/year			1660.0735	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			12.6000	(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	5151.9420	1.1300	5821.6944	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3536.8411	1.1300	3996.6304	(278)
Space and water heating			9818.3249	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	252.2552	1.5338	386.9175	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-793.9744	1.4931	-1185.4469	
PV Unit electricity exported	-860.9579	0.4560	-392.5955	
Total			-1578.0424	(283)
Total Primary energy kWh/year			8757.3007	(286)
Dwelling Primary energy Rate (DPER)			66.4900	(287)

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Main dwelling						
Ground floor	66.6600	(1b)	x 2.4000	(2b) =	159.9840	(1b) - (3b)
First floor	65.0400	(1c)	x 2.6000	(2c) =	169.1040	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	131.7000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		329.0880	(5)

2. Ventilation rate

	m3 per hour		
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	4 * 10 =	40.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1215	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3715	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3158	(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	0.4027	0.3948	0.3869	0.3474	0.3395	0.3000	0.3000	0.2921	0.3158	0.3395	0.3553	0.3711 (22b)
Effective ac	0.5811	0.5779	0.5748	0.5603	0.5576	0.5450	0.5450	0.5427	0.5499	0.5576	0.5631	0.5689 (25)

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3. Heat losses and heat loss parameter

Element	Gross	Openings	NetArea	U-value	A x U	K-value	A x K	
Main dwelling	m2	m2	m2	W/m2K	W/K	kJ/m2K	kJ/K	
TER Semi-glazed door			5.3900	1.0000	5.3900			(26a)
TER Opening Type			24.5900	1.1450	28.1565			(27)
Heatloss Floor 1			66.6600	0.1300	8.6658			(28a)
Cavity Wall	170.1300	29.9800	140.1500	0.1800	25.2270			(29a)
External Roof 1	65.0400		65.0400	0.1100	7.1544			(30)
External Roof 2	1.6200		1.6200	0.1100	0.1782			(30)
Total net area of external elements Aum(A, m2)			303.4500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		74.7719			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 166.4551 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	19.8300	0.0500	0.9915
E3 Sill	14.3900	0.0500	0.7195
E4 Jamb	37.0200	0.0500	1.8510
E5 Ground floor (normal)	34.9900	0.1600	5.5984
E6 Intermediate floor within a dwelling	33.1800	0.0000	0.0000
E10 Eaves (insulation at ceiling level)	18.0400	0.0600	1.0824
E12 Gable (insulation at ceiling level)	18.8300	0.0600	1.1298
E16 Corner (normal)	29.8000	0.0900	2.6820
E17 Corner (inverted - internal area greater than external area)	9.8000	-0.0900	-0.8820

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 13.1726 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 87.9445 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	63.1036	62.7617	62.4266	60.8527	60.5582	59.1873	59.1873	58.9334	59.7153	60.5582	61.1539	61.7767	(38)
Heat transfer coeff	151.0481	150.7062	150.3711	148.7971	148.5027	147.1318	147.1318	146.8779	147.6598	148.5027	149.0984	149.7212	(39)
Average = Sum(39)m / 12 =												148.7957	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1469	1.1443	1.1418	1.1298	1.1276	1.1172	1.1172	1.1152	1.1212	1.1276	1.1321	1.1368	(40)
HLP (average)												1.1298	
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 2.8993 (42)

Hot water usage for mixer showers	72.8310	71.7365	70.1416	67.0900	64.8380	62.3266	60.8991	62.4820	64.2171	66.9135	70.0307	72.5519 (42a)
Hot water usage for baths	31.4429	30.9760	30.3184	29.1059	28.1980	27.1913	26.6475	27.3005	28.0115	29.0887	30.3262	31.3366 (42b)
Hot water usage for other uses	44.3214	42.7097	41.0980	39.4863	37.8746	36.2629	36.2629	37.8746	39.4863	41.0980	42.7097	44.3214 (42c)
Average daily hot water use (litres/day)												136.5924 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	148.5953	145.4221	141.5579	135.6822	130.9106	125.7808	123.8096	127.6571	131.7149	137.1002	143.0665	148.2099	(44)
Energy conte	235.3386	207.0792	217.5693	185.7421	176.2308	154.6622	149.7369	158.0661	162.4176	186.0437	203.8245	232.0610	(45)
Energy content (annual)										Total = Sum(45)m =		2268.7720	
Distribution loss (46)m = 0.15 x (45)m	35.3008	31.0619	32.6354	27.8613	26.4346	23.1993	22.4605	23.7099	24.3626	27.9066	30.5737	34.8091	(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)
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	286.2647	253.0769	268.4953	235.0254	227.1569	203.9455	200.6630	208.9922	211.7009	236.9698	253.1078	282.9870	(62)
WWHRS	-33.2953	-29.4466	-30.8348	-25.5324	-23.7953	-20.3618	-19.0860	-20.2960	-21.0671	-24.8358	-28.1360	-32.6787	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	252.9694	223.6303	237.6605	209.4930	203.3616	183.5837	181.5771	188.6962	190.6338	212.1340	224.9718	250.3083	(64)
										Total per year (kWh/year) = Sum(64)m =		2559.0196	(64)
12Total per year (kWh/year)												2559	(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	118.9909	105.6520	113.0826	101.1859	99.3376	90.8518	90.5284	93.2978	93.4305	102.6004	107.1983	117.9011	(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	144.9633	144.9633	144.9633	144.9633	144.9633	144.9633	144.9633	144.9633	144.9633	144.9633	144.9633	144.9633	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	153.5678	170.0215	153.5678	158.6868	153.5678	158.6868	153.5678	153.5678	158.6868	153.5678	158.6868	153.5678	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	299.7580	302.8685	295.0301	278.3428	257.2782	237.4805	224.2544	221.1438	228.9823	245.6695	266.7341	286.5319	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													

	37.4963	37.4963	37.4963	37.4963	37.4963	37.4963	37.4963	37.4963	37.4963	37.4963	37.4963	37.4963	(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)													
	-115.9706	-115.9706	-115.9706	-115.9706	-115.9706	-115.9706	-115.9706	-115.9706	-115.9706	-115.9706	-115.9706	-115.9706	(71)
Water heating gains (Table 5)													
	159.9341	157.2203	151.9928	140.5360	133.5183	126.1831	121.6779	125.4003	129.7646	137.9038	148.8865	158.4693	(72)
Total internal gains													
	682.7489	699.5993	670.0797	647.0545	613.8534	588.8393	565.9891	566.6010	583.9226	606.6301	643.7963	668.0579	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	2.6200	11.2829	0.6300	0.7000	0.7700	9.0343	(75)
Southeast	10.4300	36.7938	0.6300	0.7000	0.7700	117.2819	(77)
Northwest	11.5400	11.2829	0.6300	0.7000	0.7700	39.7924	(81)

Solar gains	166.1086	299.1627	452.4061	632.7594	774.6498	798.0381	757.3295	647.0408	514.1642	342.2536	201.9134	140.2432	(83)
Total gains	848.8575	998.7620	1122.4858	1279.8140	1388.5032	1386.8774	1323.3186	1213.6418	1098.0868	948.8837	845.7097	808.3012	(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	40.3149	40.4063	40.4964	40.9247	41.0059	41.3880	41.3880	41.4595	41.2399	41.0059	40.8420	40.6721	
alpha	3.6877	3.6938	3.6998	3.7283	3.7337	3.7592	3.7592	3.7640	3.7493	3.7337	3.7228	3.7115	
util living area													
	0.9880	0.9775	0.9565	0.8989	0.7866	0.6185	0.4716	0.5277	0.7589	0.9305	0.9786	0.9899	(86)
MIT	19.1359	19.3937	19.7732	20.2773	20.6787	20.9065	20.9740	20.9607	20.7933	20.2642	19.6169	19.0965	(87)
Th 2	19.9627	19.9648	19.9669	19.9766	19.9784	19.9868	19.9868	19.9884	19.9836	19.9784	19.9747	19.9709	(88)
util rest of house													
	0.9852	0.9724	0.9464	0.8752	0.7383	0.5394	0.3705	0.4234	0.6889	0.9092	0.9730	0.9876	(89)
MIT 2	17.7900	18.1182	18.5976	19.2233	19.6869	19.9231	19.9754	19.9696	19.8230	19.2219	18.4110	17.7451	(90)
Living area fraction										fLA = Living area / (4) =		0.1475	(91)
MIT	17.9886	18.3064	18.7711	19.3788	19.8332	20.0682	20.1227	20.1158	19.9662	19.3756	18.5889	17.9445	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.9886	18.3064	18.7711	19.3788	19.8332	20.0682	20.1227	20.1158	19.9662	19.3756	18.5889	17.9445	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9775	0.9611	0.9311	0.8586	0.7306	0.5461	0.3846	0.4372	0.6875	0.8930	0.9621	0.9808	(94)
Useful gains	829.7927	959.9187	1045.1050	1098.8406	1014.4960	757.3902	508.8998	530.5983	754.9877	847.3771	813.6291	792.8130	(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													
	2067.6355	2020.4220	1845.2118	1559.2155	1207.8060	804.5404	518.3076	545.7673	866.1987	1303.2053	1712.9810	2057.8413	(97)
Space heating kWh													
	920.9551	712.6582	595.2795	331.4699	143.8226	0.0000	0.0000	0.0000	0.0000	339.1362	647.5334	941.1811	(98a)
Space heating requirement - total per year (kWh/year)												4632.0360	
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													
	920.9551	712.6582	595.2795	331.4699	143.8226	0.0000	0.0000	0.0000	0.0000	339.1362	647.5334	941.1811	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4632.0360	
Space heating per m2											(98c) / (4) =	35.1711	(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													
	920.9551	712.6582	595.2795	331.4699	143.8226	0.0000	0.0000	0.0000	0.0000	339.1362	647.5334	941.1811	(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)													
	997.7845	772.1108	644.9399	359.1223	155.8208	0.0000	0.0000	0.0000	0.0000	367.4282	701.5529	1019.6978	(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													
	252.9694	223.6303	237.6605	209.4930	203.3616	183.5837	181.5771	188.6962	190.6338	212.1340	224.9718	250.3083	(64)
Efficiency of water heater												79.8000	(216)
(217)m	86.6931	86.4707	86.0315	85.0839	83.2973	79.8000	79.8000	79.8000	79.8000	85.1064	86.2906	86.7447	(217)
Fuel for water heating, kWh/month													
	291.7989	258.6198	276.2482	246.2193	244.1396	230.0547	227.5402	236.4614	238.8894	249.2573	260.7140	288.5574	(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	31.9084	25.5981	23.0482	16.8861	13.0433	10.6565	11.8986	15.4662	20.0891	26.3579	29.7712	32.7952	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-58.8668	-81.2616	-114.3731	-125.7821	-133.2322	-123.4078	-121.7610	-116.0314	-105.6919	-91.4564	-64.0493	-51.0887	(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	-38.7366	-80.7919	-159.3589	-237.6502	-312.6795	-313.7040	-310.1217	-263.3827	-194.0504	-115.1014	-51.5629	-30.6951	(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	5018.4572	(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	3048.5003	(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)	257.5188	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-3294.8375	(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	5115.6387	(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	5018.4572	0.2100	1053.8760	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3048.5003	0.2100	640.1851	(264)
Space and water heating			1694.0611	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	257.5188	0.1443	37.1679	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1187.0022	0.1351	-160.3210	
PV Unit electricity exported	-2107.8353	0.1261	-265.7958	
Total			-426.1168	(269)
Total CO2, kg/year			1317.0414	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			10.0000	(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	5018.4572	1.1300	5670.8566	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3048.5003	1.1300	3444.8053	(278)
Space and water heating			9115.6619	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	257.5188	1.5338	394.9909	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1187.0022	1.4992	-1779.5533	
PV Unit electricity exported	-2107.8353	0.4629	-975.6714	
Total			-2755.2246	(283)
Total Primary energy kWh/year			6885.5290	(286)
Target Primary Energy Rate (TPER)			52.2800	(287)

Building Regulations England Part L (BREL) Compliance Report

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

Date: Fri 14 Mar 2025 09:30:59

Project Information			
Assessed By	Richard Millard	Building Type	Flat, End-terrace
OCDEA Registration	EES/025661	Assessment Date	2025-03-14

Dwelling Details			
Assessment Type	As designed	Total Floor Area	66 m^2
Site Reference	A1M (FF)	Plot Reference	Proposed
Address	17		

Client Details	
Name	Ian White
Company	Cotswold Homes Ltd
Address	West House, Yate, Bristol, BS37 5NG

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

1a Target emission rate and dwelling emission rate		
Fuel for main heating system	Electricity	
Target carbon dioxide emission rate	*11.44 $kgCO_2/m^2$*	
Dwelling carbon dioxide emission rate	3.69 $kgCO_2/m^2$	OK
1b Target primary energy rate and dwelling primary energy		
Target primary energy	*59.82 kWh_{PE}/m^2*	
Dwelling primary energy	41.86 kWh_{PE}/m^2	OK
1c Target fabric energy efficiency and dwelling fabric energy efficiency		
Target fabric energy efficiency	*30.7 kWh/m^2*	
Dwelling fabric energy efficiency	30.2 kWh/m^2	OK

2a Fabric U-values				
Element	***Maximum permitted average U-Value [W/m^2K]***	**Dwelling average U-Value [W/m^2K]**	**Element with highest individual U-Value**	
External walls	*0.26*	0.18	Walls (1) (0.18)	OK
Party walls	*0.2*	0	Party Wall (1) (0)	**N/A**
Curtain walls	*1.6*	0	N/A	**N/A**
Floors	*0.18*	N/A	N/A	**N/A**
Roofs	*0.16*	0.11	Roof (1) (0.11)	OK
Windows, doors, and roof windows	*1.6*	1.16	P-W01 (1.2)	OK
Rooflights	*2.2*	N/A	N/A	**N/A**

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))		
Name	**Net area [m^2]**	**U-Value [W/m^2K]**
Exposed wall: Walls (1)	47.45	0.18
Party wall: Party Wall (1)	23.68	0 **(!)**
Exposed roof: Roof (1)	66.38	0.11

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	**Area [m^2]**	**Orientation**	**Frame factor**	**U-Value [W/m^2K]**
P-W01, Windows	2.39	East	0.7	1.2
P-W02, Windows	1.44	South	0.7	1.2
P-ED01, Solid Doors	1.98	East	N/A	1 **(!)**
P-W03, Windows	1.44	West	0.7	1.2
P-ED02, Windows	3.21	North	0.7	1.2

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))				
Building part **1**: Thermal bridging calculated from linear thermal transmittances for each junction				
Main element	**Junction detail**	**Source**	**Psi value [W/mK]**	**Drawing / reference**
External wall	E1: Steel lintel with perforated steel base plate	Not government-approved scheme	0.241	EMPF125E101
External wall	E3: Sill	Not government-approved scheme	0.026 **(!)**	EMPF125E301

Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E4: Jamb	Not government-approved scheme	0.02 **(!)**	EMPF125E401
External wall	E11: Eaves (insulation at rafter level)	Not government-approved scheme	0.045	MCPF-E10-01
External wall	E7: Party floor between dwellings (in blocks of flats)	Calculated by person with suitable expertise	0.044	EMPF125E701
External wall	E16: Corner (normal)	Not government-approved scheme	0.037 **(!)**	EMPF125E21601
Party wall	P1: Ground floor	Calculated by person with suitable expertise	0.043	
Party wall	P3: Intermediate floor between dwellings (in blocks of flats)	SAP table default	0 **(!)**	
External wall	E18: Party wall between dwellings	Calculated by person with suitable expertise	0.034 **(!)**	EMPF125E21802

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

4 Space heating	
Main heating system 1: Heat pump with radiators or underfloor heating - Electricity	
Efficiency	233.0%
Emitter type	Radiators
Flow temperature	55°C
System type	Heat Pump
Manufacturer	Daikin Europe NV
Model	EDLA08EV3
Commissioning	
Secondary heating system: N/A	
Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water	
Cylinder/store - type: Cylinder	
Capacity	250 litres
Declared heat loss	1.8 kWh/day
Primary pipework insulated	Yes
Manufacturer	
Model	
Commissioning	
Waste water heat recovery system 1 - type: N/A	
Efficiency	
Manufacturer	
Model	

6 Controls	
Main heating 1 - type: Time and temperature zone control by arrangement of plumbing and electrical services	
Function	
Ecodesign class	
Manufacturer	
Model	
Water heating - type: Cylinder thermostat and HW separately timed	
Manufacturer	
Model	

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

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

9 Local generation	
Technology type: **Photovoltaic system (1)**	
Peak power	1.005 kWp
Orientation	East
Pitch	30°
Overshading	None or very little
Manufacturer	
MCS certificate	

10 Heat networks
N/A

11 Supporting documentary evidence
N/A

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

Full SAP Calculation Printout

Property Reference	A1M (FF)	**Issued on Date**	14/03/2025
Assessment Reference	Proposed	**Prop Type Ref**	17
Property	17		

SAP Rating	85 B	**DER**	3.69	**TER**	11.44
Environmental	97 A	**% DER < TER**			67.74
CO_2 Emissions (t/year)	0.22	**DFEE**	30.23	**TFEE**	30.69
Compliance Check	See BREL	**% DFEE < TFEE**			1.52
% DPER < TPER	30.03	**DPER**	41.86	**TPER**	59.82

Assessor Details	Mr. Richard Millard	**Assessor ID**	U367-0001
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)	
Main dwelling						
Ground floor	66.3800	(1b)	x 2.4000	(2b) =	159.3120	(1b) - (3b) (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	66.3800					
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	159.3120	(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) =	0.1255	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3755	(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) =	0.3474	(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	0.4429	0.4342	0.4255	0.3821	0.3734	0.3300	0.3300	0.3213	0.3474	0.3734	0.3908	0.4082	(22b)
Effective ac	0.5981	0.5943	0.5905	0.5730	0.5697	0.5545	0.5545	0.5516	0.5603	0.5697	0.5764	0.5833	(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	
Main dwelling								
Solid Doors			1.9800	1.0000	1.9800			(26)
Windows			8.4800	1.1450	9.7099			(27)
External Wall 1	57.9100	10.4600	47.4500	0.1800	8.5410	60.0000	2847.0000	(29a)
External Roof 1	66.3800		66.3800	0.1100	7.3018	9.0000	597.4200	(30)
Total net area of external elements Aum(A, m2)			124.2900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		27.5327			(33)
Main dwelling								
Party Wall 1			23.6800	0.0000	0.0000	140.0000	3315.2000	(32)
Party Floor 1			66.3800			40.0000	2655.2000	(32d)
Internal Wall 2			100.6100			9.0000	905.4900	(32c)
Internal Ceiling 1			66.3800			9.0000	597.4200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	10917.7300 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		164.4732 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	6.6400	0.2410	1.6002
E3 Sill	4.1700	0.0260	0.1084
E4 Jamb	16.2000	0.0200	0.3240
E11 Eaves (insulation at rafter level)	24.1300	0.0450	1.0858

E7 Party floor between dwellings (in blocks of flats)	24.1300	0.0440	1.0617	
E16 Corner (normal)	4.8000	0.0370	0.1776	
P1 Party wall - Ground floor	9.8600	0.0430	0.4240	
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	9.8600	0.0000	0.0000	
E18 Party wall between dwellings	4.8000	0.0340	0.1632	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 4.9450 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 32.4777 (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	31.4429	31.2427	31.0464	30.1246	29.9521	29.1492	29.1492	29.0005	29.4584	29.9521	30.3010	30.6658	(38)
Heat transfer coeff	63.9206	63.7204	63.5241	62.6023	62.4298	61.6269	61.6269	61.4782	61.9362	62.4298	62.7787	63.1435	(39)
Average = Sum(39)m / 12 =												62.6015	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9630	0.9599	0.9570	0.9431	0.9405	0.9284	0.9284	0.9262	0.9331	0.9405	0.9457	0.9512	(40)
HLP (average)												0.9431	
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 2.1551 (42)
Hot water usage for mixer showers

60.3542	59.4472	58.1255	55.5967	53.7305	51.6494	50.4664	51.7781	53.2160	55.4505	58.0336	60.1230	(42a)

Hot water usage for baths

26.0775	25.6902	25.1448	24.1393	23.3863	22.5514	22.1004	22.6419	23.2316	24.1250	25.1513	25.9894	(42b)

Hot water usage for other uses

36.7008	35.3662	34.0316	32.6971	31.3625	30.0279	30.0279	31.3625	32.6971	34.0316	35.3662	36.7008	(42c)

Average daily hot water use (litres/day) 113.1869 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	123.1325	120.5037	117.3020	112.4330	108.4793	104.2286	102.5947	105.7825	109.1446	113.6071	118.5511	122.8131	(44)
Energy conte	195.0118	171.5956	180.2888	153.9152	146.0340	128.1613	124.0794	130.9809	134.5862	154.1638	168.8978	192.2957	(45)
Energy content (annual)										Total = Sum(45)m =		1880.0107	
Distribution loss (46)m = 0.15 x (45)m	29.2518	25.7393	27.0433	23.0873	21.9051	19.2242	18.6119	19.6471	20.1879	23.1246	25.3347	28.8444	(46)

Water storage loss:
Store volume 250.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.8000 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 0.9720 (55)
Total storage loss

30.1320	27.2160	30.1320	29.1600	30.1320	29.1600	30.1320	30.1320	29.1600	30.1320	29.1600	30.1320	(56)

If cylinder contains dedicated solar storage

30.1320	27.2160	30.1320	29.1600	30.1320	29.1600	30.1320	30.1320	29.1600	30.1320	29.1600	30.1320	(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

248.4062	219.8228	233.6832	205.5872	199.4284	179.8333	177.4738	184.3753	186.2582	207.5582	220.5698	245.6901	(62)
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
-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

248.4062	219.8228	233.6832	205.5872	199.4284	179.8333	177.4738	184.3753	186.2582	207.5582	220.5698	245.6901	(64)
									Total per year (kWh/year) = Sum(64)m =		2508.6867	(64)

12Total per year (kWh/year) 2509 (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

107.5570	95.6373	102.6616	92.5144	91.2718	83.9512	83.9719	86.2667	86.0875	93.9750	97.4961	106.6538	(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	107.7570	107.7570	107.7570	107.7570	107.7570	107.7570	107.7570	107.7570	107.7570	107.7570	107.7570	107.7570	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	104.1906	115.3539	104.1906	107.6636	104.1906	107.6636	104.1906	104.1906	107.6636	104.1906	107.6636	104.1906	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	188.7053	190.6635	185.7290	175.2239	161.9632	149.5000	141.1739	139.2157	144.1502	154.6552	167.9159	180.3791	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	33.7757	33.7757	33.7757	33.7757	33.7757	33.7757	33.7757	33.7757	33.7757	33.7757	33.7757	33.7757	(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)	-86.2056	-86.2056	-86.2056	-86.2056	-86.2056	-86.2056	-86.2056	-86.2056	-86.2056	-86.2056	-86.2056	-86.2056	(71)
Water heating gains (Table 5)	144.5658	142.3174	137.9860	128.4922	122.6772	116.5989	112.8655	115.9498	119.5660	126.3105	135.4113	143.3519	(72)
Total internal gains	492.7888	503.6619	483.2326	466.7069	444.1581	429.0897	413.5570	414.6832	426.7069	440.4834	466.3179	483.2488	(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	3.2100	10.6334	0.6300	0.7000	0.7700	10.4315	(74)
East	2.3900	19.6403	0.6300	0.7000	0.7700	14.3455	(76)
South	1.4400	46.7521	0.6300	0.7000	0.7700	20.5748	(78)
West	1.4400	19.6403	0.6300	0.7000	0.7700	8.6433	(80)

Solar gains	53.9952	98.6025	150.8588	210.9375	256.2250	262.6264	249.8034	215.1018	171.7027	113.4368	65.9212	45.3797	(83)
Total gains	546.7840	602.2644	634.0914	677.6444	700.3831	691.7161	663.3605	629.7850	598.4096	553.9202	532.2392	528.6284	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	47.4448	47.5939	47.7410	48.4440	48.5778	49.2107	49.2107	49.3297	48.9650	48.5778	48.3078	48.0287	
alpha	4.1630	4.1729	4.1827	4.2296	4.2385	4.2807	4.2807	4.2886	4.2643	4.2385	4.2205	4.2019	
util living area	0.9689	0.9522	0.9236	0.8509	0.7266	0.5469	0.4035	0.4409	0.6556	0.8674	0.9476	0.9724	(86)
Living	19.7515	19.9487	20.2199	20.5779	20.8326	20.9622	20.9918	20.9880	20.9180	20.6057	20.1410	19.7265	
Non living	18.6711	18.9195	19.2576	19.6964	19.9826	20.1174	20.1396	20.1394	20.0775	19.7390	19.1722	18.6468	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	20.3613	19.9487	20.2199	20.5779	20.8326	20.9622	20.9918	20.9880	20.9180	20.6057	20.1410	19.9046	(87)
Th 2	20.1143	20.1169	20.1193	20.1310	20.1332	20.1434	20.1434	20.1453	20.1395	20.1332	20.1288	20.1242	(88)
util rest of house	0.9629	0.9432	0.9090	0.8234	0.6799	0.4814	0.3273	0.3625	0.5906	0.8370	0.9363	0.9670	(89)
MIT 2	19.5390	18.9195	19.2576	19.6964	19.9826	20.1174	20.1396	20.1394	20.0775	19.7390	19.1722	18.9130	(90)
Living area fraction										fLA = Living area / (4) =		0.5164	(91)
MIT	19.9636	19.4510	19.7545	20.1516	20.4215	20.5537	20.5797	20.5777	20.5116	20.1866	19.6725	19.4251	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.9636	19.4510	19.7545	20.1516	20.4215	20.5537	20.5797	20.5777	20.5116	20.1866	19.6725	19.4251	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9617	0.9351	0.9021	0.8241	0.6962	0.5133	0.3664	0.4026	0.6197	0.8390	0.9292	0.9618	(94)
Useful gains	525.8612	563.2009	571.9918	558.4416	487.5802	355.0765	243.0603	253.5596	370.8284	464.7638	494.5659	508.4503	(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	1001.2300	927.1946	841.9830	704.3755	544.4844	366.9071	245.2562	256.8354	397.1074	598.4881	789.2870	961.3663	(97)
Space heating kWh	353.6744	244.6038	200.8735	105.0724	42.3367	0.0000	0.0000	0.0000	0.0000	99.4908	212.1992	336.9695	(98a)
Space heating requirement - total per year (kWh/year)												1595.2203	
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	353.6744	244.6038	200.8735	105.0724	42.3367	0.0000	0.0000	0.0000	0.0000	99.4908	212.1992	336.9695	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1595.2203	
Space heating per m2											(98c) / (4) =	24.0316	(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 %) 233.0166 (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	353.6744	244.6038	200.8735	105.0724	42.3367	0.0000	0.0000	0.0000	0.0000	99.4908	212.1992	336.9695	(98)
Space heating efficiency (main heating system 1)	233.0166	233.0166	233.0166	233.0166	233.0166	0.0000	0.0000	0.0000	0.0000	233.0166	233.0166	233.0166	(210)
Space heating fuel (main heating system)	151.7808	104.9727	86.2056	45.0922	18.1690	0.0000	0.0000	0.0000	0.0000	42.6969	91.0661	144.6118	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	248.4062	219.8228	233.6832	205.5872	199.4284	179.8333	177.4738	184.3753	186.2582	207.5582	220.5698	245.6901	(64)
Efficiency of water heater												171.6765	(216)
(217)m	171.6765	171.6765	171.6765	171.6765	171.6765	171.6765	171.6765	171.6765	171.6765	171.6765	171.6765	171.6765	(217)
Fuel for water heating, kWh/month	144.6943	128.0448	136.1183	119.7527	116.1652	104.7512	103.3769	107.3969	108.4937	120.9007	128.4799	143.1122	(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	21.6487	17.3674	15.6374	11.4567	8.8495	7.2301	8.0728	10.4933	13.6297	17.8830	20.1988	22.2504	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-13.4421	-22.6039	-39.2383	-51.5384	-61.0083	-58.2713	-57.1316	-50.6315	-39.8661	-28.0885	-15.7266	-11.1105	(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	-2.4737	-6.4593	-16.3599	-30.9177	-47.0904	-50.3977	-49.1030	-38.1565	-24.0052	-10.7764	-3.6591	-1.8587	(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 1 684.5951 (211)

Space heating fuel - main system 2 0.0000 (213)

Space heating fuel - secondary 0.0000 (215)

Efficiency of water heater 171.6765

Water heating fuel used 1461.2868 (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)	174.7178	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-729.9148	(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	1590.6848	(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	684.5951	0.1559	106.7013	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1461.2868	0.1409	205.8368	(264)
Space and water heating			312.5381	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	174.7178	0.1443	25.2172	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-448.6571	0.1317	-59.1086	
PV Unit electricity exported	-281.2577	0.1205	-33.9006	
Total			-93.0092	(269)
Total CO2, kg/year			244.7461	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			3.6900	(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	684.5951	1.5770	1079.6075	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1461.2868	1.5208	2222.3938	(278)
Space and water heating			3302.0013	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	174.7178	1.5338	267.9880	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-448.6571	1.4868	-667.0422	
PV Unit electricity exported	-281.2577	0.4421	-124.3564	
Total			-791.3986	(283)
Total Primary energy kWh/year			2778.5907	(286)
Dwelling Primary energy Rate (DPER)			41.8600	(287)

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Main dwelling						
Ground floor	66.3800	(1b)	x 2.4000	(2b) =	159.3120	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	66.3800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		159.3120	(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) =	0.1255	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3755	(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) =	0.3474	(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	0.4429	0.4342	0.4255	0.3821	0.3734	0.3300	0.3300	0.3213	0.3474	0.3734	0.3908	0.4082	(22b)

Effective ac	0.5981	0.5943	0.5905	0.5730	0.5697	0.5545	0.5545	0.5516	0.5603	0.5697	0.5764	0.5833 (25)

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3. Heat losses and heat loss parameter

Element	Gross	Openings	NetArea	U-value	A x U	K-value	A x K	
	m2	m2	m2	W/m2K	W/K	kJ/m2K	kJ/K	
Main dwelling								
TER Opaque door			1.9800	1.0000	1.9800			(26)
TER Opening Type			8.4800	1.1450	9.7099			(27)
External Wall 1	57.9100	10.4600	47.4500	0.1800	8.5410			(29a)
External Roof 1	66.3800		66.3800	0.1100	7.3018			(30)
Total net area of external elements Aum(A, m2)			124.2900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		27.5327			(33)
Main dwelling								
Party Wall 1			23.6800	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 164.4732 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	6.6400	0.0500	0.3320
E3 Sill	4.1700	0.0500	0.2085
E4 Jamb	16.2000	0.0500	0.8100
E11 Eaves (insulation at rafter level)	24.1300	0.0400	0.9652
E7 Party floor between dwellings (in blocks of flats)	24.1300	0.0700	1.6891
E16 Corner (normal)	4.8000	0.0900	0.4320
P1 Party wall - Ground floor	9.8600	0.0800	0.7888
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	9.8600	0.0000	0.0000
E18 Party wall between dwellings	4.8000	0.0600	0.2880

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 5.5136 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 33.0463 (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	31.4429	31.2427	31.0464	30.1246	29.9521	29.1492	29.1492	29.0005	29.4584	29.9521	30.3010	30.6658	(38)
Heat transfer coeff	64.4892	64.2890	64.0927	63.1709	62.9984	62.1955	62.1955	62.0468	62.5048	62.9984	63.3473	63.7121	(39)

Average = Sum(39)m / 12 = 63.1701

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9715	0.9685	0.9655	0.9517	0.9491	0.9370	0.9370	0.9347	0.9416	0.9491	0.9543	0.9598	(40)
HLP (average)												0.9516	
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 2.1551 (42)

Hot water usage for mixer showers

60.3542	59.4472	58.1255	55.5967	53.7305	51.6494	50.4664	51.7781	53.2160	55.4505	58.0336	60.1230	(42a)

Hot water usage for baths

26.0775	25.6902	25.1448	24.1393	23.3863	22.5514	22.1004	22.6419	23.2316	24.1250	25.1513	25.9894	(42b)

Hot water usage for other uses

36.7008	35.3662	34.0316	32.6971	31.3625	30.0279	30.0279	31.3625	32.6971	34.0316	35.3662	36.7008	(42c)

Average daily hot water use (litres/day) 113.1869 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	123.1325	120.5037	117.3020	112.4330	108.4793	104.2286	102.5947	105.7825	109.1446	113.6071	118.5511	122.8131	(44)
Energy conte	195.0118	171.5956	180.2888	153.9152	146.0340	128.1613	124.0794	130.9809	134.5862	154.1638	168.8978	192.2957	(45)
Energy content (annual)										Total = Sum(45)m =		1880.0107	
Distribution loss (46)m = 0.15 x (45)m													
	29.2518	25.7393	27.0433	23.0873	21.9051	19.2242	18.6119	19.6471	20.1879	23.1246	25.3347	28.8444	(46)
Water storage loss:													
Store volume												250.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.8903	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.0208	(55)
Total storage loss													
	31.6444	28.5820	31.6444	30.6236	31.6444	30.6236	31.6444	31.6444	30.6236	31.6444	30.6236	31.6444	(56)
If cylinder contains dedicated solar storage													
	31.6444	28.5820	31.6444	30.6236	31.6444	30.6236	31.6444	31.6444	30.6236	31.6444	30.6236	31.6444	(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													
	249.9186	221.1888	235.1956	207.0508	200.9408	181.2969	178.9862	185.8877	187.7219	209.0706	222.0334	247.2025	(62)
WWHRS	-27.5914	-24.4021	-25.5525	-21.1584	-19.7189	-16.8736	-15.8163	-16.8191	-17.4581	-20.5812	-23.3160	-27.0805	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h													
	222.3272	196.7867	209.6432	185.8924	181.2219	164.4233	163.1699	169.0686	170.2638	188.4895	198.7175	220.1220	(64)
										Total per year (kWh/year) = Sum(64)m =		2270.1258	(64)
12Total per year (kWh/year)												2270	(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													
	108.7669	96.7301	103.8715	93.6853	92.4817	85.1221	85.1818	87.4766	87.2584	95.1849	98.6670	107.8637	(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	107.7570	107.7570	107.7570	107.7570	107.7570	107.7570	107.7570	107.7570	107.7570	107.7570	107.7570	107.7570	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	104.1906	115.3539	104.1906	107.6636	104.1906	107.6636	104.1906	104.1906	107.6636	104.1906	107.6636	104.1906	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	188.7053	190.6635	185.7290	175.2239	161.9632	149.5000	141.1739	139.2157	144.1502	154.6552	167.9159	180.3791	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	33.7757	33.7757	33.7757	33.7757	33.7757	33.7757	33.7757	33.7757	33.7757	33.7757	33.7757	33.7757	(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)													

	-86.2056	-86.2056	-86.2056	-86.2056	-86.2056	-86.2056	-86.2056	-86.2056	-86.2056	-86.2056	-86.2056	(71)
Water heating gains (Table 5)												
	146.1920	143.9436	139.6122	130.1185	124.3034	118.2251	114.4917	117.5760	121.1922	127.9367	137.0375	144.9782 (72)
Total internal gains												
	497.4150	508.2881	487.8588	471.3331	448.7843	430.7159	415.1833	416.3094	428.3332	445.1096	470.9442	487.8750 (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	3.2100	10.6334	0.6300	0.7000	0.7700	10.4315	(74)
East	2.3900	19.6403	0.6300	0.7000	0.7700	14.3455	(76)
South	1.4400	46.7521	0.6300	0.7000	0.7700	20.5748	(78)
West	1.4400	19.6403	0.6300	0.7000	0.7700	8.6433	(80)

Solar gains	53.9952	98.6025	150.8588	210.9375	256.2250	262.6264	249.8034	215.1018	171.7027	113.4368	65.9212	45.3797 (83)
Total gains	551.4102	606.8906	638.7177	682.2706	705.0093	693.3423	664.9867	631.4113	600.0358	558.5464	536.8654	533.2547 (84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	47.0265	47.1730	47.3174	48.0079	48.1394	48.7608	48.7608	48.8777	48.5195	48.1394	47.8742	47.6001	
alpha	4.1351	4.1449	4.1545	4.2005	4.2093	4.2507	4.2507	4.2585	4.2346	4.2093	4.1916	4.1733	
util living area													
	0.9683	0.9516	0.9230	0.8506	0.7269	0.5497	0.4059	0.4435	0.6581	0.8665	0.9469	0.9718	(86)
MIT	19.7420	19.9392	20.2115	20.5715	20.8289	20.9604	20.9913	20.9874	20.9149	20.6011	20.1338	19.7169	(87)
Th 2	20.1071	20.1097	20.1121	20.1238	20.1260	20.1362	20.1362	20.1381	20.1323	20.1260	20.1216	20.1170	(88)
util rest of house													
	0.9622	0.9425	0.9083	0.8229	0.6800	0.4835	0.3287	0.3640	0.5926	0.8359	0.9353	0.9664	(89)
MIT 2	18.6540	18.9023	19.2418	19.6828	19.9721	20.1090	20.1322	20.1319	20.0679	19.7275	19.1578	18.6296	(90)
Living area fraction									fLA = Living area / (4) =			0.5164	(91)
MIT	19.2158	19.4378	19.7426	20.1417	20.4146	20.5487	20.5758	20.5737	20.5053	20.1786	19.6619	19.1911	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.2158	19.4378	19.7426	20.1417	20.4146	20.5487	20.5758	20.5737	20.5053	20.1786	19.6619	19.1911	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9547	0.9343	0.9012	0.8235	0.6961	0.5157	0.3684	0.4046	0.6217	0.8379	0.9282	0.9592	(94)
Useful gains	526.4040	567.0268	575.6346	561.8720	490.7906	357.5687	244.9485	255.4979	373.0665	468.0157	498.3104	511.5014	(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													
	961.9096	934.6198	848.7534	710.1509	549.0055	369.9798	247.2790	258.9625	400.3643	603.4391	795.7596	955.1145	(97)
Space heating kWh													
	324.0162	247.0225	203.2004	106.7608	43.3118	0.0000	0.0000	0.0000	0.0000	100.7551	214.1634	330.0481	(98a)
Space heating requirement - total per year (kWh/year)												1569.2783	
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													
	324.0162	247.0225	203.2004	106.7608	43.3118	0.0000	0.0000	0.0000	0.0000	100.7551	214.1634	330.0481	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1569.2783	
Space heating per m2										(98c) / (4) =		23.6408	(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													
	324.0162	247.0225	203.2004	106.7608	43.3118	0.0000	0.0000	0.0000	0.0000	100.7551	214.1634	330.0481	(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)													
	351.0468	267.6300	220.1521	115.6672	46.9251	0.0000	0.0000	0.0000	0.0000	109.1604	232.0297	357.5819	(211)
Space heating efficiency (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	222.3272	196.7867	209.6432	185.8924	181.2219	164.4233	163.1699	169.0686	170.2638	188.4895	198.7175	220.1220	(64)
Efficiency of water heater												79.8000	(216)
(217)m	84.9034	84.5708	83.9898	82.8637	81.3912	79.8000	79.8000	79.8000	79.8000	82.7204	84.2280	84.9660	(217)
Fuel for water heating, kWh/month													
	261.8591	232.6888	249.6054	224.3350	222.6553	206.0442	204.4735	211.8654	213.3631	227.8633	235.9281	259.0707	(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	21.6487	17.3674	15.6374	11.4567	8.8495	7.2301	8.0728	10.4933	13.6297	17.8830	20.1988	22.2504	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-31.2978	-44.2430	-63.7663	-71.9045	-77.7271	-72.6415	-71.7766	-67.6934	-60.4755	-50.7273	-34.4641	-27.0475	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													

(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-17.2989	-36.4434	-72.5248	-109.0484	-144.2923	-144.9963	-143.2577	-121.2168	-88.7661	-52.1178	-23.0992	-13.6727	(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	1700.1932	(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	2749.7520	(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)	174.7178	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-1640.4988	(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	3070.1641	(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	1700.1932	0.2100	357.0406	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2749.7520	0.2100	577.4479	(264)
Space and water heating			934.4885	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	174.7178	0.1443	25.2172	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-673.7644	0.1345	-90.6346	
PV Unit electricity exported	-966.7344	0.1259	-121.6811	
Total			-212.3156	(269)
Total CO2, kg/year			759.3193	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			11.4400	(273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	1700.1932	1.1300	1921.2183	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2749.7520	1.1300	3107.2197	(278)
Space and water heating			5028.4380	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	174.7178	1.5338	267.9880	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-673.7644	1.4972	-1008.7319	
PV Unit electricity exported	-966.7344	0.4620	-446.6524	
Total			-1455.3842	(283)
Total Primary energy kWh/year			3971.1426	(286)
Target Primary Energy Rate (TPER)			59.8200	(287)

Building Regulations England Part L (BREL) Compliance Report

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

Date: Fri 14 Mar 2025 09:30:59

Project Information			
Assessed By	Richard Millard	Building Type	Flat, End-terrace
OCDEA Registration	EES/025661	Assessment Date	2025-03-14

Dwelling Details			
Assessment Type	As designed	Total Floor Area	66 m^2
Site Reference	A1M (FF)	Plot Reference	Regulated (Baseline)
Address	17		

Client Details	
Name	Ian White
Company	Cotswold Homes Ltd
Address	West House, Yate, Bristol, BS37 5NG

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

1a Target emission rate and dwelling emission rate		
Fuel for main heating system	Mains gas	
Target carbon dioxide emission rate	*11.95 $kgCO_2/m^2$*	
Dwelling carbon dioxide emission rate	16.11 $kgCO_2/m^2$	**FAIL**
1b Target primary energy rate and dwelling primary energy		
Target primary energy	*62.57 kWh_{PE}/m^2*	
Dwelling primary energy	89.7 kWh_{PE}/m^2	**FAIL**
1c Target fabric energy efficiency and dwelling fabric energy efficiency		
Target fabric energy efficiency	*33.1 kWh/m^2*	
Dwelling fabric energy efficiency	32.8 kWh/m^2	**OK**

2a Fabric U-values				
Element	***Maximum permitted average U-Value [W/m^2K]***	**Dwelling average U-Value [W/m^2K]**	**Element with highest individual U-Value**	
External walls	*0.26*	0.18	Walls (1) (0.18)	**OK**
Party walls	*0.2*	0	Party Wall (1) (0)	**N/A**
Curtain walls	*1.6*	0	N/A	**N/A**
Floors	*0.18*	N/A	N/A	**N/A**
Roofs	*0.16*	0.11	Roof (1) (0.11)	**OK**
Windows, doors, and roof windows	*1.6*	1.16	P-W01 (1.2)	**OK**
Rooflights	*2.2*	N/A	N/A	**N/A**

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))		
Name	**Net area [m^2]**	**U-Value [W/m^2K]**
Exposed wall: Walls (1)	47.45	0.18
Party wall: Party Wall (1)	23.68	0 **(!)**
Exposed roof: Roof (1)	66.38	0.11

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	**Area [m^2]**	**Orientation**	**Frame factor**	**U-Value [W/m^2K]**
P-W01, Windows	2.39	East	0.7	1.2
P-W02, Windows	1.44	South	0.7	1.2
P-ED01, Solid Doors	1.98	East	N/A	1 **(!)**
P-W03, Windows	1.44	West	0.7	1.2
P-ED02, Windows	3.21	North	0.7	1.2

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))				
Building part **1**: Thermal bridging calculated from linear thermal transmittances for each junction				
Main element	**Junction detail**	**Source**	**Psi value [W/mK]**	**Drawing / reference**
External wall	E2: Other lintels (including other steel lintels)	Not government-approved scheme	0.05	MCPF-125-E2-01
External wall	E3: Sill	Not government-approved scheme	0.05	MCPF-125-E3-01

Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E4: Jamb	Not government-approved scheme	0.022 **(!)**	MCPF-125-E4-01
External wall	E5: Ground floor (normal)	Not government-approved scheme	0.16	MCPF-125-E5-04
External wall	E7: Party floor between dwellings (in blocks of flats)	Calculated by person with suitable expertise	0.07	MCPF-125-E6-01
External wall	E16: Corner (normal)	Not government-approved scheme	0.09	MCPF-125-E16-01
Party wall	P1: Ground floor	Calculated by person with suitable expertise	0.08	
Party wall	P3: Intermediate floor between dwellings (in blocks of flats)	SAP table default	0 **(!)**	
External wall	E18: Party wall between dwellings	Calculated by person with suitable expertise	0.09	

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

4 Space heating	
Main heating system 1: Boiler with radiators or underfloor heating - Mains gas	
Efficiency	88.8%
Emitter type	Radiators
Flow temperature	55°C
System type	Regular boiler
Manufacturer	Bosch Thermotechnology
Model	Greenstar 8000 Life
Commissioning	
Secondary heating system: N/A	
Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water	
Cylinder/store - type: Cylinder	
Capacity	250 litres
Declared heat loss	1.8 kWh/day
Primary pipework insulated	Yes
Manufacturer	
Model	
Commissioning	
Waste water heat recovery system 1 - type: N/A	
Efficiency	
Manufacturer	
Model	

6 Controls	
Main heating 1 - type: Time and temperature zone control by arrangement of plumbing and electrical services	
Function	
Ecodesign class	
Manufacturer	
Model	
Water heating - type: Cylinder thermostat and HW separately timed	
Manufacturer	
Model	

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

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

9 Local generation
N/A

10 Heat networks
N/A

11 Supporting documentary evidence
N/A

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

Full SAP Calculation Printout

Property Reference	A1M (FF)	**Issued on Date**	14/03/2025
Assessment Reference	Regulated (Baseline)	**Prop Type Ref**	17
Property	17		

SAP Rating	84 B	**DER**	16.11	**TER**	11.95
Environmental	87 B	**% DER < TER**			-34.81
CO_2 Emissions (t/year)	1.01	**DFEE**	32.81	**TFEE**	33.06
Compliance Check	See BREL	**% DFEE < TFEE**			0.77
% DPER < TPER	-43.36	**DPER**	89.70	**TPER**	62.57

Assessor Details	Mr. Richard Millard	**Assessor ID**	U367-0001
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)	
Main dwelling						
Ground floor	66.3800	(1b)	x 2.4000	(2b) =	159.3120	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	66.3800					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	159.3120	(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) =	0.1255 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.3755 (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) =	0.3474 (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	0.4429	0.4342	0.4255	0.3821	0.3734	0.3300	0.3300	0.3213	0.3474	0.3734	0.3908	0.4082	(22b)
Effective ac	0.5981	0.5943	0.5905	0.5730	0.5697	0.5545	0.5545	0.5516	0.5603	0.5697	0.5764	0.5833	(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	
Main dwelling								
Solid Doors			1.9800	1.0000	1.9800			(26)
Windows			8.4800	1.1450	9.7099			(27)
External Wall 1	57.9100	10.4600	47.4500	0.1800	8.5410	60.0000	2847.0000	(29a)
External Roof 1	66.3800		66.3800	0.1100	7.3018	9.0000	597.4200	(30)
Total net area of external elements Aum(A, m2)			124.2900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	27.5327			(33)
Main dwelling								
Party Wall 1			23.6800	0.0000	0.0000	140.0000	3315.2000	(32)
Party Floor 1			66.3800			40.0000	2655.2000	(32d)
Internal Wall 2			100.6100			9.0000	905.4900	(32c)
Internal Ceiling 1			66.3800			9.0000	597.4200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	10917.7300 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		164.4732 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	6.6400	0.0500	0.3320
E3 Sill	4.1700	0.0500	0.2085
E4 Jamb	16.2000	0.0220	0.3564
E5 Ground floor (normal)	24.1300	0.1600	3.8608

E7 Party floor between dwellings (in blocks of flats)	24.1300	0.0700	1.6891	
E16 Corner (normal)	4.8000	0.0900	0.4320	
P1 Party wall - Ground floor	9.8600	0.0800	0.7888	
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	9.8600	0.0000	0.0000	
E18 Party wall between dwellings	4.8000	0.0900	0.4320	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 8.0996 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 35.6323 (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	31.4429	31.2427	31.0464	30.1246	29.9521	29.1492	29.1492	29.0005	29.4584	29.9521	30.3010	30.6658	(38)
Heat transfer coeff	67.0752	66.8750	66.6787	65.7569	65.5844	64.7815	64.7815	64.6328	65.0908	65.5844	65.9333	66.2981	(39)
Average = Sum(39)m / 12 =												65.7561	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0105	1.0075	1.0045	0.9906	0.9880	0.9759	0.9759	0.9737	0.9806	0.9880	0.9933	0.9988	(40)
HLP (average)												0.9906	
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 2.1551 (42)
Hot water usage for mixer showers

60.3542	59.4472	58.1255	55.5967	53.7305	51.6494	50.4664	51.7781	53.2160	55.4505	58.0336	60.1230	(42a)

Hot water usage for baths

26.0775	25.6902	25.1448	24.1393	23.3863	22.5514	22.1004	22.6419	23.2316	24.1250	25.1513	25.9894	(42b)

Hot water usage for other uses

36.7008	35.3662	34.0316	32.6971	31.3625	30.0279	30.0279	31.3625	32.6971	34.0316	35.3662	36.7008	(42c)

Average daily hot water use (litres/day) 113.1869 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	123.1325	120.5037	117.3020	112.4331	108.4793	104.2286	102.5947	105.7825	109.1446	113.6072	118.5511	122.8131	(44)
Energy conte	195.0118	171.5956	180.2888	153.9152	146.0340	128.1613	124.0794	130.9809	134.5863	154.1638	168.8978	192.2957	(45)
Energy content (annual)											Total = Sum(45)m =	1880.0107	
Distribution loss (46)m = 0.15 x (45)m	29.2518	25.7393	27.0433	23.0873	21.9051	19.2242	18.6119	19.6471	20.1879	23.1246	25.3347	28.8444	(46)

Water storage loss:
Store volume 250.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.8000 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 0.9720 (55)
Total storage loss

30.1320	27.2160	30.1320	29.1600	30.1320	29.1600	30.1320	30.1320	29.1600	30.1320	29.1600	30.1320	(56)

If cylinder contains dedicated solar storage

30.1320	27.2160	30.1320	29.1600	30.1320	29.1600	30.1320	30.1320	29.1600	30.1320	29.1600	30.1320	(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

248.4062	219.8228	233.6832	205.5872	199.4284	179.8333	177.4738	184.3753	186.2583	207.5582	220.5698	245.6901	(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

248.4062	219.8228	233.6832	205.5872	199.4284	179.8333	177.4738	184.3753	186.2583	207.5582	220.5698	245.6901	(64)
										Total per year (kWh/year) = Sum(64)m =	2508.6867	(64)
12Total per year (kWh/year)											2509	(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

107.5570	95.6373	102.6616	92.5144	91.2718	83.9512	83.9719	86.2667	86.0875	93.9750	97.4961	106.6538	(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	107.7570	107.7570	107.7570	107.7570	107.7570	107.7570	107.7570	107.7570	107.7570	107.7570	107.7570	107.7570	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	104.1906	115.3539	104.1906	107.6636	104.1906	107.6636	104.1906	104.1906	107.6636	104.1906	107.6636	104.1906	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	188.7053	190.6635	185.7290	175.2239	161.9632	149.5000	141.1739	139.2157	144.1502	154.6552	167.9159	180.3791	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	33.7757	33.7757	33.7757	33.7757	33.7757	33.7757	33.7757	33.7757	33.7757	33.7757	33.7757	33.7757	(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)	-86.2056	-86.2056	-86.2056	-86.2056	-86.2056	-86.2056	-86.2056	-86.2056	-86.2056	-86.2056	-86.2056	-86.2056	(71)
Water heating gains (Table 5)	144.5658	142.3174	137.9860	128.4922	122.6772	116.5989	112.8655	115.9498	119.5660	126.3105	135.4113	143.3519	(72)
Total internal gains	495.7888	506.6619	486.2326	469.7069	447.1581	429.0897	413.5571	414.6832	426.7069	443.4834	469.3180	486.2488	(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	3.2100	10.6334	0.6300	0.7000	0.7700	10.4315	(74)
East	2.3900	19.6403	0.6300	0.7000	0.7700	14.3455	(76)
South	1.4400	46.7521	0.6300	0.7000	0.7700	20.5748	(78)
West	1.4400	19.6403	0.6300	0.7000	0.7700	8.6433	(80)

Solar gains	53.9952	98.6025	150.8588	210.9375	256.2250	262.6264	249.8034	215.1018	171.7027	113.4368	65.9212	45.3797	(83)
Total gains	549.7840	605.2644	637.0914	680.6444	703.3831	691.7161	663.3605	629.7851	598.4096	556.9202	535.2392	531.6285	(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	45.2135	45.3488	45.4823	46.1199	46.2412	46.8143	46.8143	46.9220	46.5919	46.2412	45.9965	45.7434	
alpha	4.0142	4.0233	4.0322	4.0747	4.0827	4.1210	4.1210	4.1281	4.1061	4.0827	4.0664	4.0496	
util living area	0.9699	0.9543	0.9277	0.8602	0.7423	0.5680	0.4220	0.4606	0.6756	0.8753	0.9500	0.9732	(86)
MIT	19.6539	19.8545	20.1368	20.5155	20.7974	20.9497	20.9883	20.9832	20.8963	20.5511	20.0601	19.6280	(87)
Th 2	20.0746	20.0771	20.0796	20.0912	20.0933	20.1034	20.1034	20.1053	20.0995	20.0933	20.0889	20.0844	(88)
util rest of house	0.9640	0.9455	0.9134	0.8330	0.6948	0.4986	0.3394	0.3759	0.6083	0.8453	0.9389	0.9679	(89)
MIT 2	18.5204	18.7733	19.1260	19.5914	19.9105	20.0689	20.0981	20.0971	20.0209	19.6439	19.0429	18.4947	(90)
Living area fraction										fLA = Living area / (4) =		0.5164	(91)
MIT	19.1058	19.3317	19.6480	20.0686	20.3685	20.5238	20.5578	20.5547	20.4730	20.1124	19.5682	19.0799	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.9558	19.1817	19.4980	19.9186	20.2185	20.3738	20.4078	20.4047	20.3230	19.9624	19.4182	18.9299	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9548	0.9350	0.9027	0.8272	0.7018	0.5201	0.3679	0.4048	0.6259	0.8404	0.9288	0.9593	(94)
Useful gains	524.9248	565.9041	575.1297	563.0313	493.6220	359.7879	244.0295	254.9147	374.5378	468.0243	497.1504	509.9827	(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	983.0398	955.0863	866.6868	724.5493	558.6811	374.0326	246.6747	258.8373	405.0601	614.0247	812.1806	976.5664	(97)
Space heating kWh	340.8376	261.5304	216.9185	116.2929	48.4040	0.0000	0.0000	0.0000	0.0000	108.6243	226.8217	347.1382	(98a)
Space heating requirement - total per year (kWh/year)												1666.5677	
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	340.8376	261.5304	216.9185	116.2929	48.4040	0.0000	0.0000	0.0000	0.0000	108.6243	226.8217	347.1382	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1666.5677	
Space heating per m2											(98c) / (4) =	25.1065	(99)

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

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

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

Efficiency of main space heating system 1 (in %) 88.8000 (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	340.8376	261.5304	216.9185	116.2929	48.4040	0.0000	0.0000	0.0000	0.0000	108.6243	226.8217	347.1382	(98)
Space heating efficiency (main heating system 1)	88.8000	88.8000	88.8000	88.8000	88.8000	0.0000	0.0000	0.0000	0.0000	88.8000	88.8000	88.8000	(210)
Space heating fuel (main heating system)	383.8261	294.5162	244.2776	130.9605	54.5090	0.0000	0.0000	0.0000	0.0000	122.3246	255.4299	390.9214	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	248.4062	219.8228	233.6832	205.5872	199.4284	179.8333	177.4738	184.3753	186.2583	207.5582	220.5698	245.6901	(64)
Efficiency of water heater												79.8000	(216)
(217)m	84.7696	84.4504	83.8932	82.8331	81.4115	79.8000	79.8000	79.8000	79.8000	82.6788	84.1225	84.8347	(217)
Fuel for water heating, kWh/month	293.0369	260.2982	278.5486	248.1944	244.9633	225.3550	222.3983	231.0467	233.4063	251.0416	262.2007	289.6102	(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	21.6487	17.3674	15.6374	11.4567	8.8495	7.2301	8.0728	10.4933	13.6297	17.8830	20.1988	22.2504	(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 1876.7654 (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 3040.1002 (219)

Space cooling fuel 0.0000 (221)

Electricity for pumps and fans:

central heating pump 41.0000 (230c)

main heating flue fan 45.0000 (230e)

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

Electricity for lighting (calculated in Appendix L) 174.7178 (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	5177.5834	(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	1876.7654	0.2100	394.1207	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3040.1002	0.2100	638.4210	(264)
Space and water heating			1032.5418	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	174.7178	0.1443	25.2172	(268)
Total CO2, kg/year			1069.6882	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			16.1100	(273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	1876.7654	1.1300	2120.7449	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3040.1002	1.1300	3435.3132	(278)
Space and water heating			5556.0581	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	174.7178	1.5338	267.9880	(282)
Total Primary energy kWh/year			5954.1469	(286)
Dwelling Primary energy Rate (DPER)			89.7000	(287)

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Main dwelling						
Ground floor	66.3800	(1b)	x 2.4000	(2b) =	159.3120	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	66.3800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	159.3120	(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) =	0.1255 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.3755 (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) =	0.3474 (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	0.4429	0.4342	0.4255	0.3821	0.3734	0.3300	0.3300	0.3213	0.3474	0.3734	0.3908	0.4082	(22b)
Effective ac	0.5981	0.5943	0.5905	0.5730	0.5697	0.5545	0.5545	0.5516	0.5603	0.5697	0.5764	0.5833	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Main dwelling								
TER Opaque door			1.9800	1.0000	1.9800			(26)
TER Opening Type			8.4800	1.1450	9.7099			(27)
External Wall 1	57.9100	10.4600	47.4500	0.1800	8.5410			(29a)

External Roof 1	66.3800	66.3800	0.1100	7.3018	(30)
Total net area of external elements Aum(A, m2)		124.2900			(31)
Fabric heat loss, W/K = Sum (A x U)		(26)...(30) + (32) =		27.5327	(33)
Main dwelling					
Party Wall 1	23.6800	0.0000	0.0000		(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 164.4732 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	6.6400	0.0500	0.3320
E3 Sill	4.1700	0.0500	0.2085
E4 Jamb	16.2000	0.0500	0.8100
E5 Ground floor (normal)	24.1300	0.1600	3.8608
E7 Party floor between dwellings (in blocks of flats)	24.1300	0.0700	1.6891
E16 Corner (normal)	4.8000	0.0900	0.4320
P1 Party wall - Ground floor	9.8600	0.0800	0.7888
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	9.8600	0.0000	0.0000
E18 Party wall between dwellings	4.8000	0.0600	0.2880

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 8.4092 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 35.9419 (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	31.4429	31.2427	31.0464	30.1246	29.9521	29.1492	29.1492	29.0005	29.4584	29.9521	30.3010	30.6658	(38)
Heat transfer coeff	67.3848	67.1846	66.9883	66.0665	65.8940	65.0911	65.0911	64.9424	65.4004	65.8940	66.2429	66.6077	(39)
Average = Sum(39)m / 12 =												66.0657	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0151	1.0121	1.0092	0.9953	0.9927	0.9806	0.9806	0.9783	0.9852	0.9927	0.9979	1.0034	(40)
HLP (average)												0.9953	
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 2.1551 (42)

Hot water usage for mixer showers

60.3542	59.4472	58.1255	55.5967	53.7305	51.6494	50.4664	51.7781	53.2160	55.4505	58.0336	60.1230	(42a)

Hot water usage for baths

26.0775	25.6902	25.1448	24.1393	23.3863	22.5514	22.1004	22.6419	23.2316	24.1250	25.1513	25.9894	(42b)

Hot water usage for other uses

36.7008	35.3662	34.0316	32.6971	31.3625	30.0279	30.0279	31.3625	32.6971	34.0316	35.3662	36.7008	(42c)

Average daily hot water use (litres/day) 113.1869 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	123.1325	120.5037	117.3020	112.4331	108.4793	104.2286	102.5947	105.7825	109.1446	113.6072	118.5511	122.8131	(44)
Energy conte	195.0118	171.5956	180.2888	153.9152	146.0340	128.1613	124.0794	130.9809	134.5863	154.1638	168.8978	192.2957	(45)
Energy content (annual)										Total = Sum(45)m =		1880.0107	
Distribution loss (46)m = 0.15 x (45)m	29.2518	25.7393	27.0433	23.0873	21.9051	19.2242	18.6119	19.6471	20.1879	23.1246	25.3347	28.8444	(46)
Water storage loss:													
Store volume												250.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.8903	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.0208	(55)
Total storage loss	31.6444	28.5820	31.6444	30.6236	31.6444	30.6236	31.6444	31.6444	30.6236	31.6444	30.6236	31.6444	(56)
If cylinder contains dedicated solar storage	31.6444	28.5820	31.6444	30.6236	31.6444	30.6236	31.6444	31.6444	30.6236	31.6444	30.6236	31.6444	(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	249.9186	221.1888	235.1956	207.0508	200.9408	181.2969	178.9862	185.8877	187.7219	209.0706	222.0334	247.2025	(62)
WWHRS	-27.5914	-24.4021	-25.5525	-21.1584	-19.7189	-16.8736	-15.8163	-16.8191	-17.4581	-20.5812	-23.3160	-27.0805	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	222.3272	196.7868	209.6432	185.8924	181.2219	164.4233	163.1699	169.0686	170.2638	188.4895	198.7175	220.1220	(64)
										Total per year (kWh/year) = Sum(64)m =		2270.1258	(64)
12Total per year (kWh/year)												2270	(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	108.7669	96.7301	103.8715	93.6853	92.4817	85.1221	85.1818	87.4766	87.2584	95.1849	98.6670	107.8637	(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	107.7570	107.7570	107.7570	107.7570	107.7570	107.7570	107.7570	107.7570	107.7570	107.7570	107.7570	107.7570	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	104.1906	115.3539	104.1906	107.6636	104.1906	107.6636	104.1906	104.1906	107.6636	104.1906	107.6636	104.1906	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	188.7053	190.6635	185.7290	175.2239	161.9632	149.5000	141.1739	139.2157	144.1502	154.6552	167.9159	180.3791	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	33.7757	33.7757	33.7757	33.7757	33.7757	33.7757	33.7757	33.7757	33.7757	33.7757	33.7757	33.7757	(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)	-86.2056	-86.2056	-86.2056	-86.2056	-86.2056	-86.2056	-86.2056	-86.2056	-86.2056	-86.2056	-86.2056	-86.2056	(71)
Water heating gains (Table 5)	146.1920	143.9436	139.6122	130.1185	124.3034	118.2251	114.4917	117.5760	121.1922	127.9367	137.0375	144.9782	(72)
Total internal gains	497.4150	508.2881	487.8589	471.3331	448.7843	430.7159	415.1833	416.3094	428.3332	445.1096	470.9442	487.8750	(73)

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6. Solar gains

[Jan]	Area	Solar flux	g	FF	Access	Gains

	m2	Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c	factor Table 6d	W	
North	3.2100	10.6334	0.6300	0.7000	0.7700	10.4315	(74)
East	2.3900	19.6403	0.6300	0.7000	0.7700	14.3455	(76)
South	1.4400	46.7521	0.6300	0.7000	0.7700	20.5748	(78)
West	1.4400	19.6403	0.6300	0.7000	0.7700	8.6433	(80)

Solar gains	53.9952	98.6025	150.8588	210.9375	256.2250	262.6264	249.8034	215.1018	171.7027	113.4368	65.9212	45.3797	(83)
Total gains	551.4102	606.8906	638.7177	682.2706	705.0093	693.3423	664.9867	631.4113	600.0358	558.5464	536.8654	533.2547	(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	45.0057	45.1399	45.2721	45.9038	46.0240	46.5917	46.5917	46.6983	46.3713	46.0240	45.7815	45.5308	
alpha	4.0004	4.0093	4.0181	4.0603	4.0683	4.1061	4.1061	4.1132	4.0914	4.0683	4.0521	4.0354	
util living area	0.9698	0.9542	0.9276	0.8604	0.7428	0.5689	0.4229	0.4614	0.6762	0.8753	0.9499	0.9731	(86)
MIT	19.6471	19.8479	20.1309	20.5109	20.7947	20.9487	20.9880	20.9829	20.8949	20.5474	20.0547	19.6211	(87)
Th 2	20.0707	20.0732	20.0757	20.0873	20.0894	20.0995	20.0995	20.1014	20.0956	20.0894	20.0851	20.0805	(88)
util rest of house	0.9638	0.9453	0.9133	0.8331	0.6953	0.4992	0.3398	0.3762	0.6086	0.8452	0.9387	0.9677	(89)
MIT 2	18.5091	18.7622	19.1158	19.5829	19.9043	20.0643	20.0941	20.0930	20.0159	19.6365	19.0333	18.4833	(90)
Living area fraction									fLA = Living area / (4) =			0.5164	(91)
MIT	19.0968	19.3229	19.6400	20.0622	20.3641	20.5211	20.5557	20.5526	20.4698	20.1069	19.5608	19.0709	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.0968	19.3229	19.6400	20.0622	20.3641	20.5211	20.5557	20.5526	20.4698	20.1069	19.5608	19.0709	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9559	0.9367	0.9055	0.8323	0.7104	0.5326	0.3823	0.4196	0.6378	0.8459	0.9310	0.9603	(94)
Useful gains	527.1050	568.4586	578.3378	567.8429	500.8246	369.2468	254.2487	264.9477	382.6773	472.4504	499.8062	512.0874	(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	997.0810	968.9934	880.2267	737.4454	570.9120	385.4081	257.4809	269.6777	416.5880	626.4492	825.4391	990.5172	(97)
Space heating kWh	349.6621	269.1594	224.6054	122.1138	52.1451	0.0000	0.0000	0.0000	0.0000	114.5751	234.4557	355.9518	(98a)
Space heating requirement - total per year (kWh/year)												1722.6683	
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	349.6621	269.1594	224.6054	122.1138	52.1451	0.0000	0.0000	0.0000	0.0000	114.5751	234.4557	355.9518	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1722.6683	
Space heating per m2											(98c) / (4) =	25.9516	(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	349.6621	269.1594	224.6054	122.1138	52.1451	0.0000	0.0000	0.0000	0.0000	114.5751	234.4557	355.9518	(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)	378.8322	291.6137	243.3428	132.3010	56.4952	0.0000	0.0000	0.0000	0.0000	124.1333	254.0148	385.6465	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	222.3272	196.7868	209.6432	185.8924	181.2219	164.4233	163.1699	169.0686	170.2638	188.4895	198.7175	220.1220	(64)
Efficiency of water heater												79.8000	(216)
(217)m	85.0707	84.7626	84.2147	83.1408	81.6491	79.8000	79.8000	79.8000	79.8000	82.9795	84.4316	85.1313	(217)
Fuel for water heating, kWh/month	261.3439	232.1623	248.9390	223.5875	221.9521	206.0442	204.4735	211.8654	213.3631	227.1519	235.3590	258.5677	(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	21.6487	17.3674	15.6374	11.4567	8.8495	7.2301	8.0728	10.4933	13.6297	17.8830	20.1988	22.2504	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-31.2978	-44.2430	-63.7663	-71.9045	-77.7271	-72.6415	-71.7766	-67.6934	-60.4755	-50.7273	-34.4641	-27.0475	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-17.2989	-36.4434	-72.5248	-109.0484	-144.2923	-144.9963	-143.2577	-121.2168	-88.7661	-52.1178	-23.0992	-13.6727	(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												1866.3795	(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	2744.8097	(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)	174.7178	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-1640.4989	(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	3231.4082	(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	1866.3795	0.2100	391.9397	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2744.8097	0.2100	576.4100	(264)
Space and water heating			968.3497	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	174.7178	0.1443	25.2172	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-673.7645	0.1345	-90.6346	
PV Unit electricity exported	-966.7344	0.1259	-121.6811	
Total			-212.3156	(269)
Total CO2, kg/year			793.1806	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			11.9500	(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	1866.3795	1.1300	2109.0089	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2744.8097	1.1300	3101.6350	(278)
Space and water heating			5210.6439	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	174.7178	1.5338	267.9880	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-673.7645	1.4972	-1008.7319	
PV Unit electricity exported	-966.7344	0.4620	-446.6524	
Total			-1455.3843	(283)
Total Primary energy kWh/year			4153.3484	(286)
Target Primary Energy Rate (TPER)			62.5700	(287)

Building Regulations England Part L (BREL) Compliance Report

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

Date: Fri 14 Mar 2025 09:30:58

Project Information			
Assessed By	Richard Millard	Building Type	Flat, End-terrace
OCDEA Registration	EES/025661	Assessment Date	2025-03-14

Dwelling Details			
Assessment Type	As designed	Total Floor Area	66 m^2
Site Reference	A1M (GF)	Plot Reference	Proposed
Address	18		

Client Details	
Name	Ian White
Company	Cotswold Homes Ltd
Address	West House, Yate, Bristol, BS37 5NG

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

1a Target emission rate and dwelling emission rate		
Fuel for main heating system	Electricity	
Target carbon dioxide emission rate	*12.01 $kgCO_2/m^2$*	
Dwelling carbon dioxide emission rate	3.89 $kgCO_2/m^2$	OK
1b Target primary energy rate and dwelling primary energy		
Target primary energy	*62.88 kWh_{PE}/m^2*	
Dwelling primary energy	43.84 kWh_{PE}/m^2	OK
1c Target fabric energy efficiency and dwelling fabric energy efficiency		
Target fabric energy efficiency	*34.2 kWh/m^2*	
Dwelling fabric energy efficiency	33.8 kWh/m^2	OK

2a Fabric U-values				
Element	***Maximum permitted average U-Value [W/m^2K]***	**Dwelling average U-Value [W/m^2K]**	**Element with highest individual U-Value**	
External walls	*0.26*	0.18	Walls (1) (0.18)	OK
Party walls	*0.2*	0	Party Wall (1) (0)	**N/A**
Curtain walls	*1.6*	0	N/A	**N/A**
Floors	*0.18*	0.12	Heatloss Floor 1 (0.12)	OK
Roofs	*0.16*	N/A	N/A	**N/A**
Windows, doors, and roof windows	*1.6*	1.16	P-W01 (1.2)	OK
Rooflights	*2.2*	N/A	N/A	**N/A**

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))		
Name	**Net area [m^2]**	**U-Value [W/m^2K]**
Exposed wall: Walls (1)	47.45	0.18
Party wall: Party Wall (1)	23.68	0 **(!)**
Ground floor: Heatloss Floor 1, Heatloss Floor 1	66.38	0.12

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	**Area [m^2]**	**Orientation**	**Frame factor**	**U-Value [W/m^2K]**
P-W01, Windows	2.39	East	0.7	1.2
P-W02, Windows	1.44	South	0.7	1.2
P-ED01, Solid Doors	1.98	East	N/A	1 **(!)**
P-W03, Windows	1.44	West	0.7	1.2
P-ED02, Windows	3.21	North	0.7	1.2

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))				
Building part **1**: Thermal bridging calculated from linear thermal transmittances for each junction				
Main element	**Junction detail**	**Source**	**Psi value [W/mK]**	**Drawing / reference**
External wall	E1: Steel lintel with perforated steel base plate	Not government-approved scheme	0.241	EMPF125E101
External wall	E3: Sill	Not government-approved scheme	0.026 **(!)**	EMPF125E301

Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E4: Jamb	Not government-approved scheme	0.02 **(!)**	EMPF125E401
External wall	E5: Ground floor (normal)	Not government-approved scheme	0.045	EMPF125E504
External wall	E7: Party floor between dwellings (in blocks of flats)	Calculated by person with suitable expertise	0.044	EMPF125E701
External wall	E16: Corner (normal)	Not government-approved scheme	0.037 **(!)**	EMPF125E21601
Party wall	P1: Ground floor	SAP table default	0.32	
Party wall	P3: Intermediate floor between dwellings (in blocks of flats)	SAP table default	0 **(!)**	
External wall	E18: Party wall between dwellings	SAP table default	0.24	EMPF125E21802

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

4 Space heating	
Main heating system 1: Heat pump with radiators or underfloor heating - Electricity	
Efficiency	234.2%
Emitter type	Radiators
Flow temperature	55°C
System type	Heat Pump
Manufacturer	Daikin Europe NV
Model	EDLA08EV3
Commissioning	
Secondary heating system: N/A	
Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water	
Cylinder/store - type: Cylinder	
Capacity	210 litres
Declared heat loss	1.7 kWh/day
Primary pipework insulated	Yes
Manufacturer	
Model	
Commissioning	
Waste water heat recovery system 1 - type: N/A	
Efficiency	
Manufacturer	
Model	

6 Controls	
Main heating 1 - type: Time and temperature zone control by arrangement of plumbing and electrical services	
Function	
Ecodesign class	
Manufacturer	
Model	
Water heating - type: Cylinder thermostat and HW separately timed	
Manufacturer	
Model	

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

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

9 Local generation	
Technology type: **Photovoltaic system (1)**	
Peak power	1.005 kWp
Orientation	East
Pitch	30°
Overshading	None or very little
Manufacturer	
MCS certificate	

10 Heat networks
N/A

11 Supporting documentary evidence
N/A

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

Full SAP Calculation Printout

Property Reference	A1M (GF)	**Issued on Date**	14/03/2025
Assessment Reference	Proposed	**Prop Type Ref**	18
Property	18		

SAP Rating	84 B	**DER**	3.89	**TER**	12.01
Environmental	97 A	**% DER < TER**			67.61
CO_2 Emissions (t/year)	0.23	**DFEE**	33.80	**TFEE**	34.15
Compliance Check	See BREL	**% DFEE < TFEE**			1.02
% DPER < TPER	30.28	**DPER**	43.84	**TPER**	62.88

Assessor Details	Mr. Richard Millard	**Assessor ID**	U367-0001
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)	
Main dwelling						
Ground floor	66.3800	(1b)	x 2.4000	(2b) =	159.3120	(1b) - (3b) (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	66.3800					
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	159.3120	(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) =	0.1255 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.3755 (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) =	0.3474 (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	0.4429	0.4342	0.4255	0.3821	0.3734	0.3300	0.3300	0.3213	0.3474	0.3734	0.3908	0.4082	(22b)
Effective ac	0.5981	0.5943	0.5905	0.5730	0.5697	0.5545	0.5545	0.5516	0.5603	0.5697	0.5764	0.5833	(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	
Main dwelling								
Solid Doors			1.9800	1.0000	1.9800			(26)
Windows			8.4800	1.1450	9.7099			(27)
Heatloss Floor 1			66.3800	0.1200	7.9656	75.0000	4978.5000	(28a)
External Wall 1	57.9100	10.4600	47.4500	0.1800	8.5410	60.0000	2847.0000	(29a)
Total net area of external elements Aum(A, m2)			124.2900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		28.1965			(33)
Main dwelling								
Party Wall 1			23.6800	0.0000	0.0000	140.0000	3315.2000	(32)
Party Ceiling 1			66.3800			30.0000	1991.4000	(32b)
Internal Wall 2			100.6100			9.0000	905.4900	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	14037.5900 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		211.4732 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	6.6400	0.2410	1.6002
E3 Sill	4.1700	0.0260	0.1084
E4 Jamb	16.2000	0.0200	0.3240
E5 Ground floor (normal)	24.1300	0.0450	1.0858
E7 Party floor between dwellings (in blocks of flats)	24.1300	0.0440	1.0617

E16 Corner (normal)	4.8000	0.0370	0.1776	
P1 Party wall - Ground floor	9.8600	0.3200	3.1552	
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	9.8600	0.0000	0.0000	
E18 Party wall between dwellings	4.8000	0.2400	1.1520	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 8.6650 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 36.8616 (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	31.4429	31.2427	31.0464	30.1246	29.9521	29.1492	29.1492	29.0005	29.4584	29.9521	30.3010	30.6658	(38)
Heat transfer coeff	68.3045	68.1042	67.9080	66.9861	66.8136	66.0107	66.0107	65.8620	66.3200	66.8136	67.1625	67.5273	(39)

Average = Sum(39)m / 12 = 66.9853

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0290	1.0260	1.0230	1.0091	1.0065	0.9944	0.9944	0.9922	0.9991	1.0065	1.0118	1.0173	(40)
HLP (average)												1.0091	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.1551 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	60.3542	59.4472	58.1255	55.5967	53.7305	51.6494	50.4664	51.7781	53.2160	55.4505	58.0336	60.1230	(42a)
Hot water usage for baths	26.0775	25.6902	25.1448	24.1393	23.3863	22.5514	22.1004	22.6419	23.2316	24.1250	25.1513	25.9894	(42b)
Hot water usage for other uses	36.7008	35.3662	34.0316	32.6971	31.3625	30.0279	30.0279	31.3625	32.6971	34.0316	35.3662	36.7008	(42c)

Average daily hot water use (litres/day) 113.1869 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	123.1325	120.5037	117.3020	112.4330	108.4793	104.2286	102.5947	105.7825	109.1446	113.6071	118.5511	122.8131	(44)
Energy conte	195.0118	171.5956	180.2888	153.9152	146.0340	128.1613	124.0794	130.9809	134.5862	154.1638	168.8978	192.2957	(45)

Energy content (annual) Total = Sum(45)m = 1880.0107

Distribution loss (46)m = 0.15 x (45)m	29.2518	25.7393	27.0433	23.0873	21.9051	19.2242	18.6119	19.6471	20.1879	23.1246	25.3347	28.8444	(46)

Water storage loss:
Store volume 210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.7000 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 0.9180 (55)

Total storage loss	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(56)
If cylinder contains dedicated solar storage	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(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	246.7322	218.3108	232.0092	203.9672	197.7544	178.2133	175.7998	182.7013	184.6382	205.8842	218.9498	244.0161	(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	246.7322	218.3108	232.0092	203.9672	197.7544	178.2133	175.7998	182.7013	184.6382	205.8842	218.9498	244.0161	(64)

Total per year (kWh/year) = Sum(64)m = 2488.9767 (64)
12Total per year (kWh/year) 2489 (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	106.2178	94.4277	101.3224	91.2184	89.9326	82.6552	82.6327	84.9275	84.7915	92.6358	96.2001	105.3146	(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	107.7570	107.7570	107.7570	107.7570	107.7570	107.7570	107.7570	107.7570	107.7570	107.7570	107.7570	107.7570	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	104.1906	115.3539	104.1906	107.6636	104.1906	107.6636	104.1906	104.1906	107.6636	104.1906	107.6636	104.1906	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	188.7053	190.6635	185.7290	175.2239	161.9632	149.5000	141.1739	139.2157	144.1502	154.6552	167.9159	180.3791	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	33.7757	33.7757	33.7757	33.7757	33.7757	33.7757	33.7757	33.7757	33.7757	33.7757	33.7757	33.7757	(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)	-86.2056	-86.2056	-86.2056	-86.2056	-86.2056	-86.2056	-86.2056	-86.2056	-86.2056	-86.2056	-86.2056	-86.2056	(71)
Water heating gains (Table 5)	142.7658	140.5174	136.1860	126.6922	120.8772	114.7989	111.0655	114.1498	117.7660	124.5105	133.6113	141.5519	(72)
Total internal gains	490.9888	501.8619	481.4326	464.9069	442.3581	427.2897	411.7570	412.8832	424.9069	438.6834	464.5179	481.4488	(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	3.2100	10.6334	0.6300	0.7000	0.7700	10.4315	(74)
East	2.3900	19.6403	0.6300	0.7000	0.7700	14.3455	(76)
South	1.4400	46.7521	0.6300	0.7000	0.7700	20.5748	(78)
West	1.4400	19.6403	0.6300	0.7000	0.7700	8.6433	(80)

Solar gains	53.9952	98.6025	150.8588	210.9375	256.2250	262.6264	249.8034	215.1018	171.7027	113.4368	65.9212	45.3797	(83)
Total gains	544.9840	600.4644	632.2914	675.8444	698.5831	689.9161	661.5605	627.9850	596.6096	552.1202	530.4392	526.8284	(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	57.0875	57.2553	57.4208	58.2110	58.3613	59.0712	59.0712	59.2045	58.7957	58.3613	58.0581	57.7445	
alpha	4.8058	4.8170	4.8281	4.8807	4.8908	4.9381	4.9381	4.9470	4.9197	4.8908	4.8705	4.8496	
util living area	0.9848	0.9744	0.9544	0.8957	0.7782	0.5901	0.4348	0.4756	0.7058	0.9101	0.9715	0.9869	(86)
Living	19.8607	20.0347	20.2800	20.6114	20.8527	20.9708	20.9946	20.9918	20.9307	20.6354	20.2081	19.8379	
Non living	18.7477	18.9685	19.2763	19.6843	19.9523	20.0702	20.0860	20.0865	20.0362	19.7218	19.1978	18.7260	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	20.4172	20.0347	20.2800	20.6114	20.8527	20.9708	20.9946	20.9918	20.9307	20.6354	20.2081	20.0005	(87)
Th 2	20.0592	20.0617	20.0642	20.0757	20.0779	20.0880	20.0880	20.0898	20.0841	20.0779	20.0735	20.0690	(88)
util rest of house	0.9809	0.9679	0.9426	0.8694	0.7273	0.5145	0.3468	0.3848	0.6323	0.8817	0.9631	0.9835	(89)
MIT 2	19.5364	18.9685	19.2763	19.6843	19.9523	20.0702	20.0860	20.0865	20.0362	19.7218	19.1978	18.9680	(90)
Living area fraction										fLA = Living area / (4) =		0.5164	(91)
MIT	19.9912	19.5191	19.7946	20.1631	20.4173	20.5353	20.5552	20.5540	20.4982	20.1936	19.7196	19.5012	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.9912	19.5191	19.7946	20.1631	20.4173	20.5353	20.5552	20.5540	20.4982	20.1936	19.7196	19.5012	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9806	0.9633	0.9386	0.8722	0.7471	0.5523	0.3922	0.4316	0.6669	0.8858	0.9592	0.9809	(94)
Useful gains	534.3918	578.4421	593.4817	589.4586	521.9010	381.0631	259.4784	271.0414	397.8911	489.0418	508.8114	516.7866	(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	1071.7818	995.6227	902.8109	754.4705	582.4339	391.7911	261.0876	273.5921	424.3259	640.9813	847.5634	1033.2479	(97)
Space heating kWh	399.8182	280.3453	230.1409	118.8086	45.0365	0.0000	0.0000	0.0000	0.0000	113.0430	243.9014	384.2472	(98a)
Space heating requirement - total per year (kWh/year)												1815.3410	
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	399.8182	280.3453	230.1409	118.8086	45.0365	0.0000	0.0000	0.0000	0.0000	113.0430	243.9014	384.2472	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1815.3410	
Space heating per m2											(98c) / (4) =	27.3477	(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 %) 234.2082 (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	399.8182	280.3453	230.1409	118.8086	45.0365	0.0000	0.0000	0.0000	0.0000	113.0430	243.9014	384.2472	(98)
Space heating efficiency (main heating system 1)	234.2082	234.2082	234.2082	234.2082	234.2082	0.0000	0.0000	0.0000	0.0000	234.2082	234.2082	234.2082	(210)
Space heating fuel (main heating system)	170.7105	119.6992	98.2634	50.7277	19.2292	0.0000	0.0000	0.0000	0.0000	48.2660	104.1387	164.0622	(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	246.7322	218.3108	232.0092	203.9672	197.7544	178.2133	175.7998	182.7013	184.6382	205.8842	218.9498	244.0161	(64)
Efficiency of water heater												171.1775	(216)
(217)m	171.1775	171.1775	171.1775	171.1775	171.1775	171.1775	171.1775	171.1775	171.1775	171.1775	171.1775	171.1775	(217)
Fuel for water heating, kWh/month	144.1382	127.5348	135.5372	119.1554	115.5259	104.1102	102.7003	106.7321	107.8636	120.2753	127.9081	142.5515	(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	21.6487	17.3674	15.6374	11.4567	8.8495	7.2301	8.0728	10.4933	13.6297	17.8830	20.1988	22.2504	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-13.4804	-22.6923	-39.4094	-51.7007	-61.0304	-58.2301	-57.0885	-50.5980	-39.8455	-28.1502	-15.7738	-11.1412	(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	-2.4355	-6.3709	-16.1888	-30.7554	-47.0683	-50.4390	-49.1461	-38.1899	-24.0259	-10.7147	-3.6119	-1.8280	(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 1 775.0970 (211)

Space heating fuel - main system 2 0.0000 (213)

Space heating fuel - secondary 0.0000 (215)

Efficiency of water heater 171.1775

Water heating fuel used 1454.0326 (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) 174.7178 (232)

Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-729.9148	(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	1673.9325	(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	775.0970	0.1559	120.8356	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1454.0326	0.1409	204.8397	(264)
Space and water heating			325.6753	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	174.7178	0.1443	25.2172	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-449.1405	0.1318	-59.1858	
PV Unit electricity exported	-280.7743	0.1204	-33.8099	
Total			-92.9957	(269)
Total CO2, kg/year			257.8968	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			3.8900	(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	775.0970	1.5771	1222.4393	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1454.0326	1.5209	2211.4539	(278)
Space and water heating			3433.8932	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	174.7178	1.5338	267.9880	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-449.1405	1.4869	-667.8121	
PV Unit electricity exported	-280.7743	0.4417	-124.0212	
Total			-791.8333	(283)
Total Primary energy kWh/year			2910.0478	(286)
Dwelling Primary energy Rate (DPER)			43.8400	(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)	
Main dwelling							
Ground floor		66.3800	(1b)	x 2.4000	(2b) =	159.3120	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	66.3800						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	159.3120	(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) =	0.1255	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3755	(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) =	0.3474	(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	0.4429	0.4342	0.4255	0.3821	0.3734	0.3300	0.3300	0.3213	0.3474	0.3734	0.3908	0.4082	(22b)
Effective ac	0.5981	0.5943	0.5905	0.5730	0.5697	0.5545	0.5545	0.5516	0.5603	0.5697	0.5764	0.5833	(25)

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3. Heat losses and heat loss parameter

Element	Gross	Openings	NetArea	U-value	A x U	K-value	A x K	
Main dwelling	m2	m2	m2	W/m2K	W/K	kJ/m2K	kJ/K	
TER Opaque door			1.9800	1.0000	1.9800			(26)
TER Opening Type			8.4800	1.1450	9.7099			(27)
Heatloss Floor 1			66.3800	0.1300	8.6294			(28a)
External Wall 1	57.9100	10.4600	47.4500	0.1800	8.5410			(29a)
Total net area of external elements Aum(A, m2)			124.2900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		28.8603			(33)
Main dwelling								
Party Wall 1			23.6800	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 221.4732 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	6.6400	0.0500	0.3320
E3 Sill	4.1700	0.0500	0.2085
E4 Jamb	16.2000	0.0500	0.8100
E5 Ground floor (normal)	24.1300	0.1600	3.8608
E7 Party floor between dwellings (in blocks of flats)	24.1300	0.0700	1.6891
E16 Corner (normal)	4.8000	0.0900	0.4320
P1 Party wall - Ground floor	9.8600	0.0800	0.7888
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	9.8600	0.0000	0.0000
E18 Party wall between dwellings	4.8000	0.0600	0.2880

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 8.4092 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 37.2695 (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	31.4429	31.2427	31.0464	30.1246	29.9521	29.1492	29.1492	29.0005	29.4584	29.9521	30.3010	30.6658	(38)
Heat transfer coeff	68.7124	68.5122	68.3159	67.3941	67.2216	66.4187	66.4187	66.2700	66.7280	67.2216	67.5705	67.9353	(39)
Average = Sum(39)m / 12 =												67.3933	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0351	1.0321	1.0292	1.0153	1.0127	1.0006	1.0006	0.9983	1.0052	1.0127	1.0179	1.0234	(40)
HLP (average)												1.0153	
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 2.1551 (42)

Hot water usage for mixer showers

60.3542	59.4472	58.1255	55.5967	53.7305	51.6494	50.4664	51.7781	53.2160	55.4505	58.0336	60.1230	(42a)

Hot water usage for baths

26.0775	25.6902	25.1448	24.1393	23.3863	22.5514	22.1004	22.6419	23.2316	24.1250	25.1513	25.9894	(42b)

Hot water usage for other uses

36.7008	35.3662	34.0316	32.6971	31.3625	30.0279	30.0279	31.3625	32.6971	34.0316	35.3662	36.7008	(42c)

Average daily hot water use (litres/day) 113.1869 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	123.1325	120.5037	117.3020	112.4330	108.4793	104.2286	102.5947	105.7825	109.1446	113.6071	118.5511	122.8131	(44)
Energy conte	195.0118	171.5956	180.2888	153.9152	146.0340	128.1613	124.0794	130.9809	134.5862	154.1638	168.8978	192.2957	(45)
Energy content (annual)										Total = Sum(45)m =		1880.0107	
Distribution loss (46)m = 0.15 x (45)m	29.2518	25.7393	27.0433	23.0873	21.9051	19.2242	18.6119	19.6471	20.1879	23.1246	25.3347	28.8444	(46)

Water storage loss:

Store volume 210.0000 (47)

a) If manufacturer declared loss factor is known (kWh/day): 1.7016 (48)

Temperature factor from Table 2b 0.5400 (49)

Enter (49) or (54) in (55) 0.9188 (55)

Total storage loss

28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(56)

If cylinder contains dedicated solar storage

28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(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

246.7584	218.3345	232.0354	203.9926	197.7806	178.2386	175.8260	182.7275	184.6636	205.9104	218.9752	244.0423	(62)
WWHRS -27.5914	-24.4021	-25.5525	-21.1584	-19.7189	-16.8736	-15.8163	-16.8191	-17.4581	-20.5812	-23.3160	-27.0805	(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													
219.1670	193.9324	206.4830	182.8341	178.0617	161.3650	160.0097	165.9084	167.2055	185.3293	195.6592	216.9618	(64)
								Total per year (kWh/year) = Sum(64)m =			2232.9170	(64)
12Total per year (kWh/year)											2233	(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

106.2387	94.4466	101.3433	91.2387	89.9536	82.6755	82.6537	84.9484	84.8118	92.6567	96.2204	105.3356	(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	107.7570	107.7570	107.7570	107.7570	107.7570	107.7570	107.7570	107.7570	107.7570	107.7570	107.7570	107.7570	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	104.1906	115.3539	104.1906	107.6636	104.1906	107.6636	104.1906	104.1906	107.6636	104.1906	107.6636	104.1906	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	188.7053	190.6635	185.7290	175.2239	161.9632	149.5000	141.1739	139.2157	144.1502	154.6552	167.9159	180.3791	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	33.7757	33.7757	33.7757	33.7757	33.7757	33.7757	33.7757	33.7757	33.7757	33.7757	33.7757	33.7757	(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)													
-86.2056	-86.2056	-86.2056	-86.2056	-86.2056	-86.2056	-86.2056	-86.2056	-86.2056	-86.2056	-86.2056	-86.2056	(71)	

Water heating gains (Table 5)

	142.7940	140.5456	136.2141	126.7204	120.9053	114.8271	111.0937	114.1780	117.7942	124.5386	133.6395	141.5801 (72)

Total internal gains

	494.0170	504.8900	484.4608	467.9350	445.3863	427.3178	411.7852	412.9114	424.9351	441.7116	467.5461	484.4769 (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	3.2100	10.6334	0.6300	0.7000	0.7700	10.4315	(74)
East	2.3900	19.6403	0.6300	0.7000	0.7700	14.3455	(76)
South	1.4400	46.7521	0.6300	0.7000	0.7700	20.5748	(78)
West	1.4400	19.6403	0.6300	0.7000	0.7700	8.6433	(80)

Solar gains	53.9952	98.6025	150.8588	210.9375	256.2250	262.6264	249.8034	215.1018	171.7027	113.4368	65.9212	45.3797	(83)
Total gains	548.0122	603.4926	635.3196	678.8726	701.6112	689.9442	661.5886	628.0132	596.6378	555.1484	533.4673	529.8566	(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	59.4320	59.6057	59.7770	60.5946	60.7501	61.4845	61.4845	61.6224	61.1995	60.7501	60.4364	60.1119	
alpha	4.9621	4.9737	4.9851	5.0396	5.0500	5.0990	5.0990	5.1082	5.0800	5.0500	5.0291	5.0075	
util living area	0.9865	0.9768	0.9579	0.9007	0.7831	0.5950	0.4379	0.4791	0.7122	0.9145	0.9740	0.9884	(86)
MIT	19.8974	20.0664	20.3051	20.6278	20.8618	20.9733	20.9953	20.9928	20.9351	20.6507	20.2349	19.8752	(87)
Th 2	20.0542	20.0567	20.0591	20.0706	20.0728	20.0828	20.0828	20.0847	20.0790	20.0728	20.0684	20.0639	(88)
util rest of house	0.9829	0.9707	0.9464	0.8744	0.7314	0.5180	0.3486	0.3869	0.6373	0.8863	0.9661	0.9853	(89)
MIT 2	18.7862	19.0008	19.3005	19.6979	19.9564	20.0670	20.0812	20.0819	20.0350	19.7338	19.2240	18.7653	(90)
Living area fraction									fLA = Living area / (4) =			0.5164	(91)
MIT	19.3600	19.5511	19.8193	20.1781	20.4240	20.5351	20.5533	20.5523	20.4998	20.2073	19.7461	19.3385	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.3600	19.5511	19.8193	20.1781	20.4240	20.5351	20.5533	20.5523	20.4998	20.2073	19.7461	19.3385	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9795	0.9667	0.9430	0.8778	0.7521	0.5568	0.3947	0.4345	0.6729	0.8909	0.9627	0.9822	(94)
Useful gains	536.7583	583.3701	599.1170	595.8944	527.6470	384.1340	261.1429	272.8732	401.5015	494.5975	513.5559	520.4024	(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	1034.8123	1003.7802	909.9193	760.0796	586.4408	394.1986	262.5711	275.1717	427.0469	645.8166	854.5019	1028.4390	(97)
Space heating kWh	370.5522	282.5156	231.2369	118.2133	43.7426	0.0000	0.0000	0.0000	0.0000	112.5070	245.4811	377.9792	(98a)
Space heating requirement - total per year (kWh/year)												1782.2280	
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	370.5522	282.5156	231.2369	118.2133	43.7426	0.0000	0.0000	0.0000	0.0000	112.5070	245.4811	377.9792	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1782.2280	
Space heating per m2											(98c) / (4) =	26.8489	(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	370.5522	282.5156	231.2369	118.2133	43.7426	0.0000	0.0000	0.0000	0.0000	112.5070	245.4811	377.9792	(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)	401.4650	306.0841	250.5275	128.0751	47.3918	0.0000	0.0000	0.0000	0.0000	121.8927	265.9600	409.5116	(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	219.1670	193.9324	206.4830	182.8341	178.0617	161.3650	160.0097	165.9084	167.2055	185.3293	195.6592	216.9618	(64)
Efficiency of water heater												79.8000	(216)
(217)m	85.2277	84.9024	84.3143	83.1075	81.4276	79.8000	79.8000	79.8000	79.8000	82.9768	84.5696	85.2920	(217)
Fuel for water heating, kWh/month	257.1547	228.4179	244.8967	219.9971	218.6750	202.2118	200.5134	207.9053	209.5307	223.3507	231.3587	254.3753	(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	21.6487	17.3674	15.6374	11.4567	8.8495	7.2301	8.0728	10.4933	13.6297	17.8830	20.1988	22.2504	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-31.2978	-44.2430	-63.7663	-71.9045	-77.7271	-72.6415	-71.7766	-67.6934	-60.4755	-50.7273	-34.4641	-27.0475	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)

Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-17.2989	-36.4434	-72.5248	-109.0484	-144.2923	-144.9963	-143.2577	-121.2168	-88.7661	-52.1178	-23.0992	-13.6727	(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	1930.9079	(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	2698.3872	(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)	174.7178	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-1640.4988	(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	3249.5141	(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	1930.9079	0.2100	405.4907	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2698.3872	0.2100	566.6613	(264)
Space and water heating			972.1520	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	174.7178	0.1443	25.2172	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-673.7644	0.1345	-90.6346	
PV Unit electricity exported	-966.7344	0.1259	-121.6811	
Total			-212.3156	(269)
Total CO2, kg/year			796.9828	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			12.0100	(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	1930.9079	1.1300	2181.9259	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2698.3872	1.1300	3049.1776	(278)
Space and water heating			5231.1035	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	174.7178	1.5338	267.9880	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-673.7644	1.4972	-1008.7319	
PV Unit electricity exported	-966.7344	0.4620	-446.6524	
Total			-1455.3842	(283)
Total Primary energy kWh/year			4173.8080	(286)
Target Primary Energy Rate (TPER)			62.8800	(287)

Building Regulations England Part L (BREL) Compliance Report

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

Date: Fri 14 Mar 2025 09:30:58

Project Information			
Assessed By	Richard Millard	Building Type	Flat, End-terrace
OCDEA Registration	EES/025661	Assessment Date	2025-03-14

Dwelling Details			
Assessment Type	As designed	Total Floor Area	66 m^2
Site Reference	A1M (GF)	Plot Reference	Regulated (Baseline)
Address	18		

Client Details	
Name	Ian White
Company	Cotswold Homes Ltd
Address	West House, Yate, Bristol, BS37 5NG

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

1a Target emission rate and dwelling emission rate		
Fuel for main heating system	Mains gas	
Target carbon dioxide emission rate	*12.01 $kgCO_2/m^2$*	
Dwelling carbon dioxide emission rate	16.23 $kgCO_2/m^2$	**FAIL**
1b Target primary energy rate and dwelling primary energy		
Target primary energy	*62.88 kWh_{PE}/m^2*	
Dwelling primary energy	90.32 kWh_{PE}/m^2	**FAIL**
1c Target fabric energy efficiency and dwelling fabric energy efficiency		
Target fabric energy efficiency	*34.2 kWh/m^2*	
Dwelling fabric energy efficiency	33.9 kWh/m^2	**OK**

2a Fabric U-values				
Element	***Maximum permitted average U-Value [W/m^2K]***	**Dwelling average U-Value [W/m^2K]**	**Element with highest individual U-Value**	
External walls	*0.26*	0.18	Walls (1) (0.18)	**OK**
Party walls	*0.2*	0	Party Wall (1) (0)	**N/A**
Curtain walls	*1.6*	0	N/A	**N/A**
Floors	*0.18*	0.13	Heatloss Floor 1 (0.13)	**OK**
Roofs	*0.16*	N/A	N/A	**N/A**
Windows, doors, and roof windows	*1.6*	1.16	P-W01 (1.2)	**OK**
Rooflights	*2.2*	N/A	N/A	**N/A**

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))		
Name	**Net area [m^2]**	**U-Value [W/m^2K]**
Exposed wall: Walls (1)	47.45	0.18
Party wall: Party Wall (1)	23.68	0 **(!)**
Ground floor: Heatloss Floor 1, Heatloss Floor 1	66.38	0.13

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	**Area [m^2]**	**Orientation**	**Frame factor**	**U-Value [W/m^2K]**
P-W01, Windows	2.39	East	0.7	1.2
P-W02, Windows	1.44	South	0.7	1.2
P-ED01, Solid Doors	1.98	East	N/A	1 **(!)**
P-W03, Windows	1.44	West	0.7	1.2
P-ED02, Windows	3.21	North	0.7	1.2

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))				
Building part **1**: Thermal bridging calculated from linear thermal transmittances for each junction				
Main element	**Junction detail**	**Source**	**Psi value [W/mK]**	**Drawing / reference**
External wall	E2: Other lintels (including other steel lintels)	Not government-approved scheme	0.05	MCPF-125-E2-01
External wall	E3: Sill	Not government-approved scheme	0.05	MCPF-125-E3-01

Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E4: Jamb	Not government-approved scheme	0.022 **(!)**	MCPF-125-E4-01
External wall	E5: Ground floor (normal)	Not government-approved scheme	0.16	MCPF-125-E5-04
External wall	E7: Party floor between dwellings (in blocks of flats)	Calculated by person with suitable expertise	0.07	MCPF-125-E6-01
External wall	E16: Corner (normal)	Not government-approved scheme	0.09	MCPF-125-E16-01
Party wall	P1: Ground floor	Calculated by person with suitable expertise	0.08	
Party wall	P3: Intermediate floor between dwellings (in blocks of flats)	SAP table default	0 **(!)**	
External wall	E18: Party wall between dwellings	Calculated by person with suitable expertise	0.09	

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

4 Space heating	
Main heating system 1: Boiler with radiators or underfloor heating - Mains gas	
Efficiency	88.8%
Emitter type	Radiators
Flow temperature	55°C
System type	Regular boiler
Manufacturer	Bosch Thermotechnology
Model	Greenstar 8000 Life
Commissioning	
Secondary heating system: N/A	
Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water	
Cylinder/store - type: Cylinder	
Capacity	210 litres
Declared heat loss	1.7 kWh/day
Primary pipework insulated	Yes
Manufacturer	
Model	
Commissioning	
Waste water heat recovery system 1 - type: N/A	
Efficiency	
Manufacturer	
Model	

6 Controls	
Main heating 1 - type: Time and temperature zone control by arrangement of plumbing and electrical services	
Function	
Ecodesign class	
Manufacturer	
Model	
Water heating - type: Cylinder thermostat and HW separately timed	
Manufacturer	
Model	

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

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

9 Local generation
N/A

10 Heat networks
N/A

11 Supporting documentary evidence
N/A

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

Full SAP Calculation Printout

Property Reference	A1M (GF)	**Issued on Date**	14/03/2025
Assessment Reference	Regulated (Baseline)	**Prop Type Ref**	18
Property	18		

SAP Rating	84 B	**DER**	16.23	**TER**	12.01
Environmental	87 B	**% DER < TER**			-35.14
CO_2 Emissions (t/year)	1.01	**DFEE**	33.89	**TFEE**	34.15
Compliance Check	See BREL	**% DFEE < TFEE**			0.78
% DPER < TPER	-43.63	**DPER**	90.32	**TPER**	62.88

Assessor Details	Mr. Richard Millard	**Assessor ID**	U367-0001
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)	
Main dwelling						
Ground floor	66.3800	(1b)	x 2.4000	(2b) =	159.3120	(1b) - (3b) (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	66.3800					
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	159.3120	(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) =	0.1255	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3755	(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) =	0.3474	(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	0.4429	0.4342	0.4255	0.3821	0.3734	0.3300	0.3300	0.3213	0.3474	0.3734	0.3908	0.4082	(22b)
Effective ac	0.5981	0.5943	0.5905	0.5730	0.5697	0.5545	0.5545	0.5516	0.5603	0.5697	0.5764	0.5833	(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	
Main dwelling								
Solid Doors			1.9800	1.0000	1.9800			(26)
Windows			8.4800	1.1450	9.7099			(27)
Heatloss Floor 1			66.3800	0.1300	8.6294	75.0000	4978.5000	(28a)
External Wall 1	57.9100	10.4600	47.4500	0.1800	8.5410	60.0000	2847.0000	(29a)
Total net area of external elements Aum(A, m2)			124.2900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		28.8603			(33)
Main dwelling								
Party Wall 1			23.6800	0.0000	0.0000	140.0000	3315.2000	(32)
Party Ceiling 1			66.3800			30.0000	1991.4000	(32b)
Internal Wall 2			100.6100			9.0000	905.4900	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	14037.5900 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		211.4732 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	6.6400	0.0500	0.3320
E3 Sill	4.1700	0.0500	0.2085
E4 Jamb	16.2000	0.0220	0.3564
E5 Ground floor (normal)	24.1300	0.1600	3.8608
E7 Party floor between dwellings (in blocks of flats)	24.1300	0.0700	1.6891

E16 Corner (normal)	4.8000	0.0900	0.4320		
P1 Party wall - Ground floor	9.8600	0.0800	0.7888		
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	9.8600	0.0000	0.0000		
E18 Party wall between dwellings	4.8000	0.0900	0.4320		
Thermal bridges (Sum(L x Psi) calculated using Appendix K)				8.0996	(36)
Point Thermal bridges			(36a) =	0.0000	
Total fabric heat loss			(33) + (36) + (36a) =	36.9599	(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	31.4429	31.2427	31.0464	30.1246	29.9521	29.1492	29.1492	29.0005	29.4584	29.9521	30.3010	30.6658	(38)
Heat transfer coeff	68.4028	68.2026	68.0063	67.0845	66.9120	66.1091	66.1091	65.9604	66.4184	66.9120	67.2609	67.6257	(39)
Average = Sum(39)m / 12 =												67.0837	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0305	1.0275	1.0245	1.0106	1.0080	0.9959	0.9959	0.9937	1.0006	1.0080	1.0133	1.0188	(40)
HLP (average)												1.0106	
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												2.1551	(42)
Hot water usage for mixer showers	60.3542	59.4472	58.1255	55.5967	53.7305	51.6494	50.4664	51.7781	53.2160	55.4505	58.0336	60.1230	(42a)
Hot water usage for baths	26.0775	25.6902	25.1448	24.1393	23.3863	22.5514	22.1004	22.6419	23.2316	24.1250	25.1513	25.9894	(42b)
Hot water usage for other uses	36.7008	35.3662	34.0316	32.6971	31.3625	30.0279	30.0279	31.3625	32.6971	34.0316	35.3662	36.7008	(42c)
Average daily hot water use (litres/day)												113.1869	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	123.1325	120.5037	117.3020	112.4331	108.4793	104.2286	102.5947	105.7825	109.1446	113.6072	118.5511	122.8131	(44)
Energy conte	195.0118	171.5956	180.2888	153.9152	146.0340	128.1613	124.0794	130.9809	134.5863	154.1638	168.8978	192.2957	(45)
Energy content (annual)										Total = Sum(45)m =		1880.0107	
Distribution loss (46)m = 0.15 x (45)m	29.2518	25.7393	27.0433	23.0873	21.9051	19.2242	18.6119	19.6471	20.1879	23.1246	25.3347	28.8444	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9180	(55)
Total storage loss	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(56)
If cylinder contains dedicated solar storage	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(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	246.7322	218.3108	232.0092	203.9672	197.7544	178.2133	175.7998	182.7013	184.6383	205.8842	218.9498	244.0161	(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	246.7322	218.3108	232.0092	203.9672	197.7544	178.2133	175.7998	182.7013	184.6383	205.8842	218.9498	244.0161	(64)
										Total per year (kWh/year) = Sum(64)m =		2488.9767	(64)
12Total per year (kWh/year)												2489	(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	106.2178	94.4277	101.3224	91.2184	89.9326	82.6552	82.6327	84.9275	84.7915	92.6358	96.2001	105.3146	(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	107.7570	107.7570	107.7570	107.7570	107.7570	107.7570	107.7570	107.7570	107.7570	107.7570	107.7570	107.7570	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	104.1906	115.3539	104.1906	107.6636	104.1906	107.6636	104.1906	104.1906	107.6636	104.1906	107.6636	104.1906	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	188.7053	190.6635	185.7290	175.2239	161.9632	149.5000	141.1739	139.2157	144.1502	154.6552	167.9159	180.3791	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	33.7757	33.7757	33.7757	33.7757	33.7757	33.7757	33.7757	33.7757	33.7757	33.7757	33.7757	33.7757	(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)	-86.2056	-86.2056	-86.2056	-86.2056	-86.2056	-86.2056	-86.2056	-86.2056	-86.2056	-86.2056	-86.2056	-86.2056	(71)
Water heating gains (Table 5)	142.7658	140.5174	136.1860	126.6922	120.8772	114.7989	111.0655	114.1498	117.7660	124.5105	133.6113	141.5519	(72)
Total internal gains	493.9888	504.8619	484.4326	467.9069	445.3581	427.2897	411.7571	412.8832	424.9069	441.6834	467.5180	484.4488	(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	3.2100	10.6334	0.6300	0.7000	0.7700	10.4315	(74)
East	2.3900	19.6403	0.6300	0.7000	0.7700	14.3455	(76)
South	1.4400	46.7521	0.6300	0.7000	0.7700	20.5748	(78)
West	1.4400	19.6403	0.6300	0.7000	0.7700	8.6433	(80)

Solar gains	53.9952	98.6025	150.8588	210.9375	256.2250	262.6264	249.8034	215.1018	171.7027	113.4368	65.9212	45.3797	(83)
Total gains	547.9840	603.4644	635.2914	678.8444	701.5831	689.9161	661.5605	627.9851	596.6096	555.1202	533.4392	529.8285	(84)

7. Mean internal temperature (heating season)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
tau	57.0054	57.1728	57.3378	58.1257	58.2755	58.9833	58.9833	59.1162	58.7086	58.2755	57.9732	57.6605	
alpha	4.8004	4.8115	4.8225	4.8750	4.8850	4.9322	4.9322	4.9411	4.9139	4.8850	4.8649	4.8440	
util living area	0.9845	0.9739	0.9537	0.8947	0.7768	0.5908	0.4354	0.4762	0.7065	0.9088	0.9709	0.9866	(86)
MIT	19.8632	20.0370	20.2822	20.6130	20.8535	20.9705	20.9946	20.9917	20.9302	20.6374	20.2108	19.8405	(87)
Th 2	20.0580	20.0605	20.0630	20.0745	20.0767	20.0867	20.0867	20.0886	20.0829	20.0767	20.0723	20.0677	(88)
util rest of house	0.9805	0.9674	0.9418	0.8682	0.7257	0.5151	0.3472	0.3852	0.6329	0.8802	0.9624	0.9831	(89)
MIT 2	18.7500	18.9704	19.2779	19.6850	19.9518	20.0687	20.0847	20.0852	20.0346	19.7230	19.2001	18.7283	(90)
Living area fraction										fLA = Living area / (4) =		0.5164	(91)
MIT	19.3249	19.5213	19.7965	20.1642	20.4175	20.5344	20.5546	20.5534	20.4971	20.1952	19.7220	19.3026	(92)
Temperature adjustment												-0.1500	
adjusted MIT	19.1749	19.3713	19.6465	20.0142	20.2675	20.3844	20.4046	20.4034	20.3471	20.0452	19.5720	19.1526	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9757	0.9614	0.9355	0.8662	0.7370	0.5404	0.3782	0.4171	0.6552	0.8791	0.9567	0.9787	(94)
Useful gains	534.6520	580.1430	594.2919	588.0299	517.0578	372.8340	250.1913	261.9334	390.9073	487.9975	510.3476	518.5530	(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	1017.4830	986.9774	894.0469	745.5923	573.2671	382.4037	251.5178	264.0628	414.9218	631.9963	838.8806	1011.1832	(97)
Space heating kWh	359.2262	273.3927	223.0177	113.4449	41.8198	0.0000	0.0000	0.0000	0.0000	107.1351	236.5438	366.5168	(98a)
Space heating requirement - total per year (kWh/year)												1721.0970	
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	359.2262	273.3927	223.0177	113.4449	41.8198	0.0000	0.0000	0.0000	0.0000	107.1351	236.5438	366.5168	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1721.0970	
Space heating per m2											(98c) / (4) =	25.9279	(99)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												88.8000	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement	359.2262	273.3927	223.0177	113.4449	41.8198	0.0000	0.0000	0.0000	0.0000	107.1351	236.5438	366.5168	(98)
Space heating efficiency (main heating system 1)	88.8000	88.8000	88.8000	88.8000	88.8000	0.0000	0.0000	0.0000	0.0000	88.8000	88.8000	88.8000	(210)
Space heating fuel (main heating system)	404.5340	307.8746	251.1461	127.7532	47.0943	0.0000	0.0000	0.0000	0.0000	120.6477	266.3781	412.7442	(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	246.7322	218.3108	232.0092	203.9672	197.7544	178.2133	175.7998	182.7013	184.6383	205.8842	218.9498	244.0161	(64)
Efficiency of water heater												79.8000	(216)
(217)m	84.9012	84.5655	83.9712	82.7993	81.2372	79.8000	79.8000	79.8000	79.8000	82.6676	84.2335	84.9699	(217)
Fuel for water heating, kWh/month	290.6112	258.1560	276.2962	246.3394	243.4283	223.3249	220.3005	228.9490	231.3763	249.0505	259.9321	287.1796	(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	21.6487	17.3674	15.6374	11.4567	8.8495	7.2301	8.0728	10.4933	13.6297	17.8830	20.1988	22.2504	(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												1938.1723	(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												3014.9438	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
central heating pump												41.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												86.0000	(231)
Electricity for lighting (calculated in Appendix L)												174.7178	(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	5213.8340	(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	1938.1723	0.2100	407.0162	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3014.9438	0.2100	633.1382	(264)
Space and water heating			1040.1544	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	174.7178	0.1443	25.2172	(268)
Total CO2, kg/year			1077.3008	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			16.2300	(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	1938.1723	1.1300	2190.1347	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3014.9438	1.1300	3406.8865	(278)
Space and water heating			5597.0213	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	174.7178	1.5338	267.9880	(282)
Total Primary energy kWh/year			5995.1101	(286)
Dwelling Primary energy Rate (DPER)			90.3200	(287)

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Main dwelling						
Ground floor	66.3800	(1b)	x 2.4000	(2b) =	159.3120	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	66.3800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	159.3120	(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) = 0.1255	(8)
Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design AP50	5.0000	(17)
Infiltration rate	0.3755	(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) = 0.3474	(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	0.4429	0.4342	0.4255	0.3821	0.3734	0.3300	0.3300	0.3213	0.3474	0.3734	0.3908	0.4082	(22b)
Effective ac	0.5981	0.5943	0.5905	0.5730	0.5697	0.5545	0.5545	0.5516	0.5603	0.5697	0.5764	0.5833	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Main dwelling								
TER Opaque door			1.9800	1.0000	1.9800			(26)
TER Opening Type			8.4800	1.1450	9.7099			(27)
Heatloss Floor 1			66.3800	0.1300	8.6294			(28a)
External Wall 1	57.9100	10.4600	47.4500	0.1800	8.5410			(29a)

Total net area of external elements Aum(A, m2)	124.2900			(31)
Fabric heat loss, W/K = Sum (A x U)	(26)...(30) + (32) =	28.8603		(33)
Main dwelling				
Party Wall 1	23.6800	0.0000	0.0000	(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 221.4732 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	6.6400	0.0500	0.3320
E3 Sill	4.1700	0.0500	0.2085
E4 Jamb	16.2000	0.0500	0.8100
E5 Ground floor (normal)	24.1300	0.1600	3.8608
E7 Party floor between dwellings (in blocks of flats)	24.1300	0.0700	1.6891
E16 Corner (normal)	4.8000	0.0900	0.4320
P1 Party wall - Ground floor	9.8600	0.0800	0.7888
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	9.8600	0.0000	0.0000
E18 Party wall between dwellings	4.8000	0.0600	0.2880

Thermal bridges (Sum(L x Psi) calculated using Appendix K)			8.4092	(36)
Point Thermal bridges		(36a) =	0.0000	
Total fabric heat loss	(33) + (36) + (36a) =		37.2695	(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	31.4429	31.2427	31.0464	30.1246	29.9521	29.1492	29.1492	29.0005	29.4584	29.9521	30.3010	30.6658	(38)
Heat transfer coeff	68.7124	68.5122	68.3159	67.3941	67.2216	66.4187	66.4187	66.2700	66.7280	67.2216	67.5705	67.9353	(39)
Average = Sum(39)m / 12 =												67.3933	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0351	1.0321	1.0292	1.0153	1.0127	1.0006	1.0006	0.9983	1.0052	1.0127	1.0179	1.0234	(40)
HLP (average)												1.0153	
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												2.1551	(42)
Hot water usage for mixer showers	60.3542	59.4472	58.1255	55.5967	53.7305	51.6494	50.4664	51.7781	53.2160	55.4505	58.0336	60.1230	(42a)
Hot water usage for baths	26.0775	25.6902	25.1448	24.1393	23.3863	22.5514	22.1004	22.6419	23.2316	24.1250	25.1513	25.9894	(42b)
Hot water usage for other uses	36.7008	35.3662	34.0316	32.6971	31.3625	30.0279	30.0279	31.3625	32.6971	34.0316	35.3662	36.7008	(42c)
Average daily hot water use (litres/day)												113.1869	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	123.1325	120.5037	117.3020	112.4331	108.4793	104.2286	102.5947	105.7825	109.1446	113.6072	118.5511	122.8131	(44)
Energy conte	195.0118	171.5956	180.2888	153.9152	146.0340	128.1613	124.0794	130.9809	134.5863	154.1638	168.8978	192.2957	(45)
Energy content (annual)										Total = Sum(45)m =		1880.0107	
Distribution loss (46)m = 0.15 x (45)m	29.2518	25.7393	27.0433	23.0873	21.9051	19.2242	18.6119	19.6471	20.1879	23.1246	25.3347	28.8444	(46)

Water storage loss:		
Store volume	210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):	1.7016	(48)
Temperature factor from Table 2b	0.5400	(49)
Enter (49) or (54) in (55)	0.9188	(55)

Total storage loss	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(56)
If cylinder contains dedicated solar storage	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(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	246.7584	218.3345	232.0354	203.9926	197.7806	178.2386	175.8260	182.7275	184.6636	205.9104	218.9752	244.0423	(62)
WWHRS	-27.5914	-24.4021	-25.5525	-21.1584	-19.7189	-16.8736	-15.8163	-16.8191	-17.4581	-20.5812	-23.3160	-27.0805	(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	219.1670	193.9324	206.4830	182.8341	178.0617	161.3650	160.0097	165.9084	167.2055	185.3293	195.6592	216.9618	(64)
									Total per year (kWh/year) = Sum(64)m =			2232.9170	(64)
12Total per year (kWh/year)												2233	(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	106.2387	94.4466	101.3433	91.2387	89.9536	82.6755	82.6537	84.9484	84.8118	92.6567	96.2204	105.3356	(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	107.7570	107.7570	107.7570	107.7570	107.7570	107.7570	107.7570	107.7570	107.7570	107.7570	107.7570	107.7570	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	104.1906	115.3539	104.1906	107.6636	104.1906	107.6636	104.1906	104.1906	107.6636	104.1906	107.6636	104.1906	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	188.7053	190.6635	185.7290	175.2239	161.9632	149.5000	141.1739	139.2157	144.1502	154.6552	167.9159	180.3791	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	33.7757	33.7757	33.7757	33.7757	33.7757	33.7757	33.7757	33.7757	33.7757	33.7757	33.7757	33.7757	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-86.2056	-86.2056	-86.2056	-86.2056	-86.2056	-86.2056	-86.2056	-86.2056	-86.2056	-86.2056	-86.2056	-86.2056	(71)
Water heating gains (Table 5)	142.7940	140.5456	136.2141	126.7204	120.9053	114.8271	111.0937	114.1780	117.7942	124.5386	133.6395	141.5801	(72)
Total internal gains	494.0170	504.8900	484.4608	467.9351	445.3863	427.3178	411.7852	412.9114	424.9351	441.7116	467.5461	484.4769	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a	g Specific data	FF Specific data	Access factor	Gains W

		W/m2	or Table 6b	or Table 6c	Table 6d		
North	3.2100	10.6334	0.6300	0.7000	0.7700	10.4315	(74)
East	2.3900	19.6403	0.6300	0.7000	0.7700	14.3455	(76)
South	1.4400	46.7521	0.6300	0.7000	0.7700	20.5748	(78)
West	1.4400	19.6403	0.6300	0.7000	0.7700	8.6433	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	53.9952	98.6025	150.8588	210.9375	256.2250	262.6264	249.8034	215.1018	171.7027	113.4368	65.9212	45.3797	(83)
Total gains	548.0122	603.4926	635.3196	678.8726	701.6113	689.9442	661.5887	628.0132	596.6378	555.1484	533.4673	529.8566	(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	59.4320	59.6057	59.7770	60.5946	60.7501	61.4845	61.4845	61.6224	61.1995	60.7501	60.4364	60.1119	
alpha	4.9621	4.9737	4.9851	5.0396	5.0500	5.0990	5.0990	5.1082	5.0800	5.0500	5.0291	5.0075	
util living area	0.9865	0.9768	0.9579	0.9007	0.7831	0.5950	0.4379	0.4791	0.7122	0.9145	0.9740	0.9884	(86)
MIT	19.8974	20.0664	20.3051	20.6278	20.8618	20.9733	20.9953	20.9928	20.9351	20.6507	20.2349	19.8752	(87)
Th 2	20.0542	20.0567	20.0591	20.0706	20.0728	20.0828	20.0828	20.0847	20.0790	20.0728	20.0684	20.0639	(88)
util rest of house	0.9829	0.9707	0.9464	0.8744	0.7314	0.5180	0.3486	0.3869	0.6373	0.8863	0.9661	0.9853	(89)
MIT 2	18.7862	19.0008	19.3005	19.6979	19.9564	20.0670	20.0812	20.0819	20.0350	19.7338	19.2240	18.7653	(90)
Living area fraction									fLA = Living area / (4) =			0.5164	(91)
MIT	19.3600	19.5511	19.8193	20.1781	20.4240	20.5351	20.5533	20.5523	20.4998	20.2073	19.7461	19.3385	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.3600	19.5511	19.8193	20.1781	20.4240	20.5351	20.5533	20.5523	20.4998	20.2073	19.7461	19.3385	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9795	0.9667	0.9430	0.8778	0.7521	0.5568	0.3947	0.4345	0.6729	0.8909	0.9627	0.9822	(94)
Useful gains	536.7583	583.3701	599.1170	595.8944	527.6470	384.1340	261.1429	272.8732	401.5015	494.5975	513.5560	520.4024	(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	1034.8123	1003.7802	909.9193	760.0796	586.4408	394.1986	262.5711	275.1717	427.0469	645.8166	854.5019	1028.4390	(97)
Space heating kWh	370.5522	282.5156	231.2369	118.2133	43.7426	0.0000	0.0000	0.0000	0.0000	112.5070	245.4811	377.9792	(98a)
Space heating requirement - total per year (kWh/year)												1782.2279	
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	370.5522	282.5156	231.2369	118.2133	43.7426	0.0000	0.0000	0.0000	0.0000	112.5070	245.4811	377.9792	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1782.2279	
Space heating per m2										(98c) / (4) =		26.8489	(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	370.5522	282.5156	231.2369	118.2133	43.7426	0.0000	0.0000	0.0000	0.0000	112.5070	245.4811	377.9792	(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)	401.4650	306.0841	250.5275	128.0751	47.3918	0.0000	0.0000	0.0000	0.0000	121.8927	265.9600	409.5116	(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	219.1670	193.9324	206.4830	182.8341	178.0617	161.3650	160.0097	165.9084	167.2055	185.3293	195.6592	216.9618	(64)
Efficiency of water heater												79.8000	(216)
(217)m	85.2277	84.9024	84.3143	83.1075	81.4276	79.8000	79.8000	79.8000	79.8000	82.9768	84.5696	85.2920	(217)
Fuel for water heating, kWh/month	257.1547	228.4179	244.8967	219.9971	218.6750	202.2118	200.5134	207.9053	209.5307	223.3507	231.3587	254.3753	(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	21.6487	17.3674	15.6374	11.4567	8.8495	7.2301	8.0728	10.4933	13.6297	17.8830	20.1988	22.2504	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-31.2978	-44.2430	-63.7663	-71.9045	-77.7271	-72.6415	-71.7766	-67.6934	-60.4755	-50.7273	-34.4641	-27.0475	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-17.2989	-36.4434	-72.5248	-109.0484	-144.2923	-144.9963	-143.2577	-121.2168	-88.7661	-52.1178	-23.0992	-13.6727	(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												1930.9078	(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	2698.3873	(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)	174.7178	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-1640.4989	(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	3249.5140	(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	1930.9078	0.2100	405.4906	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2698.3873	0.2100	566.6613	(264)
Space and water heating			972.1520	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	174.7178	0.1443	25.2172	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-673.7645	0.1345	-90.6346	
PV Unit electricity exported	-966.7344	0.1259	-121.6811	
Total			-212.3156	(269)
Total CO2, kg/year			796.9828	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			12.0100	(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	1930.9078	1.1300	2181.9259	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2698.3873	1.1300	3049.1776	(278)
Space and water heating			5231.1035	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	174.7178	1.5338	267.9880	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-673.7645	1.4972	-1008.7319	
PV Unit electricity exported	-966.7344	0.4620	-446.6524	
Total			-1455.3843	(283)
Total Primary energy kWh/year			4173.8080	(286)
Target Primary Energy Rate (TPER)			62.8800	(287)

Building Regulations England Part L (BREL) Compliance Report

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

Date: Fri 14 Mar 2025 09:30:50

Project Information			
Assessed By	Richard Millard	Building Type	House, End-terrace
OCDEA Registration	EES/025661	Assessment Date	2025-03-14

Dwelling Details			
Assessment Type	As designed	Total Floor Area	82 m^2
Site Reference	A2 End	Plot Reference	Proposed
Address	46, Leonard Stanley		

Client Details	
Name	Ian White
Company	Cotswold Homes Ltd
Address	West House, Yate, Bristol, BS37 5NG

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

1a Target emission rate and dwelling emission rate		
Fuel for main heating system	Electricity	
Target carbon dioxide emission rate	*11.41 $kgCO_2/m^2$*	
Dwelling carbon dioxide emission rate	3.09 $kgCO_2/m^2$	**OK**
1b Target primary energy rate and dwelling primary energy		
Target primary energy	*59.53 kWh_{PE}/m^2*	
Dwelling primary energy	36.87 kWh_{PE}/m^2	**OK**
1c Target fabric energy efficiency and dwelling fabric energy efficiency		
Target fabric energy efficiency	*37.0 kWh/m^2*	
Dwelling fabric energy efficiency	35.0 kWh/m^2	**OK**

2a Fabric U-values				
Element	***Maximum permitted average U-Value [W/m^2K]***	**Dwelling average U-Value [W/m^2K]**	**Element with highest individual U-Value**	
External walls	*0.26*	0.18	Walls (1) (0.18)	**OK**
Party walls	*0.2*	0	Party Wall (1) (0)	**N/A**
Curtain walls	*1.6*	0	N/A	**N/A**
Floors	*0.18*	0.12	Heatloss Floor 1 (0.12)	**OK**
Roofs	*0.16*	0.11	Roof (1) (0.11)	**OK**
Windows, doors, and roof windows	*1.6*	1.17	PL-W01 (1.2)	**OK**
Rooflights	*2.2*	N/A	N/A	**N/A**

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))		
Name	**Net area [m^2]**	**U-Value [W/m^2K]**
Exposed wall: Walls (1)	73.47	0.18
Party wall: Party Wall (1)	42.83	0 **(!)**
Ground floor: Heatloss Floor 1, Heatloss Floor 1	40.92	0.12
Exposed roof: Roof (1)	40.92	0.11

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	**Area [m^2]**	**Orientation**	**Frame factor**	**U-Value [W/m^2K]**
PL-W01, Windows	1.62	East	0.7	1.2
PL-W02, Windows	1.44	South	0.7	1.2
PL-ED01, Solid Doors	2.31	West	N/A	1 **(!)**
PL-ED02, Windows	3.31	East	0.7	1.2
PL-W03, Windows	0.63	South	0.7	1.2
PL-W04, Windows	1.44	West	0.7	1.2
PL-W05, Windows	1.44	East	0.7	1.2
PL-W06, Windows	1.44	East	0.7	1.2
PL-W07, Windows	0.63	South	0.7	1.2
PL-W08, Windows	1.44	West	0.7	1.2
PL-W09, Windows	1.44	West	0.7	1.2

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))				
Building part **1**: Thermal bridging calculated from linear thermal transmittances for each junction				
Main element	**Junction detail**	**Source**	**Psi value [W/mK]**	**Drawing / reference**
External wall	E1: Steel lintel with perforated steel base plate	Not government-approved scheme	0.241	EMPF125E101
External wall	E3: Sill	Not government-approved scheme	0.026 **(!)**	EMPF125E301
External wall	E4: Jamb	Not government-approved scheme	0.02 **(!)**	EMPF125E401
External wall	E5: Ground floor (normal)	Not government-approved scheme	0.045	EMPF125E504
External wall	E6: Intermediate floor within a dwelling	Not government-approved scheme	0.002 **(!)**	EMPF125E601
External wall	E18: Party wall between dwellings	Not government-approved scheme	0.06	EMPF125E21802
Party wall	P1: Ground floor	Not government-approved scheme	0.043	MCPF-P1-04
Party wall	P2: Intermediate floor within a dwelling	SAP table default	0 **(!)**	
Party wall	P4: Roof (insulation at ceiling level)	Not government-approved scheme	0.033 **(!)**	MCPF-P4-01
External wall	E10: Eaves (insulation at ceiling level)	Not government-approved scheme	0.05	EMPF125E1001
External wall	E12: Gable (insulation at ceiling level)	Not government-approved scheme	0.031 **(!)**	EMPF125E1201
External wall	E16: Corner (normal)	Not government-approved scheme	0.037 **(!)**	EMPF125E21601

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

4 Space heating	
Main heating system 1: Heat pump with radiators or underfloor heating - Electricity	
Efficiency	238.1%
Emitter type	Radiators
Flow temperature	55°C
System type	Heat Pump
Manufacturer	Daikin Europe NV
Model	EDLA08EV3
Commissioning	
Secondary heating system: N/A	
Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water	
Cylinder/store - type: Cylinder	
Capacity	210 litres
Declared heat loss	1.7 kWh/day
Primary pipework insulated	Yes
Manufacturer	
Model	
Commissioning	
Waste water heat recovery system 1 - type: N/A	
Efficiency	
Manufacturer	
Model	

6 Controls		
Main heating 1 - type: Time and temperature zone control by arrangement of plumbing and electrical services		
Function		
Ecodesign class		
Manufacturer		
Model		
Water heating - type: Cylinder thermostat and HW separately timed		
Manufacturer		
Model		

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

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

9 Local generation	
Technology type: **Photovoltaic system (1)**	
Peak power	1.34 kWp
Orientation	South
Pitch	30°
Overshading	None or very little
Manufacturer	
MCS certificate	

10 Heat networks
N/A

11 Supporting documentary evidence
N/A

12 Declarations

a. Assessor Declaration

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

b. Client Declaration

N/A

Full SAP Calculation Printout

Property Reference	A2 End	**Issued on Date**	14/03/2025
Assessment Reference	Proposed	**Prop Type Ref**	Proposed 46
Property	46, Leonard Stanley		

SAP Rating	86 B	**DER**	3.09	**TER**	11.41
Environmental	97 A	**% DER < TER**			72.92
CO_2 Emissions (t/year)	0.22	**DFEE**	35.01	**TFEE**	36.95
Compliance Check	See BREL	**% DFEE < TFEE**			5.25
% DPER < TPER	38.06	**DPER**	36.87	**TPER**	59.53

Assessor Details	Mr. Richard Millard	**Assessor ID**	U367-0001
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)	
Main dwelling						
Ground floor	40.9200 (1b)	x	2.3500 (2b)	=	96.1620	(1b) - (3b)
First floor	40.9200 (1c)	x	2.6500 (2c)	=	108.4380	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	81.8400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	204.6000	(5)

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2. Ventilation rate

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			m3 per hour	
Number of open chimneys		0 * 80 =	0.0000	(6a)
Number of open flues		0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire		0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler		0 * 20 =	0.0000	(6d)
Number of flues attached to other heater		0 * 35 =	0.0000	(6e)
Number of blocked chimneys		0 * 20 =	0.0000	(6f)
Number of intermittent extract fans		3 * 10 =	30.0000	(7a)
Number of passive vents		0 * 10 =	0.0000	(7b)
Number of flueless gas fires		0 * 40 =	0.0000	(7c)
		Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =		30.0000 / (5) =	0.1466	(8)
Pressure test			Yes	
Pressure Test Method			Blower Door	
Measured/design AP50			5.0000	(17)
Infiltration rate			0.3966	(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) =	0.3669	(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	0.4678	0.4586	0.4494	0.4036	0.3944	0.3485	0.3485	0.3394	0.3669	0.3944	0.4127	0.4311	(22b)
Effective ac	0.6094	0.6052	0.6010	0.5814	0.5778	0.5607	0.5607	0.5576	0.5673	0.5778	0.5852	0.5929	(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	
Main dwelling								
Solid Doors			2.3100	1.0000	2.3100			(26)
Windows			14.8300	1.1450	16.9809			(27)
Heatloss Floor 1			40.9200	0.1200	4.9104	75.0000	3069.0000	(28a)
External Wall 1	90.6100	17.1400	73.4700	0.1800	13.2246	60.0000	4408.2000	(29a)
External Roof 1	40.9200		40.9200	0.1100	4.5012	9.0000	368.2800	(30)
Total net area of external elements Aum(A, m2)			172.4500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		41.9271			(33)
Main dwelling								
Party Wall 1			42.8300	0.0000	0.0000	45.0000	1927.3501	(32)
Internal Wall 1			23.4100			75.0000	1755.7500	(32c)
Internal Wall 2			124.3200			9.0000	1118.8800	(32c)
Internal Floor 1			40.9200			18.0000	736.5600	(32d)
Internal Ceiling 1			40.9200			9.0000	368.2800	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	13752.3001 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		168.0389 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	12.2800	0.2410	2.9595

E3 Sill	9.6000	0.0260	0.2496	
E4 Jamb	29.7000	0.0200	0.5940	
E5 Ground floor (normal)	18.1200	0.0450	0.8154	
E6 Intermediate floor within a dwelling	18.1200	0.0020	0.0362	
E18 Party wall between dwellings	10.0000	0.0600	0.6000	
P1 Party wall - Ground floor	8.5700	0.0430	0.3685	
P2 Party wall - Intermediate floor within a dwelling	8.5700	0.0000	0.0000	
P4 Party wall - Roof (insulation at ceiling level)	8.5700	0.0330	0.2828	
E10 Eaves (insulation at ceiling level)	8.5700	0.0500	0.4285	
E12 Gable (insulation at ceiling level)	9.5600	0.0310	0.2964	
E16 Corner (normal)	10.0000	0.0370	0.3700	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 7.0009 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 48.9280 (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	41.1458	40.8590	40.5778	39.2572	39.0102	37.8600	37.8600	37.6470	38.3030	39.0102	39.5100	40.0326	(38)
Heat transfer coeff	90.0739	89.7870	89.5059	88.1853	87.9382	86.7880	86.7880	86.5750	87.2310	87.9382	88.4380	88.9606	(39)

Average = Sum(39)m / 12 = 88.1841

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1006	1.0971	1.0937	1.0775	1.0745	1.0605	1.0605	1.0579	1.0659	1.0745	1.0806	1.0870	(40)
HLP (average)												1.0775	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.4968 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	66.0836	65.0905	63.6434	60.8745	58.8311	56.5524	55.2572	56.6934	58.2677	60.7144	63.5427	65.8304	(42a)
Hot water usage for baths	28.5413	28.1175	27.5206	26.4200	25.5958	24.6820	24.1884	24.7812	25.4266	26.4044	27.5276	28.4449	(42b)
Hot water usage for other uses	40.2002	38.7384	37.2766	35.8147	34.3529	32.8911	32.8911	34.3529	35.8147	37.2766	38.7384	40.2002	(42c)

Average daily hot water use (litres/day) 123.9349 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	134.8252	131.9464	128.4405	123.1092	118.7799	114.1255	112.3367	115.8275	119.5090	124.3953	129.8087	134.4755	(44)
Energy conte	213.5301	187.8899	197.4082	168.5303	159.9006	140.3306	135.8615	143.4186	147.3666	168.8033	184.9363	210.5561	(45)

Energy content (annual) Total = Sum(45)m = 2058.5321

Distribution loss (46)m = 0.15 x (45)m	32.0295	28.1835	29.6112	25.2795	23.9851	21.0496	20.3792	21.5128	22.1050	25.3205	27.7405	31.5834	(46)

Water storage loss:
Store volume 210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.7000 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 0.9180 (55)

Total storage loss	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(56)
If cylinder contains dedicated solar storage	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(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	265.2505	234.6051	249.1286	218.5823	211.6210	190.3826	187.5819	195.1390	197.4186	220.5237	234.9883	262.2765	(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	265.2505	234.6051	249.1286	218.5823	211.6210	190.3826	187.5819	195.1390	197.4186	220.5237	234.9883	262.2765	(64)

Total per year (kWh/year) = Sum(64)m = 2667.4981 (64)
12Total per year (kWh/year) 2667 (64)

Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)

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

Heat gains from water heating, kWh/month	112.3751	99.8455	107.0146	96.0779	94.5433	86.7015	86.5503	89.0630	89.0410	97.5034	101.5329	111.3862	(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	124.8423	124.8423	124.8423	124.8423	124.8423	124.8423	124.8423	124.8423	124.8423	124.8423	124.8423	124.8423	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	114.8836	127.1926	114.8836	118.7130	114.8836	118.7130	114.8836	114.8836	118.7130	114.8836	118.7130	114.8836	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	223.2431	225.5596	219.7220	207.2943	191.6065	176.8622	167.0122	164.6956	170.5333	182.9610	198.6487	213.3930	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.4842	35.4842	35.4842	35.4842	35.4842	35.4842	35.4842	35.4842	35.4842	35.4842	35.4842	35.4842	(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)	-99.8739	-99.8739	-99.8739	-99.8739	-99.8739	-99.8739	-99.8739	-99.8739	-99.8739	-99.8739	-99.8739	-99.8739	(71)
Water heating gains (Table 5)	151.0418	148.5797	143.8368	133.4416	127.0743	120.4188	116.3310	119.7083	123.6680	131.0530	141.0180	149.7127	(72)
Total internal gains	549.6211	561.7846	538.8950	519.9016	494.0171	476.4468	458.6795	459.7402	473.3671	489.3502	518.8324	538.4420	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	7.8100	19.6403	0.6300	0.7000	0.7700	46.8781	(76)
South	2.7000	46.7521	0.6300	0.7000	0.7700	38.5777	(78)
West	4.3200	19.6403	0.6300	0.7000	0.7700	25.9300	(80)

Solar gains	111.3858	205.6085	315.0395	433.0507	514.0308	520.3903	497.7151	437.5257	356.8731	237.1489	136.5109	93.2086	(83)
Total gains	661.0070	767.3931	853.9345	952.9522	1008.0479	996.8371	956.3945	897.2660	830.2402	726.4992	655.3434	631.6505	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	42.4106	42.5461	42.6797	43.3188	43.4406	44.0163	44.0163	44.1246	43.7927	43.4406	43.1950	42.9413	
alpha	3.8274	3.8364	3.8453	3.8879	3.8960	3.9344	3.9344	3.9416	3.9195	3.8960	3.8797	3.8628	
util living area	0.9754	0.9566	0.9212	0.8378	0.7055	0.5310	0.3927	0.4336	0.6538	0.8759	0.9573	0.9789	(86)
Living	19.4617	19.7255	20.0836	20.5163	20.8079	20.9528	20.9887	20.9834	20.8934	20.4989	19.9173	19.4265	
Non living	18.2254	18.5580	19.0033	19.5298	19.8535	20.0022	20.0284	20.0277	19.9505	19.5246	18.8127	18.1885	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	20.2131	19.7255	20.0836	20.5163	20.8079	20.9528	20.9887	20.9834	20.8934	20.4989	19.9173	19.6466	(87)
Th 2	20.0003	20.0032	20.0060	20.0192	20.0217	20.0333	20.0333	20.0354	20.0288	20.0217	20.0167	20.0115	(88)
util rest of house	0.9703	0.9478	0.9053	0.8066	0.6538	0.4596	0.3094	0.3471	0.5822	0.8445	0.9471	0.9745	(89)
MIT 2	19.2927	18.5580	19.0033	19.5298	19.8535	20.0022	20.0284	20.0277	19.9505	19.5246	18.8127	18.5170	(90)
Living area fraction										fLA = Living area / (4) =		0.2375	(91)
MIT	19.5113	18.8353	19.2599	19.7641	20.0802	20.2280	20.2565	20.2547	20.1745	19.7560	19.0751	18.7853	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.5113	18.8353	19.2599	19.7641	20.0802	20.2280	20.2565	20.2547	20.1745	19.7560	19.0751	18.7853	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9672	0.9346	0.8908	0.7975	0.6571	0.4744	0.3289	0.3672	0.5936	0.8345	0.9345	0.9672	(94)
Useful gains	639.3478	717.1901	760.7148	760.0104	662.3699	472.9350	314.5654	329.4415	492.8377	606.2654	612.4093	610.9289	(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	1370.1443	1251.2097	1142.0887	958.0548	736.9420	488.4414	317.3405	333.7231	529.8821	805.1663	1059.0511	1297.5162	(97)
Space heating kWh	543.7126	358.8612	283.7422	142.5920	55.4816	0.0000	0.0000	0.0000	0.0000	147.9822	321.5821	510.8210	(98a)
Space heating requirement - total per year (kWh/year)												2364.7749	
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	543.7126	358.8612	283.7422	142.5920	55.4816	0.0000	0.0000	0.0000	0.0000	147.9822	321.5821	510.8210	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2364.7749	
Space heating per m2											(98c) / (4) =	28.8951	(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 %)												238.0678	(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	543.7126	358.8612	283.7422	142.5920	55.4816	0.0000	0.0000	0.0000	0.0000	147.9822	321.5821	510.8210	(98)
Space heating efficiency (main heating system 1)	238.0678	238.0678	238.0678	238.0678	238.0678	0.0000	0.0000	0.0000	0.0000	238.0678	238.0678	238.0678	(210)
Space heating fuel (main heating system)	228.3856	150.7391	119.1855	59.8955	23.3050	0.0000	0.0000	0.0000	0.0000	62.1597	135.0800	214.5695	(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	265.2505	234.6051	249.1286	218.5823	211.6210	190.3826	187.5819	195.1390	197.4186	220.5237	234.9883	262.2765	(64)
Efficiency of water heater												170.8063	(216)
(217)m	170.8063	170.8063	170.8063	170.8063	170.8063	170.8063	170.8063	170.8063	170.8063	170.8063	170.8063	170.8063	(217)
Fuel for water heating, kWh/month	155.2932	137.3515	145.8545	127.9709	123.8953	111.4612	109.8214	114.2458	115.5804	129.1075	137.5759	153.5520	(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	23.8705	19.1498	17.2423	12.6325	9.7577	7.9721	8.9013	11.5702	15.0286	19.7183	22.2718	24.5340	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-26.8795	-40.6716	-62.5412	-74.0452	-82.4870	-76.9057	-75.8532	-69.7772	-59.2345	-47.5064	-30.2407	-22.8384	(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	-6.6785	-15.3270	-32.8307	-53.7721	-75.4205	-78.3425	-77.3433	-64.0714	-45.5958	-24.0803	-9.5639	-5.2439	(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												993.3199	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												170.8063	

Water heating fuel used	1561.7096	(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)	192.6489	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-1157.2504	(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	1590.4281	(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	993.3199	0.1561	155.0474	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1561.7096	0.1409	220.0822	(264)
Space and water heating			375.1296	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	192.6489	0.1443	27.8052	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-668.9805	0.1336	-89.3743	
PV Unit electricity exported	-488.2699	0.1235	-60.2894	
Total			-149.6636	(269)
Total CO2, kg/year			253.2712	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			3.0900	(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	993.3199	1.5778	1567.2910	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1561.7096	1.5211	2375.4958	(278)
Space and water heating			3942.7868	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	192.6489	1.5338	295.4914	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-668.9805	1.4937	-999.2601	
PV Unit electricity exported	-488.2699	0.4531	-221.2431	
Total			-1220.5032	(283)
Total Primary energy kWh/year			3017.7750	(286)
Dwelling Primary energy Rate (DPER)			36.8700	(287)

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

1. Overall dwelling characteristics

		Area (m2)		Storey height (m)		Volume (m3)	
Main dwelling							
Ground floor		40.9200 (1b)	x	2.3500 (2b)	=	96.1620	(1b) - (3b)
First floor		40.9200 (1c)	x	2.6500 (2c)	=	108.4380	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	81.8400						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	204.6000	(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) =	0.1466	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3966	(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) =	0.3669	(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													
	0.4678	0.4586	0.4494	0.4036	0.3944	0.3485	0.3485	0.3394	0.3669	0.3944	0.4127	0.4311	(22b)
Effective ac	0.6094	0.6052	0.6010	0.5814	0.5778	0.5607	0.5607	0.5576	0.5673	0.5778	0.5852	0.5929	(25)

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3. Heat losses and heat loss parameter

Element	Gross	Openings	NetArea	U-value	A x U	K-value	A x K	
Main dwelling	m2	m2	m2	W/m2K	W/K	kJ/m2K	kJ/K	
TER Opaque door			2.3100	1.0000	2.3100			(26)
TER Opening Type			14.8300	1.1450	16.9809			(27)
Heatloss Floor 1			40.9200	0.1300	5.3196			(28a)
External Wall 1	90.6100	17.1400	73.4700	0.1800	13.2246			(29a)
External Roof 1	40.9200		40.9200	0.1100	4.5012			(30)
Total net area of external elements Aum(A, m2)			172.4500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	42.3363			(33)
Main dwelling								
Party Wall 1			42.8300	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 168.0389 (35)

List of Thermal Bridges

	Length	Psi-value	Total	
K1 Element				
E1 Steel lintel with perforated steel base plate	12.2800	0.0500	0.6140	
E3 Sill	9.6000	0.0500	0.4800	
E4 Jamb	29.7000	0.0500	1.4850	
E5 Ground floor (normal)	18.1200	0.1600	2.8992	
E6 Intermediate floor within a dwelling	18.1200	0.0000	0.0000	
E18 Party wall between dwellings	10.0000	0.0600	0.6000	
P1 Party wall - Ground floor	8.5700	0.0800	0.6856	
P2 Party wall - Intermediate floor within a dwelling	8.5700	0.0000	0.0000	
P4 Party wall - Roof (insulation at ceiling level)	8.5700	0.1200	1.0284	
E10 Eaves (insulation at ceiling level)	8.5700	0.0600	0.5142	
E12 Gable (insulation at ceiling level)	9.5600	0.0600	0.5736	
E16 Corner (normal)	10.0000	0.0900	0.9000	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 9.7800 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 52.1163 (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	41.1458	40.8590	40.5778	39.2572	39.0102	37.8600	37.8600	37.6470	38.3030	39.0102	39.5100	40.0326	(38)
Heat transfer coeff													
	93.2622	92.9753	92.6942	91.3736	91.1265	89.9763	89.9763	89.7633	90.4193	91.1265	91.6263	92.1489	(39)
Average = Sum(39)m / 12 =												91.3724	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1396	1.1361	1.1326	1.1165	1.1135	1.0994	1.0994	1.0968	1.1048	1.1135	1.1196	1.1260	(40)
HLP (average)												1.1165	
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 2.4968 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers													
	66.0836	65.0905	63.6434	60.8745	58.8311	56.5524	55.2572	56.6934	58.2677	60.7144	63.5427	65.8304	(42a)
Hot water usage for baths													
	28.5413	28.1175	27.5206	26.4200	25.5958	24.6820	24.1884	24.7812	25.4266	26.4044	27.5276	28.4449	(42b)
Hot water usage for other uses													
	40.2002	38.7384	37.2766	35.8147	34.3529	32.8911	32.8911	34.3529	35.8147	37.2766	38.7384	40.2002	(42c)
Average daily hot water use (litres/day)												123.9349	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	134.8252	131.9464	128.4405	123.1092	118.7799	114.1255	112.3367	115.8275	119.5090	124.3953	129.8087	134.4755	(44)
Energy conte	213.5301	187.8899	197.4082	168.5303	159.9006	140.3306	135.8615	143.4186	147.3666	168.8033	184.9363	210.5561	(45)
Energy content (annual)											Total = Sum(45)m =	2058.5321	
Distribution loss (46)m = 0.15 x (45)m													
	32.0295	28.1835	29.6112	25.2795	23.9851	21.0496	20.3792	21.5128	22.1050	25.3205	27.7405	31.5834	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7016	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9188	(55)
Total storage loss													
	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(56)
If cylinder contains dedicated solar storage													
	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(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													
	265.2767	234.6287	249.1548	218.6077	211.6472	190.4080	187.6081	195.1652	197.4439	220.5499	235.0137	262.3027	(62)
WWHRS	-30.2107	-26.7186	-27.9781	-23.1670	-21.5908	-18.4754	-17.3178	-18.4157	-19.1154	-22.5349	-25.5293	-29.6512	(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													
	235.0660	207.9102	221.1767	195.4407	190.0563	171.9326	170.2903	176.7495	178.3285	198.0149	209.4844	232.6515	(64)
										Total per year (kWh/year) = Sum(64)m =		2387.1015	(64)
12Total per year (kWh/year)												2387	(64)
Electric shower(s)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000	(64a)
Heat gains from water heating, kWh/month													
	112.3960	99.8645	107.0355	96.0982	94.5642	86.7218	86.5712	89.0840	89.0613	97.5244	101.5532	111.4072	(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	124.8423	124.8423	124.8423	124.8423	124.8423	124.8423	124.8423	124.8423	124.8423	124.8423	124.8423	124.8423	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	114.8836	127.1926	114.8836	118.7130	114.8836	118.7130	114.8836	114.8836	118.7130	114.8836	118.7130	114.8836	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	223.2431	225.5596	219.7220	207.2943	191.6065	176.8622	167.0122	164.6956	170.5333	182.9610	198.6487	213.3930	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.4842	35.4842	35.4842	35.4842	35.4842	35.4842	35.4842	35.4842	35.4842	35.4842	35.4842	35.4842	(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)													
	-99.8739	-99.8739	-99.8739	-99.8739	-99.8739	-99.8739	-99.8739	-99.8739	-99.8739	-99.8739	-99.8739	-99.8739	(71)
Water heating gains (Table 5)													
	151.0699	148.6078	143.8649	133.4697	127.1024	120.4470	116.3592	119.7365	123.6962	131.0811	141.0461	149.7408	(72)
Total internal gains													
	552.6493	564.8127	541.9232	522.9297	497.0452	476.4750	458.7076	459.7684	473.3952	492.3784	521.8606	541.4701	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	7.8100	19.6403	0.6300	0.7000	0.7700	46.8781	(76)
South	2.7000	46.7521	0.6300	0.7000	0.7700	38.5777	(78)
West	4.3200	19.6403	0.6300	0.7000	0.7700	25.9300	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	111.3858	205.6085	315.0395	433.0507	514.0308	520.3903	497.7151	437.5257	356.8731	237.1489	136.5109	93.2086	(83)
Total gains	664.0351	770.4212	856.9626	955.9804	1011.0761	996.8652	956.4227	897.2941	830.2684	729.5273	658.3715	634.6787	(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	40.9607	41.0871	41.2117	41.8073	41.9207	42.4566	42.4566	42.5573	42.2485	41.9207	41.6920	41.4556	
alpha	3.7307	3.7391	3.7474	3.7872	3.7947	3.8304	3.8304	3.8372	3.8166	3.7947	3.7795	3.7637	
util living area													
	0.9757	0.9577	0.9239	0.8444	0.7166	0.5456	0.4055	0.4472	0.6675	0.8807	0.9583	0.9791	(86)
MIT	19.3877	19.6533	20.0193	20.4681	20.7807	20.9427	20.9856	20.9792	20.8754	20.4554	19.8551	19.3518	(87)
Th 2	19.9687	19.9715	19.9743	19.9874	19.9898	20.0013	20.0013	20.0034	19.9969	19.9898	19.9849	19.9797	(88)
util rest of house													
	0.9705	0.9489	0.9081	0.8134	0.6641	0.4711	0.3172	0.3558	0.5941	0.8494	0.9482	0.9746	(89)
MIT 2	18.1107	18.4457	18.9017	19.4487	19.7977	19.9636	19.9952	19.9939	19.9053	19.4496	18.7131	18.0729	(90)
Living area fraction									fLA = Living area / (4) =			0.2375	(91)
MIT	18.4140	18.7325	19.1671	19.6908	20.0312	20.1962	20.2305	20.2279	20.1357	19.6885	18.9844	18.3767	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4140	18.7325	19.1671	19.6908	20.0312	20.1962	20.2305	20.2279	20.1357	19.6885	18.9844	18.3767	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9598	0.9353	0.8930	0.8032	0.6664	0.4861	0.3378	0.3769	0.6050	0.8384	0.9351	0.9649	(94)
Useful gains	637.3649	720.5557	765.2759	767.8026	673.8122	484.6152	323.1248	338.2252	502.2805	611.6694	615.6472	612.4012	(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													
	1316.3041	1286.0857	1174.1704	985.9968	759.1912	503.5257	326.6560	343.6078	545.7460	828.2046	1088.9237	1306.3632	(97)
Space heating kWh													
	505.1308	380.0361	304.2175	157.0998	63.5220	0.0000	0.0000	0.0000	0.0000	161.1021	340.7591	516.3078	(98a)
Space heating requirement - total per year (kWh/year)												2428.1753	
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													
	505.1308	380.0361	304.2175	157.0998	63.5220	0.0000	0.0000	0.0000	0.0000	161.1021	340.7591	516.3078	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2428.1753	
Space heating per m2											(98c) / (4) =	29.6698	(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													
	505.1308	380.0361	304.2175	157.0998	63.5220	0.0000	0.0000	0.0000	0.0000	161.1021	340.7591	516.3078	(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)													
	547.2706	411.7401	329.5965	170.2057	68.8212	0.0000	0.0000	0.0000	0.0000	174.5419	369.1865	559.3800	(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													
	235.0660	207.9102	221.1767	195.4407	190.0563	171.9326	170.2903	176.7495	178.3285	198.0149	209.4844	232.6515	(64)
Efficiency of water heater												79.8000	(216)
(217)m	85.7295	85.3943	84.7750	83.5746	81.8788	79.8000	79.8000	79.8000	79.8000	83.6011	85.1441	85.7943	(217)
Fuel for water heating, kWh/month													
	274.1951	243.4708	260.8983	233.8517	232.1191	215.4544	213.3964	221.4906	223.4693	236.8569	246.0350	271.1736	(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	23.8705	19.1498	17.2423	12.6325	9.7577	7.9721	8.9013	11.5702	15.0286	19.7183	22.2718	24.5340	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-38.0695	-53.5614	-76.8370	-86.2175	-92.8210	-86.5789	-85.4958	-80.7744	-72.4337	-61.1475	-41.8087	-32.9251	(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	-21.8455	-45.9170	-91.1965	-136.8795	-180.9070	-181.7471	-179.6203	-152.1333	-111.5665	-65.6503	-29.1612	-17.2789	(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	2630.7424	(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	2872.4113	(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)	192.6489	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-2022.5734	(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	3759.2292	(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	2630.7424	0.2100	552.4559	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2872.4113	0.2100	603.2064	(264)
Space and water heating			1155.6623	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	192.6489	0.1443	27.8052	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-808.6704	0.1346	-108.8718	
PV Unit electricity exported	-1213.9030	0.1259	-152.8478	
Total			-261.7196	(269)
Total CO2, kg/year			933.6772	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			11.4100	(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	2630.7424	1.1300	2972.7389	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2872.4113	1.1300	3245.8247	(278)
Space and water heating			6218.5637	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	192.6489	1.5338	295.4914	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-808.6704	1.4976	-1211.0441	
PV Unit electricity exported	-1213.9030	0.4622	-561.0574	
Total			-1772.1015	(283)
Total Primary energy kWh/year			4872.0543	(286)
Target Primary Energy Rate (TPER)			59.5300	(287)

Building Regulations England Part L (BREL) Compliance Report

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

Date: Fri 14 Mar 2025 09:30:52

Project Information			
Assessed By	Richard Millard	Building Type	House, End-terrace
OCDEA Registration	EES/025661	Assessment Date	2025-03-14

Dwelling Details			
Assessment Type	As designed	Total Floor Area	82 m^2
Site Reference	A2 End	Plot Reference	Regulated (Baseline)
Address	46, Leonard Stanley		

Client Details	
Name	Ian White
Company	Cotswold Homes Ltd
Address	West House, Yate, Bristol, BS37 5NG

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

1a Target emission rate and dwelling emission rate		
Fuel for main heating system	Mains gas	
Target carbon dioxide emission rate	*11.41 $kgCO_2/m^2$*	
Dwelling carbon dioxide emission rate	15.4 $kgCO_2/m^2$	**FAIL**
1b Target primary energy rate and dwelling primary energy		
Target primary energy	*59.53 kWh_{PE}/m^2*	
Dwelling primary energy	85.47 kWh_{PE}/m^2	**FAIL**
1c Target fabric energy efficiency and dwelling fabric energy efficiency		
Target fabric energy efficiency	*37.0 kWh/m^2*	
Dwelling fabric energy efficiency	36.0 kWh/m^2	**OK**

2a Fabric U-values				
Element	***Maximum permitted average U-Value [W/m^2K]***	**Dwelling average U-Value [W/m^2K]**	**Element with highest individual U-Value**	
External walls	*0.26*	0.18	Walls (1) (0.18)	**OK**
Party walls	*0.2*	0	Party Wall (1) (0)	**N/A**
Curtain walls	*1.6*	0	N/A	**N/A**
Floors	*0.18*	0.13	Heatloss Floor 1 (0.13)	**OK**
Roofs	*0.16*	0.11	Roof (1) (0.11)	**OK**
Windows, doors, and roof windows	*1.6*	1.17	PL-W01 (1.2)	**OK**
Rooflights	*2.2*	N/A	N/A	**N/A**

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))		
Name	**Net area [m^2]**	**U-Value [W/m^2K]**
Exposed wall: Walls (1)	73.47	0.18
Party wall: Party Wall (1)	42.83	0 **(!)**
Ground floor: Heatloss Floor 1, Heatloss Floor 1	40.92	0.13
Exposed roof: Roof (1)	40.92	0.11

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	**Area [m^2]**	**Orientation**	**Frame factor**	**U-Value [W/m^2K]**
PL-W01, Windows	1.62	East	0.7	1.2
PL-W02, Windows	1.44	South	0.7	1.2
PL-ED01, Solid Doors	2.31	West	N/A	1 **(!)**
PL-ED02, Windows	3.31	East	0.7	1.2
PL-W03, Windows	0.63	South	0.7	1.2
PL-W04, Windows	1.44	West	0.7	1.2
PL-W05, Windows	1.44	East	0.7	1.2
PL-W06, Windows	1.44	East	0.7	1.2
PL-W07, Windows	0.63	South	0.7	1.2
PL-W08, Windows	1.44	West	0.7	1.2
PL-W09, Windows	1.44	West	0.7	1.2

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))				
Building part **1**: Thermal bridging calculated from linear thermal transmittances for each junction				
Main element	**Junction detail**	**Source**	**Psi value [W/mK]**	**Drawing / reference**
External wall	E2: Other lintels (including other steel lintels)	Not government-approved scheme	0.05	MCPF-125-E2-01
External wall	E3: Sill	Not government-approved scheme	0.05	MCPF-125-E3-01
External wall	E4: Jamb	Not government-approved scheme	0.022 **(!)**	MCPF-125-E4-01
External wall	E5: Ground floor (normal)	Not government-approved scheme	0.16	MCPF-125-E5-04
External wall	E6: Intermediate floor within a dwelling	Not government-approved scheme	0.001 **(!)**	MCPF-125-E6-01
External wall	E18: Party wall between dwellings	Not government-approved scheme	0.09	MCPF-125-E18-01
Party wall	P1: Ground floor	Not government-approved scheme	0.043	MCPF-P1-04
Party wall	P2: Intermediate floor within a dwelling	SAP table default	0 **(!)**	
Party wall	P4: Roof (insulation at ceiling level)	Not government-approved scheme	0.033 **(!)**	MCPF-P4-01
External wall	E10: Eaves (insulation at ceiling level)	Not government-approved scheme	0.06	MCPF-E10-01
External wall	E12: Gable (insulation at ceiling level)	Not government-approved scheme	0.06	MCPF-E12-01
External wall	E16: Corner (normal)	Not government-approved scheme	0.09	MCPF-E16-01

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

4 Space heating	
Main heating system 1: Boiler with radiators or underfloor heating - Mains gas	
Efficiency	88.6%
Emitter type	Radiators
Flow temperature	55°C
System type	Regular boiler
Manufacturer	Bosch Thermotechnology
Model	Greenstar 8000 Life
Commissioning	
Secondary heating system: N/A	
Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water	
Cylinder/store - type: Cylinder	
Capacity	210 litres
Declared heat loss	1.7 kWh/day
Primary pipework insulated	Yes
Manufacturer	
Model	
Commissioning	
Waste water heat recovery system 1 - type: N/A	
Efficiency	
Manufacturer	
Model	

6 Controls		
Main heating 1 - type: Time and temperature zone control by arrangement of plumbing and electrical services		
Function		
Ecodesign class		
Manufacturer		
Model		
Water heating - type: Cylinder thermostat and HW separately timed		
Manufacturer		
Model		

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

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

9 Local generation
N/A

10 Heat networks
N/A

11 Supporting documentary evidence
N/A

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

Full SAP Calculation Printout

Property Reference	A2 End	**Issued on Date**	14/03/2025
Assessment Reference	Regulated (Baseline)	**Prop Type Ref**	Proposed 46
Property	46, Leonard Stanley		

SAP Rating	84 B	**DER**	15.40	**TER**	11.41
Environmental	87 B	**% DER < TER**			-34.97
CO_2 Emissions (t/year)	1.18	**DFEE**	35.99	**TFEE**	36.95
Compliance Check	See BREL	**% DFEE < TFEE**			2.60
% DPER < TPER	-43.57	**DPER**	85.47	**TPER**	59.53

Assessor Details	Mr. Richard Millard	**Assessor ID**	U367-0001
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)	
Main dwelling						
Ground floor	40.9200 (1b)	x	2.3500 (2b)	=	96.1620	(1b) - (3b)
First floor	40.9200 (1c)	x	2.6500 (2c)	=	108.4380	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	81.8400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	204.6000	(5)

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2. Ventilation rate

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			m3 per hour	
Number of open chimneys		0 * 80 =	0.0000	(6a)
Number of open flues		0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire		0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler		0 * 20 =	0.0000	(6d)
Number of flues attached to other heater		0 * 35 =	0.0000	(6e)
Number of blocked chimneys		0 * 20 =	0.0000	(6f)
Number of intermittent extract fans		3 * 10 =	30.0000	(7a)
Number of passive vents		0 * 10 =	0.0000	(7b)
Number of flueless gas fires		0 * 40 =	0.0000	(7c)
			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =		30.0000 / (5) =	0.1466	(8)
Pressure test			Yes	
Pressure Test Method			Blower Door	
Measured/design AP50			5.0000	(17)
Infiltration rate			0.3966	(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) =	0.3669	(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	0.4678	0.4586	0.4494	0.4036	0.3944	0.3485	0.3485	0.3394	0.3669	0.3944	0.4127	0.4311	(22b)
Effective ac	0.6094	0.6052	0.6010	0.5814	0.5778	0.5607	0.5607	0.5576	0.5673	0.5778	0.5852	0.5929	(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	
Main dwelling								
Solid Doors			2.3100	1.0000	2.3100			(26)
Windows			14.8300	1.1450	16.9809			(27)
Heatloss Floor 1			40.9200	0.1300	5.3196	75.0000	3069.0000	(28a)
External Wall 1	90.6100	17.1400	73.4700	0.1800	13.2246	60.0000	4408.2000	(29a)
External Roof 1	40.9200		40.9200	0.1100	4.5012	9.0000	368.2800	(30)
Total net area of external elements Aum(A, m2)			172.4500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		42.3363			(33)
Main dwelling								
Party Wall 1			42.8300	0.0000	0.0000	45.0000	1927.3501	(32)
Internal Wall 1			23.4100			75.0000	1755.7500	(32c)
Internal Wall 2			124.3200			9.0000	1118.8800	(32c)
Internal Floor 1			40.9200			18.0000	736.5600	(32d)
Internal Ceiling 1			40.9200			9.0000	368.2800	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	13752.3001 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		168.0389 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	12.2800	0.0500	0.6140

E3 Sill	9.6000	0.0500	0.4800		
E4 Jamb	29.7000	0.0220	0.6534		
E5 Ground floor (normal)	18.1200	0.1600	2.8992		
E6 Intermediate floor within a dwelling	18.1200	0.0010	0.0181		
E18 Party wall between dwellings	10.0000	0.0900	0.9000		
P1 Party wall - Ground floor	8.5700	0.0430	0.3685		
P2 Party wall - Intermediate floor within a dwelling	8.5700	0.0000	0.0000		
P4 Party wall - Roof (insulation at ceiling level)	8.5700	0.0330	0.2828		
E10 Eaves (insulation at ceiling level)	8.5700	0.0600	0.5142		
E12 Gable (insulation at ceiling level)	9.5600	0.0600	0.5736		
E16 Corner (normal)	10.0000	0.0900	0.9000		
Thermal bridges (Sum(L x Psi) calculated using Appendix K)				8.2038	(36)
Point Thermal bridges			(36a) =	0.0000	
Total fabric heat loss			(33) + (36) + (36a) =	50.5402	(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	41.1458	40.8590	40.5778	39.2572	39.0102	37.8600	37.8600	37.6470	38.3030	39.0102	39.5100	40.0326	(38)
Heat transfer coeff	91.6860	91.3992	91.1180	89.7974	89.5503	88.4001	88.4001	88.1871	88.8432	89.5503	90.0502	90.5727	(39)
Average = Sum(39)m / 12 =												89.7962	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1203	1.1168	1.1134	1.0972	1.0942	1.0802	1.0802	1.0776	1.0856	1.0942	1.1003	1.1067	(40)
HLP (average)												1.0972	
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 2.4968 (42)

Hot water usage for mixer showers

66.0836	65.0905	63.6434	60.8745	58.8311	56.5524	55.2572	56.6934	58.2677	60.7144	63.5427	65.8304	(42a)

Hot water usage for baths

28.5413	28.1175	27.5206	26.4200	25.5958	24.6820	24.1884	24.7812	25.4266	26.4044	27.5276	28.4449	(42b)

Hot water usage for other uses

40.2002	38.7384	37.2766	35.8147	34.3529	32.8911	32.8911	34.3529	35.8147	37.2766	38.7384	40.2002	(42c)

Average daily hot water use (litres/day) 123.9349 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	134.8252	131.9464	128.4405	123.1092	118.7799	114.1255	112.3367	115.8275	119.5090	124.3953	129.8087	134.4755	(44)
Energy conte	213.5301	187.8899	197.4082	168.5303	159.9006	140.3306	135.8615	143.4186	147.3666	168.8033	184.9363	210.5561	(45)
Energy content (annual)											Total = Sum(45)m =	2058.5321	
Distribution loss (46)m = 0.15 x (45)m	32.0295	28.1835	29.6112	25.2795	23.9851	21.0496	20.3792	21.5128	22.1050	25.3205	27.7405	31.5834	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9180	(55)
Total storage loss	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(56)
If cylinder contains dedicated solar storage	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(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	265.2505	234.6051	249.1286	218.5823	211.6210	190.3826	187.5819	195.1390	197.4186	220.5237	234.9883	262.2765	(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	265.2505	234.6051	249.1286	218.5823	211.6210	190.3826	187.5819	195.1390	197.4186	220.5237	234.9883	262.2765	(64)
										Total per year (kWh/year) = Sum(64)m =		2667.4981	(64)
12Total per year (kWh/year)												2667	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000	(64a)
Heat gains from water heating, kWh/month	112.3751	99.8455	107.0146	96.0779	94.5433	86.7015	86.5503	89.0630	89.0410	97.5034	101.5329	111.3862	(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	124.8423	124.8423	124.8423	124.8423	124.8423	124.8423	124.8423	124.8423	124.8423	124.8423	124.8423	124.8423	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	114.8836	127.1926	114.8836	118.7130	114.8836	118.7130	114.8836	114.8836	118.7130	114.8836	118.7130	114.8836	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	223.2431	225.5596	219.7220	207.2943	191.6065	176.8622	167.0122	164.6956	170.5333	182.9610	198.6487	213.3930	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.4842	35.4842	35.4842	35.4842	35.4842	35.4842	35.4842	35.4842	35.4842	35.4842	35.4842	35.4842	(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)	-99.8739	-99.8739	-99.8739	-99.8739	-99.8739	-99.8739	-99.8739	-99.8739	-99.8739	-99.8739	-99.8739	-99.8739	(71)
Water heating gains (Table 5)	151.0418	148.5797	143.8368	133.4416	127.0743	120.4188	116.3310	119.7083	123.6680	131.0530	141.0180	149.7127	(72)
Total internal gains	552.6211	564.7846	541.8950	522.9016	497.0171	476.4468	458.6795	459.7402	473.3671	492.3502	521.8324	541.4420	(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	
East	7.8100	19.6403	0.6300	0.7000	0.7700	46.8781	(76)
South	2.7000	46.7521	0.6300	0.7000	0.7700	38.5777	(78)
West	4.3200	19.6403	0.6300	0.7000	0.7700	25.9300	(80)

Solar gains	111.3858	205.6085	315.0395	433.0507	514.0308	520.3903	497.7151	437.5257	356.8731	237.1489	136.5109	93.2086	(83)
Total gains	664.0070	770.3931	856.9345	955.9522	1011.0479	996.8371	956.3945	897.2660	830.2402	729.4992	658.3434	634.6505	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	41.6648	41.7956	41.9246	42.5411	42.6585	43.2136	43.2136	43.3179	42.9981	42.6585	42.4217	42.1770	
alpha	3.7777	3.7864	3.7950	3.8361	3.8439	3.8809	3.8809	3.8879	3.8665	3.8439	3.8281	3.8118	
util living area	0.9754	0.9570	0.9223	0.8407	0.7106	0.5385	0.3993	0.4406	0.6609	0.8778	0.9576	0.9789	(86)
MIT	19.4265	19.6910	20.0529	20.4933	20.7950	20.9479	20.9872	20.9813	20.8844	20.4784	19.8879	19.3910	(87)
Th 2	19.9843	19.9871	19.9899	20.0031	20.0056	20.0171	20.0171	20.0192	20.0126	20.0056	20.0006	19.9954	(88)
util rest of house	0.9702	0.9481	0.9064	0.8096	0.6584	0.4655	0.3134	0.3516	0.5883	0.8464	0.9473	0.9744	(89)
MIT 2	18.1701	18.5037	18.9540	19.4902	19.8260	19.9827	20.0116	20.0106	19.9277	19.4884	18.7648	18.1327	(90)
Living area fraction									fLA = Living area / (4) =			0.2375	(91)
MIT	18.4685	18.7857	19.2150	19.7285	20.0562	20.2120	20.2433	20.2412	20.1550	19.7235	19.0316	18.4316	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.3185	18.6357	19.0650	19.5785	19.9062	20.0620	20.0933	20.0912	20.0050	19.5735	18.8816	18.2816	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9583	0.9327	0.8884	0.7944	0.6528	0.4689	0.3202	0.3583	0.5877	0.8301	0.9322	0.9636	(94)
Useful gains	636.3486	718.5381	761.3117	759.4469	660.0236	467.4528	306.2011	321.4616	487.9566	605.5337	613.6751	611.5541	(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	1285.3014	1255.4317	1144.9012	958.9004	734.8664	482.8400	308.8121	325.5159	524.6156	803.5829	1060.9350	1275.4105	(97)
Space heating kWh	482.8209	360.7925	285.3906	143.6065	55.6831	0.0000	0.0000	0.0000	0.0000	147.3486	322.0271	493.9092	(98a)
Space heating requirement - total per year (kWh/year)												2291.5785	
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	482.8209	360.7925	285.3906	143.6065	55.6831	0.0000	0.0000	0.0000	0.0000	147.3486	322.0271	493.9092	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2291.5785	
Space heating per m2											(98c) / (4) =	28.0007	(99)

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

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

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

Efficiency of main space heating system 1 (in %) 88.6000 (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	482.8209	360.7925	285.3906	143.6065	55.6831	0.0000	0.0000	0.0000	0.0000	147.3486	322.0271	493.9092	(98)
Space heating efficiency (main heating system 1)	88.6000	88.6000	88.6000	88.6000	88.6000	0.0000	0.0000	0.0000	0.0000	88.6000	88.6000	88.6000	(210)
Space heating fuel (main heating system)	544.9446	407.2150	322.1113	162.0841	62.8477	0.0000	0.0000	0.0000	0.0000	166.3077	363.4618	557.4595	(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	265.2505	234.6051	249.1286	218.5823	211.6210	190.3826	187.5819	195.1390	197.4186	220.5237	234.9883	262.2765	(64)
Efficiency of water heater												79.6000	(216)
(217)m	85.1849	84.8211	84.1647	82.9405	81.3208	79.6000	79.6000	79.6000	79.6000	82.9761	84.5663	85.2566	(217)
Fuel for water heating, kWh/month	311.3821	276.5880	296.0012	263.5410	260.2298	239.1742	235.6557	245.1495	248.0133	265.7678	277.8748	307.6319	(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	23.8705	19.1498	17.2423	12.6325	9.7577	7.9721	8.9013	11.5702	15.0286	19.7183	22.2718	24.5340	(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 2586.4317 (211)

Space heating fuel - main system 2 0.0000 (213)

Space heating fuel - secondary 0.0000 (215)

Efficiency of water heater 79.6000

Water heating fuel used 3227.0094 (219)

Space cooling fuel 0.0000 (221)

Electricity for pumps and fans:

central heating pump 41.0000 (230c)

main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	86.0000	(231)
Electricity for lighting (calculated in Appendix L)	192.6489	(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	6092.0901	(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	2586.4317	0.2100	543.1507	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3227.0094	0.2100	677.6720	(264)
Space and water heating			1220.8226	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	192.6489	0.1443	27.8052	(268)
Total CO2, kg/year			1260.5571	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			15.4000	(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	2586.4317	1.1300	2922.6679	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3227.0094	1.1300	3646.5206	(278)
Space and water heating			6569.1885	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	192.6489	1.5338	295.4914	(282)
Total Primary energy kWh/year			6994.7806	(286)
Dwelling Primary energy Rate (DPER)			85.4700	(287)

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Main dwelling						
Ground floor	40.9200 (1b)	x	2.3500 (2b)	=	96.1620	(1b) - (3b)
First floor	40.9200 (1c)	x	2.6500 (2c)	=	108.4380	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	81.8400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	204.6000	(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) =	0.1466	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3966	(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) =	0.3669	(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	0.4678	0.4586	0.4494	0.4036	0.3944	0.3485	0.3485	0.3394	0.3669	0.3944	0.4127	0.4311	(22b)
Effective ac	0.6094	0.6052	0.6010	0.5814	0.5778	0.5607	0.5607	0.5576	0.5673	0.5778	0.5852	0.5929	(25)

3. Heat losses and heat loss parameter

Element	Gross	Openings	NetArea	U-value	A x U	K-value	A x K	
Main dwelling	m2	m2	m2	W/m2K	W/K	kJ/m2K	kJ/K	
TER Opaque door			2.3100	1.0000	2.3100			(26)
TER Opening Type			14.8300	1.1450	16.9809			(27)
Heatloss Floor 1			40.9200	0.1300	5.3196			(28a)
External Wall 1	90.6100	17.1400	73.4700	0.1800	13.2246			(29a)
External Roof 1	40.9200		40.9200	0.1100	4.5012			(30)
Total net area of external elements Aum(A, m2)			172.4500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		42.3363			(33)
Main dwelling								
Party Wall 1			42.8300	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 168.0389 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	12.2800	0.0500	0.6140
E3 Sill	9.6000	0.0500	0.4800
E4 Jamb	29.7000	0.0500	1.4850
E5 Ground floor (normal)	18.1200	0.1600	2.8992
E6 Intermediate floor within a dwelling	18.1200	0.0000	0.0000
E18 Party wall between dwellings	10.0000	0.0600	0.6000
P1 Party wall - Ground floor	8.5700	0.0800	0.6856
P2 Party wall - Intermediate floor within a dwelling	8.5700	0.0000	0.0000
P4 Party wall - Roof (insulation at ceiling level)	8.5700	0.1200	1.0284
E10 Eaves (insulation at ceiling level)	8.5700	0.0600	0.5142
E12 Gable (insulation at ceiling level)	9.5600	0.0600	0.5736
E16 Corner (normal)	10.0000	0.0900	0.9000

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 9.7800 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 52.1163 (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	41.1458	40.8590	40.5778	39.2572	39.0102	37.8600	37.8600	37.6470	38.3030	39.0102	39.5100	40.0326	(38)
Heat transfer coeff	93.2622	92.9753	92.6942	91.3736	91.1265	89.9763	89.9763	89.7633	90.4193	91.1265	91.6263	92.1489	(39)
Average = Sum(39)m / 12 =												91.3724	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1396	1.1361	1.1326	1.1165	1.1135	1.0994	1.0994	1.0968	1.1048	1.1135	1.1196	1.1260	(40)
HLP (average)												1.1165	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.4968 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	66.0836	65.0905	63.6434	60.8745	58.8311	56.5524	55.2572	56.6934	58.2677	60.7144	63.5427	65.8304	(42a)
Hot water usage for baths	28.5413	28.1175	27.5206	26.4200	25.5958	24.6820	24.1884	24.7812	25.4266	26.4044	27.5276	28.4449	(42b)
Hot water usage for other uses	40.2002	38.7384	37.2766	35.8147	34.3529	32.8911	32.8911	34.3529	35.8147	37.2766	38.7384	40.2002	(42c)
Average daily hot water use (litres/day)												123.9349	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	134.8252	131.9464	128.4405	123.1092	118.7799	114.1255	112.3367	115.8275	119.5090	124.3953	129.8087	134.4755	(44)
Energy conte	213.5301	187.8899	197.4082	168.5303	159.9006	140.3306	135.8615	143.4186	147.3666	168.8033	184.9363	210.5561	(45)
Energy content (annual)										Total = Sum(45)m =		2058.5321	
Distribution loss (46)m = 0.15 x (45)m	32.0295	28.1835	29.6112	25.2795	23.9851	21.0496	20.3792	21.5128	22.1050	25.3205	27.7405	31.5834	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7016	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9188	(55)
Total storage loss	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(56)
If cylinder contains dedicated solar storage	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(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	265.2767	234.6287	249.1548	218.6077	211.6472	190.4080	187.6081	195.1652	197.4439	220.5499	235.0137	262.3027	(62)
WWHRS	-30.2107	-26.7186	-27.9781	-23.1670	-21.5908	-18.4754	-17.3178	-18.4157	-19.1154	-22.5349	-25.5293	-29.6512	(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	235.0660	207.9102	221.1767	195.4407	190.0563	171.9326	170.2903	176.7495	178.3285	198.0149	209.4844	232.6515	(64)
										Total per year (kWh/year) = Sum(64)m =		2387.1015	(64)
12Total per year (kWh/year)												2387	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000	(64a)
Heat gains from water heating, kWh/month	112.3960	99.8645	107.0355	96.0982	94.5642	86.7218	86.5712	89.0840	89.0613	97.5244	101.5532	111.4072	(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	124.8423	124.8423	124.8423	124.8423	124.8423	124.8423	124.8423	124.8423	124.8423	124.8423	124.8423	124.8423	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	114.8836	127.1926	114.8836	118.7130	114.8836	118.7130	114.8836	114.8836	118.7130	114.8836	118.7130	114.8836	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	223.2431	225.5596	219.7220	207.2943	191.6065	176.8622	167.0122	164.6956	170.5333	182.9610	198.6487	213.3930	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.4842	35.4842	35.4842	35.4842	35.4842	35.4842	35.4842	35.4842	35.4842	35.4842	35.4842	35.4842	(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)	-99.8739	-99.8739	-99.8739	-99.8739	-99.8739	-99.8739	-99.8739	-99.8739	-99.8739	-99.8739	-99.8739	-99.8739	(71)
Water heating gains (Table 5)	151.0699	148.6078	143.8649	133.4697	127.1024	120.4470	116.3592	119.7365	123.6962	131.0811	141.0461	149.7408	(72)

Total internal gains

	552.6493	564.8127	541.9232	522.9297	497.0452	476.4750	458.7076	459.7684	473.3952	492.3784	521.8606	541.4701 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	7.8100	19.6403	0.6300	0.7000	0.7700	46.8781	(76)
South	2.7000	46.7521	0.6300	0.7000	0.7700	38.5777	(78)
West	4.3200	19.6403	0.6300	0.7000	0.7700	25.9300	(80)

Solar gains	111.3858	205.6085	315.0395	433.0507	514.0308	520.3903	497.7151	437.5257	356.8731	237.1489	136.5109	93.2086	(83)
Total gains	664.0351	770.4212	856.9626	955.9804	1011.0761	996.8652	956.4227	897.2941	830.2684	729.5273	658.3715	634.6787	(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	40.9607	41.0871	41.2117	41.8073	41.9207	42.4566	42.4566	42.5573	42.2485	41.9207	41.6920	41.4556	
alpha	3.7307	3.7391	3.7474	3.7872	3.7947	3.8304	3.8304	3.8372	3.8166	3.7947	3.7795	3.7637	
util living area	0.9757	0.9577	0.9239	0.8444	0.7166	0.5456	0.4055	0.4472	0.6675	0.8807	0.9583	0.9791	(86)
MIT	19.3877	19.6533	20.0193	20.4681	20.7807	20.9427	20.9856	20.9792	20.8754	20.4554	19.8551	19.3518	(87)
Th 2	19.9687	19.9715	19.9743	19.9874	19.9898	20.0013	20.0013	20.0034	19.9969	19.9898	19.9849	19.9797	(88)
util rest of house	0.9705	0.9489	0.9081	0.8134	0.6641	0.4711	0.3172	0.3558	0.5941	0.8494	0.9482	0.9746	(89)
MIT 2	18.1107	18.4457	18.9017	19.4487	19.7977	19.9636	19.9952	19.9939	19.9053	19.4496	18.7131	18.0729	(90)
Living area fraction									fLA = Living area / (4) =			0.2375	(91)
MIT	18.4140	18.7325	19.1671	19.6908	20.0312	20.1962	20.2305	20.2279	20.1357	19.6885	18.9844	18.3767	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4140	18.7325	19.1671	19.6908	20.0312	20.1962	20.2305	20.2279	20.1357	19.6885	18.9844	18.3767	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9598	0.9353	0.8930	0.8032	0.6664	0.4861	0.3378	0.3769	0.6050	0.8384	0.9351	0.9649	(94)
Useful gains	637.3649	720.5557	765.2759	767.8026	673.8122	484.6152	323.1248	338.2252	502.2805	611.6694	615.6472	612.4012	(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	1316.3041	1286.0857	1174.1704	985.9968	759.1912	503.5257	326.6560	343.6078	545.7460	828.2046	1088.9237	1306.3632	(97)
Space heating kWh	505.1308	380.0361	304.2175	157.0998	63.5220	0.0000	0.0000	0.0000	0.0000	161.1021	340.7591	516.3078	(98a)
Space heating requirement - total per year (kWh/year)												2428.1753	
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	505.1308	380.0361	304.2175	157.0998	63.5220	0.0000	0.0000	0.0000	0.0000	161.1021	340.7591	516.3078	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2428.1753	
Space heating per m2											(98c) / (4) =	29.6698	(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	505.1308	380.0361	304.2175	157.0998	63.5220	0.0000	0.0000	0.0000	0.0000	161.1021	340.7591	516.3078	(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)	547.2706	411.7401	329.5965	170.2057	68.8212	0.0000	0.0000	0.0000	0.0000	174.5419	369.1865	559.3800	(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	235.0660	207.9102	221.1767	195.4407	190.0563	171.9326	170.2903	176.7495	178.3285	198.0149	209.4844	232.6515	(64)
Efficiency of water heater												79.8000	(216)
(217)m	85.7295	85.3943	84.7750	83.5746	81.8788	79.8000	79.8000	79.8000	79.8000	83.6011	85.1441	85.7943	(217)
Fuel for water heating, kWh/month	274.1951	243.4708	260.8983	233.8517	232.1191	215.4544	213.3964	221.4906	223.4693	236.8569	246.0350	271.1736	(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	23.8705	19.1498	17.2423	12.6325	9.7577	7.9721	8.9013	11.5702	15.0286	19.7183	22.2718	24.5340	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-38.0695	-53.5614	-76.8370	-86.2175	-92.8210	-86.5789	-85.4958	-80.7744	-72.4337	-61.1475	-41.8087	-32.9251	(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	-21.8455	-45.9170	-91.1965	-136.8795	-180.9070	-181.7471	-179.6203	-152.1333	-111.5665	-65.6503	-29.1612	-17.2789	(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	2630.7424	(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	2872.4113	(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)	192.6489	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-2022.5734	(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	3759.2292	(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	2630.7424	0.2100	552.4559	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2872.4113	0.2100	603.2064	(264)
Space and water heating			1155.6623	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	192.6489	0.1443	27.8052	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-808.6704	0.1346	-108.8718	
PV Unit electricity exported	-1213.9030	0.1259	-152.8478	
Total			-261.7196	(269)
Total CO2, kg/year			933.6772	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			11.4100	(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	2630.7424	1.1300	2972.7389	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2872.4113	1.1300	3245.8247	(278)
Space and water heating			6218.5637	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	192.6489	1.5338	295.4914	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-808.6704	1.4976	-1211.0441	
PV Unit electricity exported	-1213.9030	0.4622	-561.0574	
Total			-1772.1015	(283)
Total Primary energy kWh/year			4872.0543	(286)
Target Primary Energy Rate (TPER)			59.5300	(287)

Building Regulations England Part L (BREL) Compliance Report

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

Date: Fri 14 Mar 2025 09:30:50

Project Information			
Assessed By	Richard Millard	Building Type	House, Mid-terrace
OCDEA Registration	EES/025661	Assessment Date	2025-03-14

Dwelling Details			
Assessment Type	As designed	Total Floor Area	82 m^2
Site Reference	A2 Mid	Plot Reference	Proposed
Address	45, Leonard Stanley		

Client Details	
Name	Ian White
Company	Cotswold Homes Ltd
Address	West House, Yate, Bristol, BS37 5NG

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

1a Target emission rate and dwelling emission rate		
Fuel for main heating system	Electricity	
Target carbon dioxide emission rate	*10.35 $kgCO_2/m^2$*	
Dwelling carbon dioxide emission rate	2.83 $kgCO_2/m^2$	OK
1b Target primary energy rate and dwelling primary energy		
Target primary energy	*53.9 kWh_{PE}/m^2*	
Dwelling primary energy	34.18 kWh_{PE}/m^2	OK
1c Target fabric energy efficiency and dwelling fabric energy efficiency		
Target fabric energy efficiency	*31.7 kWh/m^2*	
Dwelling fabric energy efficiency	30.3 kWh/m^2	OK

2a Fabric U-values				
Element	***Maximum permitted average U-Value [W/m^2K]***	**Dwelling average U-Value [W/m^2K]**	**Element with highest individual U-Value**	
External walls	*0.26*	0.18	Walls (1) (0.18)	OK
Party walls	*0.2*	0	Party Wall (1) (0)	**N/A**
Curtain walls	*1.6*	0	N/A	**N/A**
Floors	*0.18*	0.12	Heatloss Floor 1 (0.12)	OK
Roofs	*0.16*	0.11	Roof (1) (0.11)	OK
Windows, doors, and roof windows	*1.6*	1.2	PL-W01 (1.2)	OK
Rooflights	*2.2*	N/A	N/A	**N/A**

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))		
Name	**Net area [m^2]**	**U-Value [W/m^2K]**
Exposed wall: Walls (1)	33.34	0.18
Party wall: Party Wall (1)	85.65	0 **(!)**
Ground floor: Heatloss Floor 1, Heatloss Floor 1	40.92	0.12
Exposed roof: Roof (1)	40.92	0.11

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	**Area [m^2]**	**Orientation**	**Frame factor**	**U-Value [W/m^2K]**
PL-W01, Windows	1.62	East	0.7	1.2
PL-ED01, Half Glazed Door	2.31	West	N/A	1.2
PL-ED02, Windows	3.31	East	0.7	1.2
PL-W04, Windows	1.44	West	0.7	1.2
PL-W05, Windows	1.44	East	0.7	1.2
PL-W06, Windows	1.44	East	0.7	1.2
PL-W08, Windows	1.44	West	0.7	1.2
PL-W09, Windows	1.44	West	0.7	1.2

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))
Building part **1**: Thermal bridging calculated from linear thermal transmittances for each junction

Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E1: Steel lintel with perforated steel base plate	Not government-approved scheme	0.241	EMPF125E101
External wall	E3: Sill	Not government-approved scheme	0.026 **(!)**	EMPF125E301
External wall	E4: Jamb	Not government-approved scheme	0.02 **(!)**	EMPF125E401
External wall	E5: Ground floor (normal)	Not government-approved scheme	0.045	EMPF125E504
External wall	E6: Intermediate floor within a dwelling	Not government-approved scheme	0.002 **(!)**	EMPF125E601
External wall	E18: Party wall between dwellings	Not government-approved scheme	0.06	EMPF125E21802
Party wall	P1: Ground floor	Not government-approved scheme	0.043	MCPF-P1-04
Party wall	P2: Intermediate floor within a dwelling	SAP table default	0 **(!)**	
Party wall	P4: Roof (insulation at ceiling level)	Not government-approved scheme	0.033 **(!)**	MCPF-P4-01
External wall	E10: Eaves (insulation at ceiling level)	Not government-approved scheme	0.05	EMPF125E1001

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

4 Space heating	
Main heating system 1: Heat pump with radiators or underfloor heating - Electricity	
Efficiency	236.5%
Emitter type	Radiators
Flow temperature	55°C
System type	Heat Pump
Manufacturer	Daikin Europe NV
Model	EDLA08EV3
Commissioning	
Secondary heating system: N/A	
Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water	
Cylinder/store - type: Cylinder	
Capacity	210 litres
Declared heat loss	1.7 kWh/day
Primary pipework insulated	Yes
Manufacturer	
Model	
Commissioning	
Waste water heat recovery system 1 - type: N/A	
Efficiency	
Manufacturer	
Model	

6 Controls	
Main heating 1 - type: Time and temperature zone control by arrangement of plumbing and electrical services	
Function	
Ecodesign class	
Manufacturer	
Model	
Water heating - type: Cylinder thermostat and HW separately timed	
Manufacturer	
Model	

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

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

9 Local generation	
Technology type: **Photovoltaic system (1)**	
Peak power	1.34 kWp
Orientation	South
Pitch	30°
Overshading	None or very little
Manufacturer	
MCS certificate	

10 Heat networks
N/A

11 Supporting documentary evidence
N/A

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

Full SAP Calculation Printout

Property Reference	A2 Mid	**Issued on Date**	14/03/2025
Assessment Reference	Proposed	**Prop Type Ref**	Proposed 45
Property	45, Leonard Stanley		

SAP Rating	87 B	**DER**	2.83	**TER**	10.35
Environmental	98 A	**% DER < TER**			72.66
CO_2 Emissions (t/year)	0.2	**DFEE**	30.33	**TFEE**	31.71
Compliance Check	See BREL	**% DFEE < TFEE**			4.37
% DPER < TPER	36.58	**DPER**	34.18	**TPER**	53.90

Assessor Details	Mr. Richard Millard	**Assessor ID**	U367-0001
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)	
Main dwelling						
Ground floor	40.9200 (1b)	x	2.3500 (2b)	=	96.1620	(1b) - (3b)
First floor	40.9200 (1c)	x	2.6500 (2c)	=	108.4380	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	81.8400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	204.6000	(5)

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2. Ventilation rate

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			m3 per hour	
Number of open chimneys		0 * 80 =	0.0000	(6a)
Number of open flues		0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire		0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler		0 * 20 =	0.0000	(6d)
Number of flues attached to other heater		0 * 35 =	0.0000	(6e)
Number of blocked chimneys		0 * 20 =	0.0000	(6f)
Number of intermittent extract fans		3 * 10 =	30.0000	(7a)
Number of passive vents		0 * 10 =	0.0000	(7b)
Number of flueless gas fires		0 * 40 =	0.0000	(7c)
			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =		30.0000 / (5) =	0.1466	(8)
Pressure test			Yes	
Pressure Test Method			Blower Door	
Measured/design AP50			5.0000	(17)
Infiltration rate			0.3966	(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) =	0.3669	(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	0.4678	0.4586	0.4494	0.4036	0.3944	0.3485	0.3485	0.3394	0.3669	0.3944	0.4127	0.4311	(22b)
Effective ac	0.6094	0.6052	0.6010	0.5814	0.5778	0.5607	0.5607	0.5576	0.5673	0.5778	0.5852	0.5929	(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	
Main dwelling								
Windows			12.1300	1.1450	13.8893			(27)
Half Glazed Door			2.3100	1.2000	2.7720			(26a)
Heatloss Floor 1			40.9200	0.1200	4.9104	75.0000	3069.0000	(28a)
External Wall 1	47.7800	14.4400	33.3400	0.1800	6.0012	60.0000	2000.3999	(29a)
External Roof 1	40.9200		40.9200	0.1100	4.5012	9.0000	368.2800	(30)
Total net area of external elements Aum(A, m2)			129.6200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		32.0741			(33)
Main dwelling								
Party Wall 1			85.6500	0.0000	0.0000	45.0000	3854.2501	(32)
Internal Wall 1			23.4100			75.0000	1755.7500	(32c)
Internal Wall 2			124.3200			9.0000	1118.8800	(32c)
Internal Floor 1			40.9200			18.0000	736.5600	(32d)
Internal Ceiling 1			40.9200			9.0000	368.2800	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		13271.4000	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							162.1628	(35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	9.8800	0.2410	2.3811

E3 Sill	7.2000	0.0260	0.1872	
E4 Jamb	23.1000	0.0200	0.4620	
E5 Ground floor (normal)	9.5600	0.0450	0.4302	
E6 Intermediate floor within a dwelling	9.5600	0.0020	0.0191	
E18 Party wall between dwellings	20.0000	0.0600	1.2000	
P1 Party wall - Ground floor	17.1300	0.0430	0.7366	
P2 Party wall - Intermediate floor within a dwelling	17.1300	0.0000	0.0000	
P4 Party wall - Roof (insulation at ceiling level)	17.1300	0.0330	0.5653	
E10 Eaves (insulation at ceiling level)	9.5600	0.0500	0.4780	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 6.4595 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 38.5336 (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	41.1458	40.8590	40.5778	39.2572	39.0102	37.8600	37.8600	37.6470	38.3030	39.0102	39.5100	40.0326	(38)
Heat transfer coeff	79.6794	79.3926	79.1114	77.7908	77.5438	76.3936	76.3936	76.1806	76.8366	77.5438	78.0436	78.5662	(39)

Average = Sum(39)m / 12 = 77.7897

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9736	0.9701	0.9667	0.9505	0.9475	0.9335	0.9335	0.9308	0.9389	0.9475	0.9536	0.9600	(40)
HLP (average)												0.9505	
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 2.4968 (42)

Hot water usage for mixer showers

66.0836	65.0905	63.6434	60.8745	58.8311	56.5524	55.2572	56.6934	58.2677	60.7144	63.5427	65.8304	(42a)

Hot water usage for baths

28.5413	28.1175	27.5206	26.4200	25.5958	24.6820	24.1884	24.7812	25.4266	26.4044	27.5276	28.4449	(42b)

Hot water usage for other uses

40.2002	38.7384	37.2766	35.8147	34.3529	32.8911	32.8911	34.3529	35.8147	37.2766	38.7384	40.2002	(42c)

Average daily hot water use (litres/day) 123.9349 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	134.8252	131.9464	128.4405	123.1092	118.7799	114.1255	112.3367	115.8275	119.5090	124.3953	129.8087	134.4755	(44)
Energy conte	213.5301	187.8899	197.4082	168.5303	159.9006	140.3306	135.8615	143.4186	147.3666	168.8033	184.9363	210.5561	(45)
Energy content (annual)										Total = Sum(45)m =		2058.5321	
Distribution loss (46)m = 0.15 x (45)m	32.0295	28.1835	29.6112	25.2795	23.9851	21.0496	20.3792	21.5128	22.1050	25.3205	27.7405	31.5834	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9180	(55)
Total storage loss	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(56)
If cylinder contains dedicated solar storage	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(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	265.2505	234.6051	249.1286	218.5823	211.6210	190.3826	187.5819	195.1390	197.4186	220.5237	234.9883	262.2765	(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	265.2505	234.6051	249.1286	218.5823	211.6210	190.3826	187.5819	195.1390	197.4186	220.5237	234.9883	262.2765	(64)
										Total per year (kWh/year) = Sum(64)m =		2667.4981	(64)
12Total per year (kWh/year)												2667	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000	(64a)
Heat gains from water heating, kWh/month	112.3751	99.8455	107.0146	96.0779	94.5433	86.7015	86.5503	89.0630	89.0410	97.5034	101.5329	111.3862	(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	124.8423	124.8423	124.8423	124.8423	124.8423	124.8423	124.8423	124.8423	124.8423	124.8423	124.8423	124.8423	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	119.3296	132.1150	119.3296	123.3073	119.3296	123.3073	119.3296	119.3296	123.3073	119.3296	123.3073	119.3296	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	223.2431	225.5596	219.7220	207.2943	191.6065	176.8622	167.0122	164.6956	170.5333	182.9610	198.6487	213.3930	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.4842	35.4842	35.4842	35.4842	35.4842	35.4842	35.4842	35.4842	35.4842	35.4842	35.4842	35.4842	(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)	-99.8739	-99.8739	-99.8739	-99.8739	-99.8739	-99.8739	-99.8739	-99.8739	-99.8739	-99.8739	-99.8739	-99.8739	(71)
Water heating gains (Table 5)	151.0418	148.5797	143.8368	133.4416	127.0743	120.4188	116.3310	119.7083	123.6680	131.0530	141.0180	149.7127	(72)
Total internal gains	554.0672	566.7070	543.3411	524.4958	498.4631	481.0410	463.1255	464.1863	477.9613	493.7963	523.4267	542.8880	(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	
East	7.8100	19.6403	0.6300	0.7000	0.7700	46.8781	(76)
West	4.3200	19.6403	0.6300	0.7000	0.7700	25.9300	(80)

Solar gains	72.8081	142.4282	234.5589	342.0902	419.2444	429.1712	408.5885	350.9715	272.8017	169.0030	90.7832	59.8739	(83)
Total gains	626.8753	709.1351	777.9000	866.5860	917.7075	910.2122	871.7140	815.1577	750.7630	662.7993	614.2099	602.7619	(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	46.2666	46.4338	46.5988	47.3899	47.5409	48.2567	48.2567	48.3916	47.9784	47.5409	47.2364	46.9222	
alpha	4.0844	4.0956	4.1066	4.1593	4.1694	4.2171	4.2171	4.2261	4.1986	4.1694	4.1491	4.1281	
util living area	0.9750	0.9580	0.9243	0.8380	0.6993	0.5183	0.3813	0.4229	0.6486	0.8766	0.9567	0.9782	(86)
Living	19.6345	19.8624	20.1859	20.5893	20.8483	20.9671	20.9928	20.9890	20.9172	20.5692	20.0514	19.6090	
Non living	18.5193	18.8072	19.2108	19.7035	19.9919	20.1167	20.1359	20.1360	20.0718	19.6933	19.0581	18.4951	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	20.3015	19.8624	20.1859	20.5893	20.8483	20.9671	20.9928	20.9890	20.9172	20.5692	20.0514	19.8035	(87)
Th 2	20.1054	20.1083	20.1112	20.1248	20.1273	20.1392	20.1392	20.1414	20.1346	20.1273	20.1222	20.1168	(88)
util rest of house	0.9701	0.9500	0.9098	0.8092	0.6519	0.4549	0.3086	0.3470	0.5836	0.8477	0.9471	0.9739	(89)
MIT 2	19.4731	18.8072	19.2108	19.7035	19.9919	20.1167	20.1359	20.1360	20.0718	19.6933	19.0581	18.7873	(90)
Living area fraction									fLA = Living area / (4) =			0.2375	(91)
MIT	19.6698	19.0578	19.4424	19.9139	20.1953	20.3187	20.3394	20.3386	20.2726	19.9014	19.2940	19.0287	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.6698	19.0578	19.4424	19.9139	20.1953	20.3187	20.3394	20.3386	20.2726	19.9014	19.2940	19.0287	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9672	0.9381	0.8969	0.8016	0.6558	0.4684	0.3257	0.3647	0.5945	0.8390	0.9356	0.9671	(94)
Useful gains	606.3409	665.2587	697.7177	694.6220	601.8451	426.3637	283.9239	297.2530	446.3220	556.1182	574.6590	582.9302	(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	1224.6601	1124.0283	1023.8921	856.7795	658.7595	436.8726	285.6676	300.0444	474.2846	721.2644	951.6673	1165.0346	(97)
Space heating kWh	460.0295	308.2932	242.6738	116.7534	42.3443	0.0000	0.0000	0.0000	0.0000	122.8687	271.4460	433.0857	(98a)
Space heating requirement - total per year (kWh/year)												1997.4946	
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	460.0295	308.2932	242.6738	116.7534	42.3443	0.0000	0.0000	0.0000	0.0000	122.8687	271.4460	433.0857	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1997.4946	
Space heating per m2										(98c) / (4) =		24.4073	(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 %) 236.4667 (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	460.0295	308.2932	242.6738	116.7534	42.3443	0.0000	0.0000	0.0000	0.0000	122.8687	271.4460	433.0857	(98)
Space heating efficiency (main heating system 1)	236.4667	236.4667	236.4667	236.4667	236.4667	0.0000	0.0000	0.0000	0.0000	236.4667	236.4667	236.4667	(210)
Space heating fuel (main heating system)	194.5430	130.3749	102.6249	49.3741	17.9071	0.0000	0.0000	0.0000	0.0000	51.9603	114.7925	183.1487	(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	265.2505	234.6051	249.1286	218.5823	211.6210	190.3826	187.5819	195.1390	197.4186	220.5237	234.9883	262.2765	(64)
Efficiency of water heater												170.7804	(216)
(217)m	170.7804	170.7804	170.7804	170.7804	170.7804	170.7804	170.7804	170.7804	170.7804	170.7804	170.7804	170.7804	(217)
Fuel for water heating, kWh/month	155.3167	137.3724	145.8766	127.9903	123.9141	111.4780	109.8381	114.2631	115.5979	129.1270	137.5968	153.5753	(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	24.7943	19.8909	17.9096	13.1213	10.1353	8.2806	9.2458	12.0180	15.6102	20.4814	23.1337	25.4835	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-26.7252	-40.4286	-62.1402	-73.5688	-82.1309	-76.9332	-75.8837	-69.8103	-59.2657	-47.2862	-30.0798	-22.7210	(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	-6.8327	-15.5700	-33.2318	-54.2485	-75.7766	-78.3150	-77.3128	-64.0383	-45.5646	-24.3006	-9.7248	-5.3612	(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												844.7255	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												170.7804	
Water heating fuel used												1561.9463	(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)	200.1045	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-1157.2504	(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	1449.5260	(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	844.7255	0.1562	131.9498	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1561.9463	0.1409	220.1156	(264)
Space and water heating			352.0654	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	200.1045	0.1443	28.8813	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-666.9736	0.1336	-89.0746	
PV Unit electricity exported	-490.2768	0.1237	-60.6232	
Total			-149.6978	(269)
Total CO2, kg/year			231.2489	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			2.8300	(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	844.7255	1.5783	1333.1967	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1561.9463	1.5211	2375.8558	(278)
Space and water heating			3709.0525	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	200.1045	1.5338	306.9270	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-666.9736	1.4935	-996.1432	
PV Unit electricity exported	-490.2768	0.4538	-222.4747	
Total			-1218.6179	(283)
Total Primary energy kWh/year			2797.3617	(286)
Dwelling Primary energy Rate (DPER)			34.1800	(287)

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Main dwelling						
Ground floor	40.9200	(1b)	x 2.3500	(2b) =	96.1620	(1b) - (3b)
First floor	40.9200	(1c)	x 2.6500	(2c) =	108.4380	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	81.8400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		204.6000	(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) =	0.1466	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3966	(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) =	0.3669	(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	0.4678	0.4586	0.4494	0.4036	0.3944	0.3485	0.3485	0.3394	0.3669	0.3944	0.4127	0.4311	(22b)
Effective ac	0.6094	0.6052	0.6010	0.5814	0.5778	0.5607	0.5607	0.5576	0.5673	0.5778	0.5852	0.5929	(25)

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3. Heat losses and heat loss parameter

Element	Gross	Openings	NetArea	U-value	A x U	K-value	A x K	
Main dwelling	m2	m2	m2	W/m2K	W/K	kJ/m2K	kJ/K	
TER Semi-glazed door			2.3100	1.0000	2.3100			(26a)
TER Opening Type			12.1300	1.1450	13.8893			(27)
Heatloss Floor 1			40.9200	0.1300	5.3196			(28a)
External Wall 1	47.7800	14.4400	33.3400	0.1800	6.0012			(29a)
External Roof 1	40.9200		40.9200	0.1100	4.5012			(30)
Total net area of external elements Aum(A, m2)			129.6200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	32.0213			(33)
Main dwelling								
Party Wall 1			85.6500	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 162.1628 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	9.8800	0.0500	0.4940
E3 Sill	7.2000	0.0500	0.3600
E4 Jamb	23.1000	0.0500	1.1550
E5 Ground floor (normal)	9.5600	0.1600	1.5296
E6 Intermediate floor within a dwelling	9.5600	0.0000	0.0000
E18 Party wall between dwellings	20.0000	0.0600	1.2000
P1 Party wall - Ground floor	17.1300	0.0800	1.3704
P2 Party wall - Intermediate floor within a dwelling	17.1300	0.0000	0.0000
P4 Party wall - Roof (insulation at ceiling level)	17.1300	0.1200	2.0556
E10 Eaves (insulation at ceiling level)	9.5600	0.0600	0.5736

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 8.7382 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 40.7595 (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	41.1458	40.8590	40.5778	39.2572	39.0102	37.8600	37.8600	37.6470	38.3030	39.0102	39.5100	40.0326	(38)
Heat transfer coeff	81.9054	81.6185	81.3374	80.0168	79.7697	78.6195	78.6195	78.4065	79.0625	79.7697	80.2695	80.7921	(39)
Average = Sum(39)m / 12 =												80.0156	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0008	0.9973	0.9939	0.9777	0.9747	0.9606	0.9606	0.9580	0.9661	0.9747	0.9808	0.9872	(40)
HLP (average)												0.9777	
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 2.4968 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	66.0836	65.0905	63.6434	60.8745	58.8311	56.5524	55.2572	56.6934	58.2677	60.7144	63.5427	65.8304	(42a)
Hot water usage for baths	28.5413	28.1175	27.5206	26.4200	25.5958	24.6820	24.1884	24.7812	25.4266	26.4044	27.5276	28.4449	(42b)
Hot water usage for other uses	40.2002	38.7384	37.2766	35.8147	34.3529	32.8911	32.8911	34.3529	35.8147	37.2766	38.7384	40.2002	(42c)
Average daily hot water use (litres/day)												123.9349	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	134.8252	131.9464	128.4405	123.1092	118.7799	114.1255	112.3367	115.8275	119.5090	124.3953	129.8087	134.4755	(44)
Energy conte	213.5301	187.8899	197.4082	168.5303	159.9006	140.3306	135.8615	143.4186	147.3666	168.8033	184.9363	210.5561	(45)
Energy content (annual)											Total = Sum(45)m =	2058.5321	
Distribution loss (46)m = 0.15 x (45)m	32.0295	28.1835	29.6112	25.2795	23.9851	21.0496	20.3792	21.5128	22.1050	25.3205	27.7405	31.5834	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7016	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9188	(55)
Total storage loss	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(56)
If cylinder contains dedicated solar storage	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(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	265.2767	234.6287	249.1548	218.6077	211.6472	190.4080	187.6081	195.1652	197.4439	220.5499	235.0137	262.3027	(62)
WWHRS	-30.2107	-26.7186	-27.9781	-23.1670	-21.5908	-18.4754	-17.3178	-18.4157	-19.1154	-22.5349	-25.5293	-29.6512	(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	235.0660	207.9102	221.1767	195.4407	190.0563	171.9326	170.2903	176.7495	178.3285	198.0149	209.4844	232.6515	(64)
										Total per year (kWh/year) = Sum(64)m =		2387.1015	(64)
12Total per year (kWh/year)												2387	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000	(64a)
Heat gains from water heating, kWh/month	112.3960	99.8645	107.0355	96.0982	94.5642	86.7218	86.5712	89.0840	89.0613	97.5244	101.5532	111.4072	(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	124.8423	124.8423	124.8423	124.8423	124.8423	124.8423	124.8423	124.8423	124.8423	124.8423	124.8423	124.8423	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	119.3296	132.1150	119.3296	123.3073	119.3296	123.3073	119.3296	119.3296	123.3073	119.3296	123.3073	119.3296	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													

	223.2431	225.5596	219.7220	207.2943	191.6065	176.8622	167.0122	164.6956	170.5333	182.9610	198.6487	213.3930 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	35.4842	35.4842	35.4842	35.4842	35.4842	35.4842	35.4842	35.4842	35.4842	35.4842	35.4842	35.4842 (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)												
	-99.8739	-99.8739	-99.8739	-99.8739	-99.8739	-99.8739	-99.8739	-99.8739	-99.8739	-99.8739	-99.8739	-99.8739 (71)
Water heating gains (Table 5)												
	151.0699	148.6078	143.8649	133.4697	127.1024	120.4470	116.3592	119.7365	123.6962	131.0811	141.0461	149.7408 (72)
Total internal gains												
	557.0953	569.7351	546.3692	527.5240	501.4913	481.0692	463.1537	464.2144	477.9895	496.8244	526.4548	545.9162 (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	
East	7.8100	19.6403	0.6300	0.7000	0.7700	46.8781	(76)
West	4.3200	19.6403	0.6300	0.7000	0.7700	25.9300	(80)

Solar gains	72.8081	142.4282	234.5589	342.0902	419.2444	429.1712	408.5885	350.9715	272.8017	169.0030	90.7832	59.8739	(83)
Total gains	629.9035	712.1633	780.9281	869.6142	920.7356	910.2404	871.7422	815.1859	750.7912	665.8275	617.2380	605.7900	(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	45.0093	45.1674	45.3236	46.0716	46.2143	46.8904	46.8904	47.0178	46.6277	46.2143	45.9265	45.6295	
alpha	4.0006	4.0112	4.0216	4.0714	4.0810	4.1260	4.1260	4.1345	4.1085	4.0810	4.0618	4.0420	
util living area													
	0.9752	0.9588	0.9263	0.8434	0.7084	0.5303	0.3915	0.4338	0.6601	0.8804	0.9575	0.9784	(86)
MIT	19.5800	19.8094	20.1391	20.5549	20.8300	20.9610	20.9912	20.9866	20.9051	20.5382	20.0060	19.5540	(87)
Th 2	20.0827	20.0856	20.0885	20.1019	20.1045	20.1163	20.1163	20.1184	20.1117	20.1045	20.0994	20.0940	(88)
util rest of house													
	0.9703	0.9509	0.9120	0.8148	0.6604	0.4645	0.3152	0.3544	0.5938	0.8516	0.9479	0.9741	(89)
MIT 2	18.4347	18.7247	19.1364	19.6451	19.9526	20.0896	20.1122	20.1119	20.0397	19.6391	18.9852	18.4098	(90)
Living area fraction										fLA = Living area / (4) =		0.2375	(91)
MIT	18.7068	18.9824	19.3746	19.8612	20.1610	20.2966	20.3210	20.3197	20.2452	19.8526	19.2276	18.6815	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7068	18.9824	19.3746	19.8612	20.1610	20.2966	20.3210	20.3197	20.2452	19.8526	19.2276	18.6815	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9604	0.9387	0.8986	0.8062	0.6636	0.4783	0.3331	0.3728	0.6043	0.8422	0.9361	0.9650	(94)
Useful gains	604.9875	668.4805	701.7612	701.1113	611.0041	435.3400	290.3860	303.9125	453.6970	560.7844	577.8167	584.5993	(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													
	1179.9921	1149.3829	1047.1829	877.0775	674.9325	447.8638	292.5422	307.3274	485.8587	738.0799	973.4804	1169.9941	(97)
Space heating kWh													
	427.8034	323.1664	256.9938	126.6957	47.5627	0.0000	0.0000	0.0000	0.0000	131.9078	284.8779	435.5337	(98a)
Space heating requirement - total per year (kWh/year)												2034.5414	
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													
	427.8034	323.1664	256.9938	126.6957	47.5627	0.0000	0.0000	0.0000	0.0000	131.9078	284.8779	435.5337	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2034.5414	
Space heating per m2											(98c) / (4) =	24.8600	(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													
	427.8034	323.1664	256.9938	126.6957	47.5627	0.0000	0.0000	0.0000	0.0000	131.9078	284.8779	435.5337	(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)													
	463.4923	350.1261	278.4331	137.2651	51.5306	0.0000	0.0000	0.0000	0.0000	142.9121	308.6434	471.8675	(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													
	235.0660	207.9102	221.1767	195.4407	190.0563	171.9326	170.2903	176.7495	178.3285	198.0149	209.4844	232.6515	(64)
Efficiency of water heater												79.8000	(216)
(217)m	85.3851	85.0450	84.3972	83.1130	81.4524	79.8000	79.8000	79.8000	79.8000	83.1702	84.7497	85.4447	(217)
Fuel for water heating, kWh/month													
	275.3011	244.4707	262.0662	235.1505	233.3342	215.4544	213.3964	221.4906	223.4693	238.0840	247.1800	272.2832	(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	24.7943	19.8909	17.9096	13.1213	10.1353	8.2806	9.2458	12.0180	15.6102	20.4814	23.1337	25.4835	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-38.0969	-53.6082	-76.9085	-86.2963	-92.8992	-86.6484	-85.5734	-80.8635	-72.5238	-61.2176	-41.8461	-32.9485	(233a)

Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233b)m	-21.8181	-45.8702	-91.1250	-136.8007	-180.8288	-181.6777	-179.5427	-152.0442	-111.4764	-65.5802	-29.1237	-17.2554 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235b)m	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	(235d)

Annual totals kWh/year		
Space heating fuel - main system 1	2204.2702	(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	2881.6806	(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)	200.1045	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-2022.5734	(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	3349.4819	(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	2204.2702	0.2100	462.8967	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2881.6806	0.2100	605.1529	(264)
Space and water heating			1068.0497	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	200.1045	0.1443	28.8813	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-809.4303	0.1346	-108.9732	
PV Unit electricity exported	-1213.1431	0.1259	-152.7455	
Total			-261.7187	(269)
Total CO2, kg/year			847.1415	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			10.3500	(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	2204.2702	1.1300	2490.8254	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2881.6806	1.1300	3256.2991	(278)
Space and water heating			5747.1244	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	200.1045	1.5338	306.9270	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-809.4303	1.4976	-1212.1788	
PV Unit electricity exported	-1213.1431	0.4622	-560.6819	
Total			-1772.8607	(283)
Total Primary energy kWh/year			4411.2915	(286)
Target Primary Energy Rate (TPER)			53.9000	(287)

Building Regulations England Part L (BREL) Compliance Report

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

Date: Fri 14 Mar 2025 09:30:52

Project Information			
Assessed By	Richard Millard	Building Type	House, Mid-terrace
OCDEA Registration	EES/025661	Assessment Date	2025-03-14

Dwelling Details			
Assessment Type	As designed	Total Floor Area	82 m^2
Site Reference	A2 Mid	Plot Reference	Regulated (Baseline)
Address	45, Leonard Stanley		

Client Details	
Name	Ian White
Company	Cotswold Homes Ltd
Address	West House, Yate, Bristol, BS37 5NG

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

1a Target emission rate and dwelling emission rate		
Fuel for main heating system	Mains gas	
Target carbon dioxide emission rate	*10.35 $kgCO_2/m^2$*	
Dwelling carbon dioxide emission rate	14.31 $kgCO_2/m^2$	**FAIL**
1b Target primary energy rate and dwelling primary energy		
Target primary energy	*53.9 kWh_{PE}/m^2*	
Dwelling primary energy	79.64 kWh_{PE}/m^2	**FAIL**
1c Target fabric energy efficiency and dwelling fabric energy efficiency		
Target fabric energy efficiency	*31.7 kWh/m^2*	
Dwelling fabric energy efficiency	30.7 kWh/m^2	**OK**

2a Fabric U-values				
Element	***Maximum permitted average U-Value [W/m^2K]***	**Dwelling average U-Value [W/m^2K]**	**Element with highest individual U-Value**	
External walls	*0.26*	0.18	Walls (1) (0.18)	**OK**
Party walls	*0.2*	0	Party Wall (1) (0)	**N/A**
Curtain walls	*1.6*	0	N/A	**N/A**
Floors	*0.18*	0.13	Heatloss Floor 1 (0.13)	**OK**
Roofs	*0.16*	0.11	Roof (1) (0.11)	**OK**
Windows, doors, and roof windows	*1.6*	1.2	PL-W01 (1.2)	**OK**
Rooflights	*2.2*	N/A	N/A	**N/A**

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))		
Name	**Net area [m^2]**	**U-Value [W/m^2K]**
Exposed wall: Walls (1)	33.34	0.18
Party wall: Party Wall (1)	85.65	0 **(!)**
Ground floor: Heatloss Floor 1, Heatloss Floor 1	40.92	0.13
Exposed roof: Roof (1)	40.92	0.11

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	**Area [m^2]**	**Orientation**	**Frame factor**	**U-Value [W/m^2K]**
PL-W01, Windows	1.62	East	0.7	1.2
PL-ED01, Half Glazed Door	2.31	West	N/A	1.2
PL-ED02, Windows	3.31	East	0.7	1.2
PL-W04, Windows	1.44	West	0.7	1.2
PL-W05, Windows	1.44	East	0.7	1.2
PL-W06, Windows	1.44	East	0.7	1.2
PL-W08, Windows	1.44	West	0.7	1.2
PL-W09, Windows	1.44	West	0.7	1.2

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))
Building part **1**: Thermal bridging calculated from linear thermal transmittances for each junction

Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E2: Other lintels (including other steel lintels)	Not government-approved scheme	0.05	MCPF-125-E2-01
External wall	E3: Sill	Not government-approved scheme	0.05	MCPF-125-E3-01
External wall	E4: Jamb	Not government-approved scheme	0.022 **(!)**	MCPF-125-E4-01
External wall	E5: Ground floor (normal)	Not government-approved scheme	0.16	MCPF-125-E5-04
External wall	E6: Intermediate floor within a dwelling	Not government-approved scheme	0.001 **(!)**	MCPF-125-E6-01
External wall	E18: Party wall between dwellings	Not government-approved scheme	0.09	MCPF-125-E18-01
Party wall	P1: Ground floor	Not government-approved scheme	0.043	MCPF-P1-04
Party wall	P2: Intermediate floor within a dwelling	SAP table default	0 **(!)**	
Party wall	P4: Roof (insulation at ceiling level)	Not government-approved scheme	0.033 **(!)**	MCPF-P4-01
External wall	E10: Eaves (insulation at ceiling level)	Not government-approved scheme	0.06	MCPF-E10-01

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

4 Space heating	
Main heating system 1: Boiler with radiators or underfloor heating - Mains gas	
Efficiency	88.6%
Emitter type	Radiators
Flow temperature	55°C
System type	Regular boiler
Manufacturer	Bosch Thermotechnology
Model	Greenstar 8000 Life
Commissioning	
Secondary heating system: N/A	
Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water	
Cylinder/store - type: Cylinder	
Capacity	210 litres
Declared heat loss	1.7 kWh/day
Primary pipework insulated	Yes
Manufacturer	
Model	
Commissioning	
Waste water heat recovery system 1 - type: N/A	
Efficiency	
Manufacturer	
Model	

6 Controls	
Main heating 1 - type: Time and temperature zone control by arrangement of plumbing and electrical services	
Function	
Ecodesign class	
Manufacturer	
Model	
Water heating - type: Cylinder thermostat and HW separately timed	
Manufacturer	
Model	

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

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

9 Local generation
N/A

10 Heat networks
N/A

11 Supporting documentary evidence
N/A

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

Full SAP Calculation Printout

Property Reference	A2 Mid	**Issued on Date**	14/03/2025
Assessment Reference	Regulated (Baseline)	**Prop Type Ref**	Proposed 45
Property	45, Leonard Stanley		

SAP Rating	85 B	**DER**	14.31	**TER**	10.35
Environmental	88 B	**% DER < TER**			-38.26
CO_2 Emissions (t/year)	1.1	**DFEE**	30.65	**TFEE**	31.71
Compliance Check	See BREL	**% DFEE < TFEE**			3.34
% DPER < TPER	-47.76	**DPER**	79.64	**TPER**	53.90

Assessor Details	Mr. Richard Millard	**Assessor ID**	U367-0001
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)	
Main dwelling						
Ground floor	40.9200 (1b)	x	2.3500 (2b)	=	96.1620	(1b) - (3b)
First floor	40.9200 (1c)	x	2.6500 (2c)	=	108.4380	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	81.8400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	204.6000	(5)

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2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1466	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3966	(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) =	0.3669	(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	0.4678	0.4586	0.4494	0.4036	0.3944	0.3485	0.3485	0.3394	0.3669	0.3944	0.4127	0.4311	(22b)
Effective ac	0.6094	0.6052	0.6010	0.5814	0.5778	0.5607	0.5607	0.5576	0.5673	0.5778	0.5852	0.5929	(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	
Main dwelling								
Windows			12.1300	1.1450	13.8893			(27)
Half Glazed Door			2.3100	1.2000	2.7720			(26a)
Heatloss Floor 1			40.9200	0.1300	5.3196	75.0000	3069.0000	(28a)
External Wall 1	47.7800	14.4400	33.3400	0.1800	6.0012	60.0000	2000.3999	(29a)
External Roof 1	40.9200		40.9200	0.1100	4.5012	9.0000	368.2800	(30)
Total net area of external elements Aum(A, m2)			129.6200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		32.4833			(33)
Main dwelling								
Party Wall 1			85.6500	0.0000	0.0000	45.0000	3854.2501	(32)
Internal Wall 1			23.4100			75.0000	1755.7500	(32c)
Internal Wall 2			124.3200			9.0000	1118.8800	(32c)
Internal Floor 1			40.9200			18.0000	736.5600	(32d)
Internal Ceiling 1			40.9200			9.0000	368.2800	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	13271.4000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		162.1628 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	9.8800	0.0500	0.4940

E3 Sill	7.2000	0.0500	0.3600	
E4 Jamb	23.1000	0.0220	0.5082	
E5 Ground floor (normal)	9.5600	0.1600	1.5296	
E6 Intermediate floor within a dwelling	9.5600	0.0010	0.0096	
E18 Party wall between dwellings	20.0000	0.0900	1.8000	
P1 Party wall - Ground floor	17.1300	0.0430	0.7366	
P2 Party wall - Intermediate floor within a dwelling	17.1300	0.0000	0.0000	
P4 Party wall - Roof (insulation at ceiling level)	17.1300	0.0330	0.5653	
E10 Eaves (insulation at ceiling level)	9.5600	0.0600	0.5736	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 6.5768 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 39.0602 (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	41.1458	40.8590	40.5778	39.2572	39.0102	37.8600	37.8600	37.6470	38.3030	39.0102	39.5100	40.0326	(38)
Heat transfer coeff	80.2060	79.9192	79.6380	78.3174	78.0703	76.9201	76.9201	76.7071	77.3632	78.0703	78.5702	79.0927	(39)

Average = Sum(39)m / 12 = 78.3162

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9800	0.9765	0.9731	0.9570	0.9539	0.9399	0.9399	0.9373	0.9453	0.9539	0.9600	0.9664	(40)
HLP (average)												0.9569	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.4968 (42)

Hot water usage for mixer showers

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
66.0836	65.0905	63.6434	60.8745	58.8311	56.5524	55.2572	56.6934	58.2677	60.7144	63.5427	65.8304	(42a)

Hot water usage for baths

28.5413	28.1175	27.5206	26.4200	25.5958	24.6820	24.1884	24.7812	25.4266	26.4044	27.5276	28.4449	(42b)

Hot water usage for other uses

40.2002	38.7384	37.2766	35.8147	34.3529	32.8911	32.8911	34.3529	35.8147	37.2766	38.7384	40.2002	(42c)

Average daily hot water use (litres/day) 123.9349 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	134.8252	131.9464	128.4405	123.1092	118.7799	114.1255	112.3367	115.8275	119.5090	124.3953	129.8087	134.4755	(44)
Energy conte	213.5301	187.8899	197.4082	168.5303	159.9006	140.3306	135.8615	143.4186	147.3666	168.8033	184.9363	210.5561	(45)
Energy content (annual)										Total = Sum(45)m =		2058.5321	
Distribution loss (46)m = 0.15 x (45)m	32.0295	28.1835	29.6112	25.2795	23.9851	21.0496	20.3792	21.5128	22.1050	25.3205	27.7405	31.5834	(46)

Water storage loss:

Store volume 210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.7000 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 0.9180 (55)

Total storage loss

28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(56)

If cylinder contains dedicated solar storage

28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(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

265.2505	234.6051	249.1286	218.5823	211.6210	190.3826	187.5819	195.1390	197.4186	220.5237	234.9883	262.2765	(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

265.2505	234.6051	249.1286	218.5823	211.6210	190.3826	187.5819	195.1390	197.4186	220.5237	234.9883	262.2765	(64)
									Total per year (kWh/year) = Sum(64)m =		2667.4981	(64)
12Total per year (kWh/year)											2667	(64)

Electric shower(s)

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

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

Heat gains from water heating, kWh/month

112.3751	99.8455	107.0146	96.0779	94.5433	86.7015	86.5503	89.0630	89.0410	97.5034	101.5329	111.3862	(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	124.8423	124.8423	124.8423	124.8423	124.8423	124.8423	124.8423	124.8423	124.8423	124.8423	124.8423	124.8423	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	119.3296	132.1150	119.3296	123.3073	119.3296	123.3073	119.3296	119.3296	123.3073	119.3296	123.3073	119.3296	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	223.2431	225.5596	219.7220	207.2943	191.6065	176.8622	167.0122	164.6956	170.5333	182.9610	198.6487	213.3930	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.4842	35.4842	35.4842	35.4842	35.4842	35.4842	35.4842	35.4842	35.4842	35.4842	35.4842	35.4842	(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)	-99.8739	-99.8739	-99.8739	-99.8739	-99.8739	-99.8739	-99.8739	-99.8739	-99.8739	-99.8739	-99.8739	-99.8739	(71)
Water heating gains (Table 5)	151.0418	148.5797	143.8368	133.4416	127.0743	120.4188	116.3310	119.7083	123.6680	131.0530	141.0180	149.7127	(72)
Total internal gains	557.0672	569.7070	546.3411	527.4958	501.4631	481.0410	463.1255	464.1863	477.9613	496.7963	526.4267	545.8880	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	7.8100	19.6403	0.6300	0.7000	0.7700	46.8781	(76)
West	4.3200	19.6403	0.6300	0.7000	0.7700	25.9300	(80)

Solar gains	72.8081	142.4282	234.5589	342.0902	419.2444	429.1712	408.5885	350.9715	272.8017	169.0030	90.7832	59.8739	(83)
Total gains	629.8753	712.1351	780.9000	869.5860	920.7075	910.2122	871.7140	815.1577	750.7630	665.7993	617.2099	605.7619	(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	45.9629	46.1279	46.2907	47.0713	47.2203	47.9263	47.9263	48.0594	47.6519	47.2203	46.9198	46.6099	
alpha	4.0642	4.0752	4.0860	4.1381	4.1480	4.1951	4.1951	4.2040	4.1768	4.1480	4.1280	4.1073	
util living area	0.9748	0.9578	0.9242	0.8384	0.7004	0.5212	0.3837	0.4255	0.6514	0.8765	0.9564	0.9780	(86)
MIT	19.6254	19.8534	20.1779	20.5832	20.8450	20.9657	20.9925	20.9885	20.9144	20.5643	20.0442	19.5998	(87)
Th 2	20.1000	20.1029	20.1058	20.1194	20.1219	20.1337	20.1337	20.1359	20.1292	20.1219	20.1168	20.1114	(88)
util rest of house	0.9698	0.9497	0.9097	0.8095	0.6528	0.4572	0.3102	0.3487	0.5861	0.8474	0.9467	0.9736	(89)
MIT 2	18.5040	18.7920	19.1968	19.6920	19.9836	20.1103	20.1303	20.1303	20.0643	19.6833	19.0452	18.4797	(90)
Living area fraction									fLA = Living area / (4) =			0.2375	(91)
MIT	18.7704	19.0441	19.4299	19.9037	20.1882	20.3135	20.3351	20.3341	20.2662	19.8926	19.2825	18.7458	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.6204	18.8941	19.2799	19.7537	20.0382	20.1635	20.1851	20.1841	20.1162	19.7426	19.1325	18.5958	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9587	0.9358	0.8935	0.7961	0.6479	0.4594	0.3146	0.3531	0.5850	0.8327	0.9327	0.9635	(94)
Useful gains	603.8813	666.4030	697.7114	692.2856	596.5621	418.1899	274.2513	287.8236	439.2156	554.4168	575.6901	583.6571	(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	1148.5813	1118.4006	1017.7633	850.0323	650.9676	427.9460	275.7635	290.2694	465.4326	713.7618	945.3926	1138.6025	(97)
Space heating kWh	405.2568	303.7424	238.1186	113.5776	40.4777	0.0000	0.0000	0.0000	0.0000	118.5527	266.1858	412.8793	(98a)
Space heating requirement - total per year (kWh/year)												1898.7908	
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	405.2568	303.7424	238.1186	113.5776	40.4777	0.0000	0.0000	0.0000	0.0000	118.5527	266.1858	412.8793	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1898.7908	
Space heating per m2										(98c) / (4) =		23.2013	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 88.6000 (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	405.2568	303.7424	238.1186	113.5776	40.4777	0.0000	0.0000	0.0000	0.0000	118.5527	266.1858	412.8793	(98)
Space heating efficiency (main heating system 1)	88.6000	88.6000	88.6000	88.6000	88.6000	0.0000	0.0000	0.0000	0.0000	88.6000	88.6000	88.6000	(210)
Space heating fuel (main heating system)	457.4004	342.8244	268.7569	128.1914	45.6859	0.0000	0.0000	0.0000	0.0000	133.8067	300.4354	466.0037	(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	265.2505	234.6051	249.1286	218.5823	211.6210	190.3826	187.5819	195.1390	197.4186	220.5237	234.9883	262.2765	(64)
Efficiency of water heater												79.6000	(216)
(217)m	84.8067	84.4395	83.7579	82.4643	80.9198	79.6000	79.6000	79.6000	79.6000	82.5312	84.1395	84.8722	(217)
Fuel for water heating, kWh/month	312.7706	277.8382	297.4388	265.0629	261.5194	239.1742	235.6557	245.1495	248.0133	267.2005	279.2843	309.0252	(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	24.7943	19.8909	17.9096	13.1213	10.1353	8.2806	9.2458	12.0180	15.6102	20.4814	23.1337	25.4835	(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 2143.1048 (211)
Space heating fuel - main system 2 0.0000 (213)
Space heating fuel - secondary 0.0000 (215)
Efficiency of water heater 79.6000
Water heating fuel used 3238.1324 (219)
Space cooling fuel 0.0000 (221)

Electricity for pumps and fans:
central heating pump 41.0000 (230c)
main heating flue fan 45.0000 (230e)
Total electricity for the above, kWh/year 86.0000 (231)
Electricity for lighting (calculated in Appendix L) 200.1045 (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	5667.3417	(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	2143.1048	0.2100	450.0520	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3238.1324	0.2100	680.0078	(264)
Space and water heating			1130.0598	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	200.1045	0.1443	28.8813	(268)
Total CO2, kg/year			1170.8703	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			14.3100	(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	2143.1048	1.1300	2421.7084	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3238.1324	1.1300	3659.0896	(278)
Space and water heating			6080.7980	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	200.1045	1.5338	306.9270	(282)
Total Primary energy kWh/year			6517.8259	(286)
Dwelling Primary energy Rate (DPER)			79.6400	(287)

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Main dwelling						
Ground floor	40.9200 (1b)	x	2.3500 (2b)	=	96.1620	(1b) - (3b)
First floor	40.9200 (1c)	x	2.6500 (2c)	=	108.4380	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 81.8400						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	204.6000	(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) =	0.1466	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3966	(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) =	0.3669	(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	0.4678	0.4586	0.4494	0.4036	0.3944	0.3485	0.3485	0.3394	0.3669	0.3944	0.4127	0.4311	(22b)
Effective ac	0.6094	0.6052	0.6010	0.5814	0.5778	0.5607	0.5607	0.5576	0.5673	0.5778	0.5852	0.5929	(25)

3. Heat losses and heat loss parameter

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

TER Semi-glazed door			2.3100	1.0000	2.3100		(26a)
TER Opening Type			12.1300	1.1450	13.8893		(27)
Heatloss Floor 1			40.9200	0.1300	5.3196		(28a)
External Wall 1	47.7800	14.4400	33.3400	0.1800	6.0012		(29a)
External Roof 1	40.9200		40.9200	0.1100	4.5012		(30)
Total net area of external elements Aum(A, m2)			129.6200				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		32.0213		(33)
Main dwelling							
Party Wall 1			85.6500	0.0000	0.0000		(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 162.1628 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	9.8800	0.0500	0.4940
E3 Sill	7.2000	0.0500	0.3600
E4 Jamb	23.1000	0.0500	1.1550
E5 Ground floor (normal)	9.5600	0.1600	1.5296
E6 Intermediate floor within a dwelling	9.5600	0.0000	0.0000
E18 Party wall between dwellings	20.0000	0.0600	1.2000
P1 Party wall - Ground floor	17.1300	0.0800	1.3704
P2 Party wall - Intermediate floor within a dwelling	17.1300	0.0000	0.0000
P4 Party wall - Roof (insulation at ceiling level)	17.1300	0.1200	2.0556
E10 Eaves (insulation at ceiling level)	9.5600	0.0600	0.5736

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		8.7382	(36)
Point Thermal bridges	(36a) =	0.0000	
Total fabric heat loss	(33) + (36) + (36a) =	40.7595	(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	41.1458	40.8590	40.5778	39.2572	39.0102	37.8600	37.8600	37.6470	38.3030	39.0102	39.5100	40.0326	(38)
Heat transfer coeff	81.9054	81.6185	81.3374	80.0168	79.7697	78.6195	78.6195	78.4065	79.0625	79.7697	80.2695	80.7921	(39)
Average = Sum(39)m / 12 =												80.0156	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0008	0.9973	0.9939	0.9777	0.9747	0.9606	0.9606	0.9580	0.9661	0.9747	0.9808	0.9872	(40)
HLP (average)												0.9777	
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											2.4968	(42)
Hot water usage for mixer showers	66.0836	65.0905	63.6434	60.8745	58.8311	56.5524	55.2572	56.6934	58.2677	60.7144	63.5427	65.8304	(42a)
Hot water usage for baths	28.5413	28.1175	27.5206	26.4200	25.5958	24.6820	24.1884	24.7812	25.4266	26.4044	27.5276	28.4449	(42b)
Hot water usage for other uses	40.2002	38.7384	37.2766	35.8147	34.3529	32.8911	32.8911	34.3529	35.8147	37.2766	38.7384	40.2002	(42c)
Average daily hot water use (litres/day)												123.9349	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	134.8252	131.9464	128.4405	123.1092	118.7799	114.1255	112.3367	115.8275	119.5090	124.3953	129.8087	134.4755	(44)
Energy conte	213.5301	187.8899	197.4082	168.5303	159.9006	140.3306	135.8615	143.4186	147.3666	168.8033	184.9363	210.5561	(45)
Energy content (annual)										Total = Sum(45)m =		2058.5321	
Distribution loss (46)m = 0.15 x (45)m	32.0295	28.1835	29.6112	25.2795	23.9851	21.0496	20.3792	21.5128	22.1050	25.3205	27.7405	31.5834	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7016	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9188	(55)
Total storage loss	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(56)
If cylinder contains dedicated solar storage	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(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	265.2767	234.6287	249.1548	218.6077	211.6472	190.4080	187.6081	195.1652	197.4439	220.5499	235.0137	262.3027	(62)
WWHRS	-30.2107	-26.7186	-27.9781	-23.1670	-21.5908	-18.4754	-17.3178	-18.4157	-19.1154	-22.5349	-25.5293	-29.6512	(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	235.0660	207.9102	221.1767	195.4407	190.0563	171.9326	170.2903	176.7495	178.3285	198.0149	209.4844	232.6515	(64)
									Total per year (kWh/year) = Sum(64)m =			2387.1015	(64)
12Total per year (kWh/year)												2387	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
									Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =			0.0000	(64a)
Heat gains from water heating, kWh/month	112.3960	99.8645	107.0355	96.0982	94.5642	86.7218	86.5712	89.0840	89.0613	97.5244	101.5532	111.4072	(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	124.8423	124.8423	124.8423	124.8423	124.8423	124.8423	124.8423	124.8423	124.8423	124.8423	124.8423	124.8423	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	119.3296	132.1150	119.3296	123.3073	119.3296	123.3073	119.3296	119.3296	123.3073	119.3296	123.3073	119.3296	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	223.2431	225.5596	219.7220	207.2943	191.6065	176.8622	167.0122	164.6956	170.5333	182.9610	198.6487	213.3930	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.4842	35.4842	35.4842	35.4842	35.4842	35.4842	35.4842	35.4842	35.4842	35.4842	35.4842	35.4842	(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)	-99.8739	-99.8739	-99.8739	-99.8739	-99.8739	-99.8739	-99.8739	-99.8739	-99.8739	-99.8739	-99.8739	-99.8739	(71)
Water heating gains (Table 5)	151.0699	148.6078	143.8649	133.4697	127.1024	120.4470	116.3592	119.7365	123.6962	131.0811	141.0461	149.7408	(72)
Total internal gains	557.0953	569.7351	546.3692	527.5240	501.4913	481.0692	463.1537	464.2144	477.9895	496.8244	526.4548	545.9162	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	7.8100	19.6403	0.6300	0.7000	0.7700	46.8781	(76)
West	4.3200	19.6403	0.6300	0.7000	0.7700	25.9300	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	72.8081	142.4282	234.5589	342.0902	419.2444	429.1712	408.5885	350.9715	272.8017	169.0030	90.7832	59.8739	(83)
Total gains	629.9035	712.1633	780.9281	869.6142	920.7356	910.2404	871.7422	815.1859	750.7912	665.8275	617.2380	605.7900	(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	45.0093	45.1674	45.3236	46.0716	46.2143	46.8904	46.8904	47.0178	46.6277	46.2143	45.9265	45.6295	
alpha	4.0006	4.0112	4.0216	4.0714	4.0810	4.1260	4.1260	4.1345	4.1085	4.0810	4.0618	4.0420	
util living area	0.9752	0.9588	0.9263	0.8434	0.7084	0.5303	0.3915	0.4338	0.6601	0.8804	0.9575	0.9784	(86)
MIT	19.5800	19.8094	20.1391	20.5549	20.8300	20.9610	20.9912	20.9866	20.9051	20.5382	20.0060	19.5540	(87)
Th 2	20.0827	20.0856	20.0885	20.1019	20.1045	20.1163	20.1163	20.1184	20.1117	20.1045	20.0994	20.0940	(88)
util rest of house	0.9703	0.9509	0.9120	0.8148	0.6604	0.4645	0.3152	0.3544	0.5938	0.8516	0.9479	0.9741	(89)
MIT 2	18.4347	18.7247	19.1364	19.6451	19.9526	20.0896	20.1122	20.1119	20.0397	19.6391	18.9852	18.4098	(90)
Living area fraction									fLA = Living area / (4) =			0.2375	(91)
MIT	18.7068	18.9824	19.3746	19.8612	20.1610	20.2966	20.3210	20.3197	20.2452	19.8526	19.2276	18.6815	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7068	18.9824	19.3746	19.8612	20.1610	20.2966	20.3210	20.3197	20.2452	19.8526	19.2276	18.6815	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9604	0.9387	0.8986	0.8062	0.6636	0.4783	0.3331	0.3728	0.6043	0.8422	0.9361	0.9650	(94)
Useful gains	604.9875	668.4805	701.7612	701.1113	611.0041	435.3400	290.3860	303.9125	453.6970	560.7844	577.8167	584.5993	(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	1179.9921	1149.3829	1047.1829	877.0775	674.9325	447.8638	292.5422	307.3274	485.8587	738.0799	973.4804	1169.9941	(97)
Space heating kWh	427.8034	323.1664	256.9938	126.6957	47.5627	0.0000	0.0000	0.0000	0.0000	131.9078	284.8779	435.5337	(98a)
Space heating requirement - total per year (kWh/year)												2034.5414	
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	427.8034	323.1664	256.9938	126.6957	47.5627	0.0000	0.0000	0.0000	0.0000	131.9078	284.8779	435.5337	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2034.5414	
Space heating per m2										(98c) / (4) =		24.8600	(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	427.8034	323.1664	256.9938	126.6957	47.5627	0.0000	0.0000	0.0000	0.0000	131.9078	284.8779	435.5337	(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)	463.4923	350.1261	278.4331	137.2651	51.5306	0.0000	0.0000	0.0000	0.0000	142.9121	308.6434	471.8675	(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	235.0660	207.9102	221.1767	195.4407	190.0563	171.9326	170.2903	176.7495	178.3285	198.0149	209.4844	232.6515	(64)
Efficiency of water heater												79.8000	(216)
(217)m	85.3851	85.0450	84.3972	83.1130	81.4524	79.8000	79.8000	79.8000	79.8000	83.1702	84.7497	85.4447	(217)
Fuel for water heating, kWh/month	275.3011	244.4707	262.0662	235.1505	233.3342	215.4544	213.3964	221.4906	223.4693	238.0840	247.1800	272.2832	(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	24.7943	19.8909	17.9096	13.1213	10.1353	8.2806	9.2458	12.0180	15.6102	20.4814	23.1337	25.4835	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-38.0969	-53.6082	-76.9085	-86.2963	-92.8992	-86.6484	-85.5734	-80.8635	-72.5238	-61.2176	-41.8461	-32.9485	(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	-21.8181	-45.8702	-91.1250	-136.8007	-180.8288	-181.6777	-179.5427	-152.0442	-111.4764	-65.5802	-29.1237	-17.2554	(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	(235d)

Annual totals kWh/year		
Space heating fuel - main system 1	2204.2702	(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	2881.6806	(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)	200.1045	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-2022.5734	(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	3349.4819	(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	2204.2702	0.2100	462.8967	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2881.6806	0.2100	605.1529	(264)
Space and water heating			1068.0497	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	200.1045	0.1443	28.8813	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-809.4303	0.1346	-108.9732	
PV Unit electricity exported	-1213.1431	0.1259	-152.7455	
Total			-261.7187	(269)
Total CO2, kg/year			847.1415	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			10.3500	(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	2204.2702	1.1300	2490.8254	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2881.6806	1.1300	3256.2991	(278)
Space and water heating			5747.1244	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	200.1045	1.5338	306.9270	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-809.4303	1.4976	-1212.1788	
PV Unit electricity exported	-1213.1431	0.4622	-560.6819	
Total			-1772.8607	(283)
Total Primary energy kWh/year			4411.2915	(286)
Target Primary Energy Rate (TPER)			53.9000	(287)

Building Regulations England Part L (BREL) Compliance Report

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

Date: Fri 14 Mar 2025 09:30:50

Project Information			
Assessed By	Richard Millard	Building Type	House, End-terrace
OCDEA Registration	EES/025661	Assessment Date	2025-03-14

Dwelling Details			
Assessment Type	As designed	Total Floor Area	95 m^2
Site Reference	A3 End	Plot Reference	Proposed
Address	38, Leonard Stanley		

Client Details	
Name	Ian White
Company	Cotswold Homes Ltd
Address	West House, Yate, Bristol, BS37 5NG

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

1a Target emission rate and dwelling emission rate		
Fuel for main heating system	Electricity	
Target carbon dioxide emission rate	*10.57 $kgCO_2/m^2$*	
Dwelling carbon dioxide emission rate	3.32 $kgCO_2/m^2$	**OK**
1b Target primary energy rate and dwelling primary energy		
Target primary energy	*55.13 kWh_{PE}/m^2*	
Dwelling primary energy	37.56 kWh_{PE}/m^2	**OK**
1c Target fabric energy efficiency and dwelling fabric energy efficiency		
Target fabric energy efficiency	*35.9 kWh/m^2*	
Dwelling fabric energy efficiency	34.0 kWh/m^2	**OK**

2a Fabric U-values				
Element	***Maximum permitted average U-Value [W/m^2K]***	**Dwelling average U-Value [W/m^2K]**	**Element with highest individual U-Value**	
External walls	*0.26*	0.18	Walls (1) (0.18)	**OK**
Party walls	*0.2*	0	Party Wall (1) (0)	**N/A**
Curtain walls	*1.6*	0	N/A	**N/A**
Floors	*0.18*	0.12	Heatloss Floor 1 (0.12)	**OK**
Roofs	*0.16*	0.11	Roof (1) (0.11)	**OK**
Windows, doors, and roof windows	*1.6*	1.17	PL-W01 (1.2)	**OK**
Rooflights	*2.2*	N/A	N/A	**N/A**

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))		
Name	**Net area [m^2]**	**U-Value [W/m^2K]**
Exposed wall: Walls (1)	81.34	0.18
Party wall: Party Wall (1)	42.83	0 **(!)**
Ground floor: Heatloss Floor 1, Heatloss Floor 1	47.45	0.12
Exposed roof: Roof (1)	47.45	0.11

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	**Area [m^2]**	**Orientation**	**Frame factor**	**U-Value [W/m^2K]**
PL-W01, Windows	1.44	North	0.7	1.2
PL-W02, Windows	0.72	East	0.7	1.2
PL-ED01, Solid Doors	2.31	North	N/A	1 **(!)**
PL-ED02, Windows	3.31	South	0.7	1.2
PL-W03, Windows	1.44	East	0.7	1.2
PL-W04, Windows	1.62	South	0.7	1.2
PL-W05, Windows	1.1	North	0.7	1.2
PL-W06, Windows	1.44	North	0.7	1.2
PL-W07, Windows	0.63	East	0.7	1.2
PL-W08, Windows	1.44	North	0.7	1.2
PL-W09, Windows	1.44	North	0.7	1.2

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))				
Building part **1**: Thermal bridging calculated from linear thermal transmittances for each junction				
Main element	**Junction detail**	**Source**	**Psi value [W/mK]**	**Drawing / reference**
External wall	E1: Steel lintel with perforated steel base plate	Not government-approved scheme	0.241	EMPF125E101
External wall	E3: Sill	Not government-approved scheme	0.026 **(!)**	EMPF125E301
External wall	E4: Jamb	Not government-approved scheme	0.02 **(!)**	EMPF125E401
External wall	E5: Ground floor (normal)	Not government-approved scheme	0.045	EMPF125E504
External wall	E6: Intermediate floor within a dwelling	Not government-approved scheme	0.002 **(!)**	EMPF125E601
External wall	E10: Eaves (insulation at ceiling level)	Not government-approved scheme	0.05	EMPF125E1001
External wall	E18: Party wall between dwellings	Not government-approved scheme	0.06	EMPF125E21802
Party wall	P1: Ground floor	Not government-approved scheme	0.043	MCPF-P1-04
Party wall	P2: Intermediate floor within a dwelling	SAP table default	0 **(!)**	
Party wall	P4: Roof (insulation at ceiling level)	Not government-approved scheme	0.033 **(!)**	MCPF-P4-01
External wall	E12: Gable (insulation at ceiling level)	Not government-approved scheme	0.031 **(!)**	EMPF125E1201
External wall	E16: Corner (normal)	Not government-approved scheme	0.037 **(!)**	EMPF125E21601

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

4 Space heating	
Main heating system 1: Heat pump with radiators or underfloor heating - Electricity	
Efficiency	239.0%
Emitter type	Radiators
Flow temperature	55°C
System type	Heat Pump
Manufacturer	Daikin Europe NV
Model	EDLA08EV3
Commissioning	
Secondary heating system: N/A	
Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water	
Cylinder/store - type: Cylinder	
Capacity	210 litres
Declared heat loss	1.7 kWh/day
Primary pipework insulated	Yes
Manufacturer	
Model	
Commissioning	
Waste water heat recovery system 1 - type: N/A	
Efficiency	
Manufacturer	
Model	

6 Controls		
Main heating 1 - type: Time and temperature zone control by arrangement of plumbing and electrical services		
Function		
Ecodesign class		
Manufacturer		
Model		
Water heating - type: Cylinder thermostat and HW separately timed		
Manufacturer		
Model		

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

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

9 Local generation	
Technology type: **Photovoltaic system (1)**	
Peak power	1.34 kWp
Orientation	East
Pitch	30°
Overshading	None or very little
Manufacturer	
MCS certificate	

10 Heat networks
N/A

11 Supporting documentary evidence
N/A

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

Full SAP Calculation Printout

Property Reference	A3 End	**Issued on Date**	14/03/2025
Assessment Reference	Proposed	**Prop Type Ref**	Proposed 38
Property	38, Leonard Stanley		

SAP Rating	85 B	**DER**	3.32	**TER**	10.57
Environmental	97 A	**% DER < TER**			68.59
CO_2 Emissions (t/year)	0.28	**DFEE**	33.96	**TFEE**	35.86
Compliance Check	See BREL	**% DFEE < TFEE**			5.30
% DPER < TPER	31.87	**DPER**	37.56	**TPER**	55.13

Assessor Details	Mr. Richard Millard	**Assessor ID**	U367-0001
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)	
Main dwelling						
Ground floor	47.4500 (1b)	x	2.3500 (2b)	=	111.5075	(1b) - (3b)
First floor	47.4500 (1c)	x	2.6500 (2c)	=	125.7425	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	94.9000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	237.2500	(5)

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2. Ventilation rate

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			m3 per hour	
Number of open chimneys		0 * 80 =	0.0000	(6a)
Number of open flues		0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire		0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler		0 * 20 =	0.0000	(6d)
Number of flues attached to other heater		0 * 35 =	0.0000	(6e)
Number of blocked chimneys		0 * 20 =	0.0000	(6f)
Number of intermittent extract fans		3 * 10 =	30.0000	(7a)
Number of passive vents		0 * 10 =	0.0000	(7b)
Number of flueless gas fires		0 * 40 =	0.0000	(7c)
			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =		30.0000 / (5) =	0.1264	(8)
Pressure test			Yes	
Pressure Test Method			Blower Door	
Measured/design AP50			5.0000	(17)
Infiltration rate			0.3764	(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) =	0.3482	(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	0.4440	0.4353	0.4266	0.3830	0.3743	0.3308	0.3308	0.3221	0.3482	0.3743	0.3917	0.4092	(22b)
Effective ac	0.5986	0.5947	0.5910	0.5734	0.5701	0.5547	0.5547	0.5519	0.5606	0.5701	0.5767	0.5837	(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	
Main dwelling								
Solid Doors			2.3100	1.0000	2.3100			(26)
Windows			14.5800	1.1450	16.6947			(27)
Heatloss Floor 1			47.4500	0.1200	5.6940	75.0000	3558.7500	(28a)
External Wall 1	98.2300	16.8900	81.3400	0.1800	14.6412	60.0000	4880.4002	(29a)
External Roof 1	47.4500		47.4500	0.1100	5.2195	9.0000	427.0500	(30)
Total net area of external elements Aum(A, m2)			193.1300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		44.5594			(33)
Main dwelling								
Party Wall 1			42.8300	0.0000	0.0000	45.0000	1927.3501	(32)
Internal Wall 1			26.0400			75.0000	1953.0001	(32c)
Internal Wall 2			147.2900			9.0000	1325.6099	(32c)
Internal Floor 1			47.4500			18.0000	854.1000	(32d)
Internal Ceiling 1			47.4500			9.0000	427.0500	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	15353.3103 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		161.7841 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	11.9900	0.2410	2.8896

E3 Sill	9.3200	0.0260	0.2423		
E4 Jamb	30.0000	0.0200	0.6000		
E5 Ground floor (normal)	19.6500	0.0450	0.8842		
E6 Intermediate floor within a dwelling	19.6500	0.0020	0.0393		
E10 Eaves (insulation at ceiling level)	11.0800	0.0500	0.5540		
E18 Party wall between dwellings	10.0000	0.0600	0.6000		
P1 Party wall - Ground floor	8.6600	0.0430	0.3724		
P2 Party wall - Intermediate floor within a dwelling	8.6600	0.0000	0.0000		
P4 Party wall - Roof (insulation at ceiling level)	8.6600	0.0330	0.2858		
E12 Gable (insulation at ceiling level)	8.5700	0.0310	0.2657		
E16 Corner (normal)	10.0000	0.0370	0.3700		
Thermal bridges (Sum(L x Psi) calculated using Appendix K)				7.1033	(36)
Point Thermal bridges			(36a) =	0.0000	
Total fabric heat loss			(33) + (36) + (36a) =	51.6626	(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	46.8625	46.5629	46.2692	44.8897	44.6316	43.4301	43.4301	43.2076	43.8929	44.6316	45.1537	45.6996	(38)
Heat transfer coeff	98.5251	98.2255	97.9318	96.5523	96.2942	95.0927	95.0927	94.8702	95.5555	96.2942	96.8164	97.3622	(39)
Average = Sum(39)m / 12 =												96.5511	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0382	1.0350	1.0319	1.0174	1.0147	1.0020	1.0020	0.9997	1.0069	1.0147	1.0202	1.0259	(40)
HLP (average)												1.0174	
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												2.6870	(42)
Hot water usage for mixer showers	69.2725	68.2315	66.7145	63.8120	61.6700	59.2813	57.9236	59.4291	61.0794	63.6442	66.6090	69.0071	(42a)
Hot water usage for baths	29.9127	29.4684	28.8428	27.6893	26.8256	25.8679	25.3506	25.9718	26.6482	27.6730	28.8502	29.8115	(42b)
Hot water usage for other uses	42.1479	40.6153	39.0826	37.5500	36.0173	34.4847	34.4847	36.0173	37.5500	39.0826	40.6153	42.1479	(42c)
Average daily hot water use (litres/day)												129.9169	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	141.3331	138.3151	134.6399	129.0513	124.5130	119.6339	117.7589	121.4183	125.2776	130.3998	136.0745	140.9665	(44)
Energy conte	223.8370	196.9589	206.9365	176.6648	167.6184	147.1039	142.4192	150.3412	154.4798	176.9513	193.8630	220.7195	(45)
Energy content (annual)											Total = Sum(45)m =	2157.8934	
Distribution loss (46)m = 0.15 x (45)m	33.5756	29.5438	31.0405	26.4997	25.1428	22.0656	21.3629	22.5512	23.1720	26.5427	29.0795	33.1079	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9180	(55)
Total storage loss	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(56)
If cylinder contains dedicated solar storage	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(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	275.5574	243.6741	258.6569	226.7168	219.3388	197.1559	194.1396	202.0616	204.5318	228.6717	243.9150	272.4399	(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	275.5574	243.6741	258.6569	226.7168	219.3388	197.1559	194.1396	202.0616	204.5318	228.6717	243.9150	272.4399	(64)
										Total per year (kWh/year) = Sum(64)m =		2766.8594	(64)
12Total per year (kWh/year)												2767	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000	(64a)
Heat gains from water heating, kWh/month	115.8021	102.8610	110.1827	98.7826	97.1094	88.9536	88.7307	91.3648	91.4061	100.2126	104.5011	114.7656	(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	134.3517	134.3517	134.3517	134.3517	134.3517	134.3517	134.3517	134.3517	134.3517	134.3517	134.3517	134.3517	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	131.4727	145.5591	131.4727	135.8551	131.4727	135.8551	131.4727	131.4727	135.8551	131.4727	135.8551	131.4727	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	247.8096	250.3811	243.9010	230.1057	212.6916	196.3248	185.3908	182.8193	189.2994	203.0947	220.5088	236.8756	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.4352	36.4352	36.4352	36.4352	36.4352	36.4352	36.4352	36.4352	36.4352	36.4352	36.4352	36.4352	(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)	-107.4813	-107.4813	-107.4813	-107.4813	-107.4813	-107.4813	-107.4813	-107.4813	-107.4813	-107.4813	-107.4813	-107.4813	(71)
Water heating gains (Table 5)	155.6480	153.0670	148.0950	137.1981	130.5234	123.5467	119.2617	122.8021	126.9530	134.6944	145.1404	154.2548	(72)
Total internal gains	598.2358	612.3126	586.7743	566.4644	537.9933	519.0322	499.4307	500.3996	515.4130	532.5673	564.8098	585.9086	(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	6.8600	10.6334	0.6300	0.7000	0.7700	22.2930	(74)
East	2.7900	19.6403	0.6300	0.7000	0.7700	16.7465	(76)
South	4.9300	46.7521	0.6300	0.7000	0.7700	70.4400	(78)

Solar gains	109.4795	190.7253	273.2949	361.0522	426.1446	432.9620	413.2771	362.9783	303.2946	214.0148	131.8776	93.2227	(83)
Total gains	707.7153	803.0379	860.0691	927.5167	964.1379	951.9942	912.7078	863.3779	818.7076	746.5821	696.6874	679.1312	(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	43.2865	43.4185	43.5488	44.1710	44.2893	44.8489	44.8489	44.9541	44.6317	44.2893	44.0505	43.8035	
alpha	3.8858	3.8946	3.9033	3.9447	3.9526	3.9899	3.9899	3.9969	3.9754	3.9526	3.9367	3.9202	
util living area	0.9782	0.9635	0.9391	0.8782	0.7676	0.5959	0.4471	0.4886	0.7048	0.8960	0.9624	0.9811	(86)
Living	19.4635	19.6969	20.0112	20.4266	20.7479	20.9329	20.9832	20.9762	20.8662	20.4607	19.9063	19.4323	
Non living	18.2667	18.5623	18.9571	19.4716	19.8406	20.0348	20.0739	20.0718	19.9743	19.5236	18.8383	18.2342	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	20.2140	19.6969	20.0112	20.4266	20.7479	20.9329	20.9832	20.9762	20.8662	20.4607	19.9063	19.6516	(87)
Th 2	20.0516	20.0542	20.0568	20.0688	20.0711	20.0816	20.0816	20.0836	20.0776	20.0711	20.0665	20.0618	(88)
util rest of house	0.9737	0.9562	0.9266	0.8530	0.7212	0.5240	0.3587	0.3982	0.6372	0.8692	0.9537	0.9772	(89)
MIT 2	19.3401	18.5623	18.9571	19.4716	19.8406	20.0348	20.0739	20.0718	19.9743	19.5236	18.8383	18.5635	(90)
Living area fraction									fLA = Living area / (4) =			0.2335	(91)
MIT	19.5441	18.8272	19.2033	19.6946	20.0525	20.2445	20.2862	20.2830	20.1825	19.7424	19.0877	18.8176	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.5441	18.8272	19.2033	19.6946	20.0525	20.2445	20.2862	20.2830	20.1825	19.7424	19.0877	18.8176	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9709	0.9440	0.9126	0.8414	0.7202	0.5373	0.3788	0.4184	0.6454	0.8580	0.9417	0.9705	(94)
Useful gains	687.0877	758.0686	784.9211	780.4445	694.3674	511.5078	345.7503	361.2592	528.4345	640.5909	656.0721	659.0757	(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	1501.9294	1368.0070	1244.0554	1042.2421	804.2939	536.7500	350.5336	368.3779	581.2209	880.3617	1160.6029	1423.1988	(97)
Space heating kWh	606.2423	409.8786	341.5959	188.4942	81.7853	0.0000	0.0000	0.0000	0.0000	178.3895	363.2622	568.5075	(98a)
Space heating requirement - total per year (kWh/year)												2738.1555	
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	606.2423	409.8786	341.5959	188.4942	81.7853	0.0000	0.0000	0.0000	0.0000	178.3895	363.2622	568.5075	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2738.1555	
Space heating per m2											(98c) / (4) =	28.8531	(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 %) 239.0026 (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	606.2423	409.8786	341.5959	188.4942	81.7853	0.0000	0.0000	0.0000	0.0000	178.3895	363.2622	568.5075	(98)
Space heating efficiency (main heating system 1)	239.0026	239.0026	239.0026	239.0026	239.0026	0.0000	0.0000	0.0000	0.0000	239.0026	239.0026	239.0026	(210)
Space heating fuel (main heating system)	253.6551	171.4955	142.9256	78.8670	34.2194	0.0000	0.0000	0.0000	0.0000	74.6391	151.9909	237.8667	(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	275.5574	243.6741	258.6569	226.7168	219.3388	197.1559	194.1396	202.0616	204.5318	228.6717	243.9150	272.4399	(64)
Efficiency of water heater												170.7026	(216)
(217)m	170.7026	170.7026	170.7026	170.7026	170.7026	170.7026	170.7026	170.7026	170.7026	170.7026	170.7026	170.7026	(217)
Fuel for water heating, kWh/month	161.4255	142.7478	151.5249	132.8139	128.4918	115.4967	113.7297	118.3705	119.8176	133.9591	142.8889	159.5992	(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	27.3174	21.9151	19.7321	14.4566	11.1667	9.1233	10.1866	13.2409	17.1987	22.5656	25.4878	28.0767	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-17.9432	-30.1036	-52.1397	-68.1558	-79.9866	-75.5226	-74.0208	-65.7567	-52.0077	-37.2107	-20.9411	-14.8205	(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	-3.2779	-8.6474	-21.9912	-41.7856	-64.1450	-69.3695	-67.6253	-52.6272	-33.1541	-14.6091	-4.9065	-2.4719	(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												1145.6593	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												170.7026	

Water heating fuel used	1620.8656	(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)	220.4673	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-973.2197	(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	2013.7725	(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	1145.6593	0.1556	178.3214	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1620.8656	0.1409	228.4568	(264)
Space and water heating			406.7782	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	220.4673	0.1443	31.8202	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-588.6091	0.1319	-77.6504	
PV Unit electricity exported	-384.6107	0.1203	-46.2500	
Total			-123.9004	(269)
Total CO2, kg/year			314.6980	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			3.3200	(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	1145.6593	1.5762	1805.8032	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1620.8656	1.5212	2465.6198	(278)
Space and water heating			4271.4230	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	220.4673	1.5338	338.1601	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-588.6091	1.4874	-875.5076	
PV Unit electricity exported	-384.6107	0.4411	-169.6463	
Total			-1045.1538	(283)
Total Primary energy kWh/year			3564.4293	(286)
Dwelling Primary energy Rate (DPER)			37.5600	(287)

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

1. Overall dwelling characteristics

		Area (m2)		Storey height (m)		Volume (m3)	
Main dwelling							
Ground floor		47.4500 (1b)	x	2.3500 (2b)	=	111.5075	(1b) - (3b)
First floor		47.4500 (1c)	x	2.6500 (2c)	=	125.7425	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	94.9000						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	237.2500	(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) =	0.1264	(8)	
Pressure test		Yes		
Pressure Test Method		Blower Door		
Measured/design AP50		5.0000	(17)	
Infiltration rate		0.3764	(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) =	0.3482	(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	0.4440	0.4353	0.4266	0.3830	0.3743	0.3308	0.3308	0.3221	0.3482	0.3743	0.3917	0.4092	(22b)
Effective ac	0.5986	0.5947	0.5910	0.5734	0.5701	0.5547	0.5547	0.5519	0.5606	0.5701	0.5767	0.5837	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Main dwelling								
TER Opaque door			2.3100	1.0000	2.3100			(26)
TER Opening Type			14.5800	1.1450	16.6947			(27)
Heatloss Floor 1			47.4500	0.1300	6.1685			(28a)
External Wall 1	98.2300	16.8900	81.3400	0.1800	14.6412			(29a)
External Roof 1	47.4500		47.4500	0.1100	5.2195			(30)
Total net area of external elements Aum(A, m2)			193.1300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	45.0339			(33)
Main dwelling								
Party Wall 1			42.8300	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 161.7841 (35)

List of Thermal Bridges

	Length	Psi-value	Total	
K1 Element				
E1 Steel lintel with perforated steel base plate	11.9900	0.0500	0.5995	
E3 Sill	9.3200	0.0500	0.4660	
E4 Jamb	30.0000	0.0500	1.5000	
E5 Ground floor (normal)	19.6500	0.1600	3.1440	
E6 Intermediate floor within a dwelling	19.6500	0.0000	0.0000	
E10 Eaves (insulation at ceiling level)	11.0800	0.0600	0.6648	
E18 Party wall between dwellings	10.0000	0.0600	0.6000	
P1 Party wall - Ground floor	8.6600	0.0800	0.6928	
P2 Party wall - Intermediate floor within a dwelling	8.6600	0.0000	0.0000	
P4 Party wall - Roof (insulation at ceiling level)	8.6600	0.1200	1.0392	
E12 Gable (insulation at ceiling level)	8.5700	0.0600	0.5142	
E16 Corner (normal)	10.0000	0.0900	0.9000	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 10.1205 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 55.1544 (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	46.8625	46.5629	46.2692	44.8897	44.6316	43.4301	43.4301	43.2076	43.8929	44.6316	45.1537	45.6996	(38)
Heat transfer coeff	102.0169	101.7172	101.4235	100.0440	99.7859	98.5844	98.5844	98.3619	99.0472	99.7859	100.3081	100.8539	(39)
Average = Sum(39)m / 12 =												100.0428	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0750	1.0718	1.0687	1.0542	1.0515	1.0388	1.0388	1.0365	1.0437	1.0515	1.0570	1.0627	(40)
HLP (average)												1.0542	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.6870 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	69.2725	68.2315	66.7145	63.8120	61.6700	59.2813	57.9236	59.4291	61.0794	63.6442	66.6090	69.0071	(42a)
Hot water usage for baths	29.9127	29.4684	28.8428	27.6893	26.8256	25.8679	25.3506	25.9718	26.6482	27.6730	28.8502	29.8115	(42b)
Hot water usage for other uses	42.1479	40.6153	39.0826	37.5500	36.0173	34.4847	34.4847	36.0173	37.5500	39.0826	40.6153	42.1479	(42c)
Average daily hot water use (litres/day)												129.9169	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	141.3331	138.3151	134.6399	129.0513	124.5130	119.6339	117.7589	121.4183	125.2776	130.3998	136.0745	140.9665	(44)
Energy conte	223.8370	196.9589	206.9365	176.6648	167.6184	147.1039	142.4192	150.3412	154.4798	176.9513	193.8630	220.7195	(45)
Energy content (annual)										Total = Sum(45)m =		2157.8934	
Distribution loss (46)m = 0.15 x (45)m	33.5756	29.5438	31.0405	26.4997	25.1428	22.0656	21.3629	22.5512	23.1720	26.5427	29.0795	33.1079	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7016	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9188	(55)
Total storage loss	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(56)
If cylinder contains dedicated solar storage	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(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	275.5836	243.6978	258.6831	226.7421	219.3650	197.1812	194.1658	202.0877	204.5572	228.6979	243.9404	272.4661	(62)
WWHRS	-31.6685	-28.0079	-29.3282	-24.2849	-22.6327	-19.3669	-18.1534	-19.3043	-20.0378	-23.6223	-26.7613	-31.0820	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	243.9151	215.6899	229.3549	202.4572	196.7323	177.8143	176.0123	182.7834	184.5194	205.0755	217.1791	241.3841	(64)
										Total per year (kWh/year) = Sum(64)m =		2472.9174	(64)
12Total per year (kWh/year)												2473	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												0.0000	(64a)
Heat gains from water heating, kWh/month	115.8231	102.8799	110.2037	98.8029	97.1304	88.9739	88.7516	91.3857	91.4264	100.2336	104.5213	114.7865	(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	134.3517	134.3517	134.3517	134.3517	134.3517	134.3517	134.3517	134.3517	134.3517	134.3517	134.3517	134.3517	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	131.4727	145.5591	131.4727	135.8551	131.4727	135.8551	131.4727	131.4727	135.8551	131.4727	135.8551	131.4727	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	247.8096	250.3811	243.9010	230.1057	212.6916	196.3248	185.3908	182.8193	189.2994	203.0947	220.5088	236.8756	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.4352	36.4352	36.4352	36.4352	36.4352	36.4352	36.4352	36.4352	36.4352	36.4352	36.4352	36.4352	(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)													
	-107.4813	-107.4813	-107.4813	-107.4813	-107.4813	-107.4813	-107.4813	-107.4813	-107.4813	-107.4813	-107.4813	-107.4813	(71)
Water heating gains (Table 5)													
	155.6762	153.0951	148.1232	137.2263	130.5516	123.5749	119.2898	122.8303	126.9811	134.7225	145.1685	154.2829	(72)
Total internal gains													
	601.2640	615.3408	589.8024	569.4926	541.0214	519.0603	499.4589	500.4278	515.4412	535.5954	567.8379	588.9367	(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	6.8600	10.6334	0.6300	0.7000	0.7700	22.2930	(74)
East	2.7900	19.6403	0.6300	0.7000	0.7700	16.7465	(76)
South	4.9300	46.7521	0.6300	0.7000	0.7700	70.4400	(78)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	109.4795	190.7253	273.2949	361.0522	426.1446	432.9620	413.2771	362.9783	303.2946	214.0148	131.8776	93.2227	(83)
Total gains	710.7434	806.0660	863.0973	930.5448	967.1660	952.0223	912.7360	863.4061	818.7357	749.6102	699.7155	682.1594	(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	41.8049	41.9281	42.0495	42.6293	42.7396	43.2605	43.2605	43.3583	43.0583	42.7396	42.5171	42.2870	
alpha	3.7870	3.7952	3.8033	3.8420	3.8493	3.8840	3.8840	3.8906	3.8706	3.8493	3.8345	3.8191	
util living area													
	0.9784	0.9643	0.9410	0.8831	0.7771	0.6105	0.4610	0.5030	0.7176	0.8999	0.9633	0.9813	(86)
MIT	19.3899	19.6251	19.9469	20.3759	20.7165	20.9199	20.9790	20.9706	20.8456	20.4166	19.8445	19.3581	(87)
Th 2	20.0213	20.0239	20.0264	20.0384	20.0406	20.0511	20.0511	20.0530	20.0471	20.0406	20.0361	20.0314	(88)
util rest of house													
	0.9739	0.9571	0.9287	0.8583	0.7304	0.5361	0.3677	0.4080	0.6488	0.8734	0.9546	0.9774	(89)
MIT 2	18.1534	18.4513	18.8558	19.3881	19.7812	19.9952	20.0415	20.0385	19.9276	19.4484	18.7399	18.1199	(90)
Living area fraction										fLA = Living area / (4) =		0.2335	(91)
MIT	18.4421	18.7254	19.1106	19.6187	19.9996	20.2111	20.2604	20.2562	20.1420	19.6745	18.9978	18.4090	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4421	18.7254	19.1106	19.6187	19.9996	20.2111	20.2604	20.2562	20.1420	19.6745	18.9978	18.4090	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9640	0.9445	0.9142	0.8456	0.7282	0.5493	0.3888	0.4291	0.6562	0.8613	0.9422	0.9683	(94)
Useful gains	685.1848	761.3452	789.0140	786.9124	704.2987	522.8988	354.8577	370.4752	537.2889	645.6685	659.2911	660.5654	(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													
	1442.7332	1406.2785	1279.0105	1072.3452	828.1827	553.1657	360.8589	379.3005	598.4391	905.5030	1193.4459	1433.0348	(97)
Space heating kWh													
	563.6160	433.3952	364.5574	205.5116	92.1697	0.0000	0.0000	0.0000	0.0000	193.3169	384.5915	574.7172	(98a)
Space heating requirement - total per year (kWh/year)												2811.8756	
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													
	563.6160	433.3952	364.5574	205.5116	92.1697	0.0000	0.0000	0.0000	193.3169	384.5915		574.7172	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2811.8756	
Space heating per m2											(98c) / (4) =	29.6299	(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													
	563.6160	433.3952	364.5574	205.5116	92.1697	0.0000	0.0000	0.0000	0.0000	193.3169	384.5915	574.7172	(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)													
	610.6349	469.5506	394.9701	222.6562	99.8589	0.0000	0.0000	0.0000	0.0000	209.4441	416.6755	622.6622	(211)
Space heating efficiency (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	243.9151	215.6899	229.3549	202.4572	196.7323	177.8143	176.0123	182.7834	184.5194	205.0755	217.1791	241.3841	(64)
Efficiency of water heater												79.8000	(216)
(217)m	85.8746	85.5922	85.0938	84.0934	82.4665	79.8000	79.8000	79.8000	79.8000	83.9276	85.3269	85.9334	(217)
Fuel for water heating, kWh/month													
	284.0364	251.9970	269.5317	240.7528	238.5602	222.8249	220.5668	229.0519	231.2273	244.3482	254.5259	280.8967	(219)

Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	27.3174	21.9151	19.7321	14.4566	11.1667	9.1233	10.1866	13.2409	17.1987	22.5656	25.4878	28.0767	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-43.6487	-61.1527	-87.3472	-97.5522	-104.6143	-97.4074	-96.1715	-91.0575	-81.9671	-69.5916	-47.8382	-37.7794	(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	-25.8274	-54.2004	-107.5010	-161.1467	-212.7952	-213.7380	-211.2517	-179.0175	-131.3959	-77.4406	-34.4570	-20.4360	(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	3046.4525	(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	2968.3197	(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)	220.4673	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-2345.3352	(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	3975.9043	(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	3046.4525	0.2100	639.7550	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2968.3197	0.2100	623.3471	(264)
Space and water heating			1263.1022	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	220.4673	0.1443	31.8202	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-916.1277	0.1347	-123.4308	
PV Unit electricity exported	-1429.2074	0.1259	-180.0084	
Total			-303.4392	(269)
Total CO2, kg/year			1003.4125	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			10.5700	(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	3046.4525	1.1300	3442.4913	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2968.3197	1.1300	3354.2013	(278)
Space and water heating			6796.6925	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	220.4673	1.5338	338.1601	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-916.1277	1.4980	-1372.3144	
PV Unit electricity exported	-1429.2074	0.4623	-660.7579	
Total			-2033.0723	(283)
Total Primary energy kWh/year			5231.8812	(286)
Target Primary Energy Rate (TPER)			55.1300	(287)

Building Regulations England Part L (BREL) Compliance Report

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

Date: Fri 14 Mar 2025 09:30:52

Project Information			
Assessed By	Richard Millard	Building Type	House, End-terrace
OCDEA Registration	EES/025661	Assessment Date	2025-03-14

Dwelling Details			
Assessment Type	As designed	Total Floor Area	95 m^2
Site Reference	A3 End	Plot Reference	Regulated (Baseline)
Address	38, Leonard Stanley		

Client Details	
Name	Ian White
Company	Cotswold Homes Ltd
Address	West House, Yate, Bristol, BS37 5NG

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

1a Target emission rate and dwelling emission rate		
Fuel for main heating system	Mains gas	
Target carbon dioxide emission rate	*10.65 $kgCO_2/m^2$*	
Dwelling carbon dioxide emission rate	14.54 $kgCO_2/m^2$	**FAIL**
1b Target primary energy rate and dwelling primary energy		
Target primary energy	*55.54 kWh_{PE}/m^2*	
Dwelling primary energy	80.69 kWh_{PE}/m^2	**FAIL**
1c Target fabric energy efficiency and dwelling fabric energy efficiency		
Target fabric energy efficiency	*35.9 kWh/m^2*	
Dwelling fabric energy efficiency	35.0 kWh/m^2	**OK**

2a Fabric U-values				
Element	***Maximum permitted average U-Value [W/m^2K]***	**Dwelling average U-Value [W/m^2K]**	**Element with highest individual U-Value**	
External walls	*0.26*	0.18	Walls (1) (0.18)	**OK**
Party walls	*0.2*	0	Party Wall (1) (0)	**N/A**
Curtain walls	*1.6*	0	N/A	**N/A**
Floors	*0.18*	0.13	Heatloss Floor 1 (0.13)	**OK**
Roofs	*0.16*	0.11	Roof (1) (0.11)	**OK**
Windows, doors, and roof windows	*1.6*	1.17	PL-W01 (1.2)	**OK**
Rooflights	*2.2*	N/A	N/A	**N/A**

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))		
Name	**Net area [m^2]**	**U-Value [W/m^2K]**
Exposed wall: Walls (1)	81.34	0.18
Party wall: Party Wall (1)	42.83	0 **(!)**
Ground floor: Heatloss Floor 1, Heatloss Floor 1	47.45	0.13
Exposed roof: Roof (1)	47.45	0.11

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	**Area [m^2]**	**Orientation**	**Frame factor**	**U-Value [W/m^2K]**
PL-W01, Windows	1.44	North	0.7	1.2
PL-W02, Windows	0.72	East	0.7	1.2
PL-ED01, Solid Doors	2.31	North	N/A	1 **(!)**
PL-ED02, Windows	3.31	South	0.7	1.2
PL-W03, Windows	1.44	East	0.7	1.2
PL-W04, Windows	1.62	South	0.7	1.2
PL-W05, Windows	1.1	North	0.7	1.2
PL-W06, Windows	1.44	North	0.7	1.2
PL-W07, Windows	0.63	East	0.7	1.2
PL-W08, Windows	1.44	North	0.7	1.2
PL-W09, Windows	1.44	North	0.7	1.2

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))				
Building part **1**: Thermal bridging calculated from linear thermal transmittances for each junction				
Main element	**Junction detail**	**Source**	**Psi value [W/mK]**	**Drawing / reference**
External wall	E2: Other lintels (including other steel lintels)	Not government-approved scheme	0.05	MCPF-125-E2-01
External wall	E3: Sill	Not government-approved scheme	0.05	MCPF-125-E3-01
External wall	E4: Jamb	Not government-approved scheme	0.022 **(!)**	MCPF-125-E4-01
External wall	E5: Ground floor (normal)	Not government-approved scheme	0.16	MCPF-125-E5-04
External wall	E6: Intermediate floor within a dwelling	Not government-approved scheme	0.001 **(!)**	MCPF-125-E6-01
External wall	E10: Eaves (insulation at ceiling level)	Not government-approved scheme	0.06	MCPF-125-E10-01
External wall	E18: Party wall between dwellings	Not government-approved scheme	0.09	MCPF-125-E18-01
Party wall	P1: Ground floor	Not government-approved scheme	0.043	MCPF-P1-04
Party wall	P2: Intermediate floor within a dwelling	SAP table default	0 **(!)**	
Party wall	P4: Roof (insulation at ceiling level)	Not government-approved scheme	0.033 **(!)**	MCPF-P4-01
External wall	E12: Gable (insulation at ceiling level)	Not government-approved scheme	0.06	MCPF-E12-01
External wall	E16: Corner (normal)	Not government-approved scheme	0.09	MCPF-E16-01

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

4 Space heating	
Main heating system 1: Boiler with radiators or underfloor heating - Mains gas	
Efficiency	88.6%
Emitter type	Radiators
Flow temperature	55°C
System type	Regular boiler
Manufacturer	Bosch Thermotechnology
Model	Greenstar 8000 Life
Commissioning	
Secondary heating system: N/A	
Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water	
Cylinder/store - type: Cylinder	
Capacity	250 litres
Declared heat loss	1.8 kWh/day
Primary pipework insulated	Yes
Manufacturer	
Model	
Commissioning	
Waste water heat recovery system 1 - type: N/A	
Efficiency	
Manufacturer	
Model	

6 Controls		
Main heating 1 - type: Time and temperature zone control by arrangement of plumbing and electrical services		
Function		
Ecodesign class		
Manufacturer		
Model		
Water heating - type: Cylinder thermostat and HW separately timed		
Manufacturer		
Model		

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

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

9 Local generation
N/A

10 Heat networks
N/A

11 Supporting documentary evidence
N/A

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

Full SAP Calculation Printout

Property Reference	A3 End	**Issued on Date**	14/03/2025
Assessment Reference	Regulated (Baseline)	**Prop Type Ref**	Proposed 38
Property	38, Leonard Stanley		

SAP Rating	85 B	**DER**	14.54	**TER**	10.65
Environmental	87 B	**% DER < TER**			-36.53
CO_2 Emissions (t/year)	1.29	**DFEE**	34.99	**TFEE**	35.86
Compliance Check	See BREL	**% DFEE < TFEE**			2.42
% DPER < TPER	-45.29	**DPER**	80.69	**TPER**	55.54

Assessor Details	Mr. Richard Millard	**Assessor ID**	U367-0001
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)	
Main dwelling						
Ground floor	47.4500 (1b)	x	2.3500 (2b)	=	111.5075	(1b) - (3b)
First floor	47.4500 (1c)	x	2.6500 (2c)	=	125.7425	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	94.9000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	237.2500	(5)

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2. Ventilation rate

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			m3 per hour	
Number of open chimneys		0 * 80 =	0.0000	(6a)
Number of open flues		0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire		0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler		0 * 20 =	0.0000	(6d)
Number of flues attached to other heater		0 * 35 =	0.0000	(6e)
Number of blocked chimneys		0 * 20 =	0.0000	(6f)
Number of intermittent extract fans		3 * 10 =	30.0000	(7a)
Number of passive vents		0 * 10 =	0.0000	(7b)
Number of flueless gas fires		0 * 40 =	0.0000	(7c)
			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =		30.0000 / (5) =	0.1264	(8)
Pressure test			Yes	
Pressure Test Method			Blower Door	
Measured/design AP50			5.0000	(17)
Infiltration rate			0.3764	(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) =	0.3482	(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	0.4440	0.4353	0.4266	0.3830	0.3743	0.3308	0.3308	0.3221	0.3482	0.3743	0.3917	0.4092	(22b)
Effective ac	0.5986	0.5947	0.5910	0.5734	0.5701	0.5547	0.5547	0.5519	0.5606	0.5701	0.5767	0.5837	(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	
Main dwelling								
Solid Doors			2.3100	1.0000	2.3100			(26)
Windows			14.5800	1.1450	16.6947			(27)
Heatloss Floor 1			47.4500	0.1300	6.1685	75.0000	3558.7500	(28a)
External Wall 1	98.2300	16.8900	81.3400	0.1800	14.6412	60.0000	4880.4002	(29a)
External Roof 1	47.4500		47.4500	0.1100	5.2195	9.0000	427.0500	(30)
Total net area of external elements Aum(A, m2)			193.1300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		45.0339			(33)
Main dwelling								
Party Wall 1			42.8300	0.0000	0.0000	45.0000	1927.3501	(32)
Internal Wall 1			26.0400			75.0000	1953.0001	(32c)
Internal Wall 2			147.2900			9.0000	1325.6099	(32c)
Internal Floor 1			47.4500			18.0000	854.1000	(32d)
Internal Ceiling 1			47.4500			9.0000	427.0500	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	15353.3103 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		161.7841 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	11.9900	0.0500	0.5995

E3 Sill	9.3200	0.0500	0.4660	
E4 Jamb	30.0000	0.0220	0.6600	
E5 Ground floor (normal)	19.6500	0.1600	3.1440	
E6 Intermediate floor within a dwelling	19.6500	0.0010	0.0196	
E10 Eaves (insulation at ceiling level)	11.0800	0.0600	0.6648	
E18 Party wall between dwellings	10.0000	0.0900	0.9000	
P1 Party wall - Ground floor	8.6600	0.0430	0.3724	
P2 Party wall - Intermediate floor within a dwelling	8.6600	0.0000	0.0000	
P4 Party wall - Roof (insulation at ceiling level)	8.6600	0.0330	0.2858	
E12 Gable (insulation at ceiling level)	8.5700	0.0600	0.5142	
E16 Corner (normal)	10.0000	0.0900	0.9000	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 8.5263 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 53.5602 (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	46.8625	46.5629	46.2692	44.8897	44.6316	43.4301	43.4301	43.2076	43.8929	44.6316	45.1537	45.6996	(38)
Heat transfer coeff	100.4227	100.1230	99.8293	98.4498	98.1917	96.9903	96.9903	96.7678	97.4531	98.1917	98.7139	99.2597	(39)

Average = Sum(39)m / 12 = 98.4486

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0582	1.0550	1.0519	1.0374	1.0347	1.0220	1.0220	1.0197	1.0269	1.0347	1.0402	1.0459	(40)
HLP (average)												1.0374	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.6870 (42)

Hot water usage for mixer showers

69.2725	68.2315	66.7145	63.8120	61.6700	59.2813	57.9236	59.4291	61.0794	63.6442	66.6090	69.0071	(42a)

Hot water usage for baths

29.9127	29.4684	28.8428	27.6893	26.8256	25.8679	25.3506	25.9718	26.6482	27.6730	28.8502	29.8115	(42b)

Hot water usage for other uses

42.1479	40.6153	39.0826	37.5500	36.0173	34.4847	34.4847	36.0173	37.5500	39.0826	40.6153	42.1479	(42c)

Average daily hot water use (litres/day) 129.9169 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	141.3331	138.3151	134.6399	129.0513	124.5130	119.6339	117.7589	121.4183	125.2776	130.3998	136.0745	140.9665	(44)
Energy conte	223.8370	196.9589	206.9365	176.6648	167.6184	147.1039	142.4192	150.3412	154.4798	176.9513	193.8630	220.7195	(45)
Energy content (annual)											Total = Sum(45)m =	2157.8934	
Distribution loss (46)m = 0.15 x (45)m	33.5756	29.5438	31.0405	26.4997	25.1428	22.0656	21.3629	22.5512	23.1720	26.5427	29.0795	33.1079	(46)

Water storage loss:
Store volume 250.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.8000 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 0.9720 (55)

Total storage loss

30.1320	27.2160	30.1320	29.1600	30.1320	29.1600	30.1320	30.1320	29.1600	30.1320	29.1600	30.1320	(56)

If cylinder contains dedicated solar storage

30.1320	27.2160	30.1320	29.1600	30.1320	29.1600	30.1320	30.1320	29.1600	30.1320	29.1600	30.1320	(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

277.2314	245.1861	260.3309	228.3368	221.0128	198.7759	195.8136	203.7356	206.1518	230.3457	245.5350	274.1139	(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													
277.2314	245.1861	260.3309	228.3368	221.0128	198.7759	195.8136	203.7356	206.1518	230.3457	245.5350	274.1139	(64)
									Total per year (kWh/year) = Sum(64)m =		2786.5694	(64)
12Total per year (kWh/year)											2787	(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													
117.1413	104.0706	111.5219	100.0786	98.4486	90.2496	90.0699	92.7040	92.7021	101.5518	105.7971	116.1048	(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	134.3517	134.3517	134.3517	134.3517	134.3517	134.3517	134.3517	134.3517	134.3517	134.3517	134.3517	134.3517	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	131.4727	145.5591	131.4727	135.8551	131.4727	135.8551	131.4727	131.4727	135.8551	131.4727	135.8551	131.4727	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	247.8096	250.3811	243.9010	230.1057	212.6916	196.3248	185.3908	182.8193	189.2994	203.0947	220.5088	236.8756	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.4352	36.4352	36.4352	36.4352	36.4352	36.4352	36.4352	36.4352	36.4352	36.4352	36.4352	36.4352	(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)	-107.4813	-107.4813	-107.4813	-107.4813	-107.4813	-107.4813	-107.4813	-107.4813	-107.4813	-107.4813	-107.4813	-107.4813	(71)
Water heating gains (Table 5)	157.4480	154.8670	149.8950	138.9981	132.3234	125.3467	121.0617	124.6021	128.7530	136.4944	146.9404	156.0548	(72)
Total internal gains	603.0358	617.1126	591.5743	571.2644	542.7933	520.8322	501.2307	502.1996	517.2130	537.3673	569.6098	590.7086	(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	6.8600	10.6334	0.6300	0.7000	0.7700	22.2930	(74)
East	2.7900	19.6403	0.6300	0.7000	0.7700	16.7465	(76)
South	4.9300	46.7521	0.6300	0.7000	0.7700	70.4400	(78)

Solar gains	109.4795	190.7253	273.2949	361.0522	426.1446	432.9620	413.2771	362.9783	303.2946	214.0148	131.8776	93.2227	(83)
Total gains	712.5153	807.8379	864.8691	932.3167	968.9379	953.7942	914.5078	865.1779	820.5076	751.3821	701.4874	683.9312	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	42.4686	42.5957	42.7210	43.3196	43.4335	43.9715	43.9715	44.0726	43.7627	43.4335	43.2037	42.9661	
alpha	3.8312	3.8397	3.8481	3.8880	3.8956	3.9314	3.9314	3.9382	3.9175	3.8956	3.8802	3.8644	
util living area	0.9780	0.9636	0.9396	0.8799	0.7715	0.6031	0.4539	0.4955	0.7109	0.8971	0.9624	0.9809	(86)
MIT	19.4279	19.6620	19.9801	20.4020	20.7327	20.9263	20.9811	20.9734	20.8559	20.4399	19.8769	19.3965	(87)
Th 2	20.0351	20.0377	20.0403	20.0523	20.0545	20.0650	20.0650	20.0670	20.0610	20.0545	20.0500	20.0452	(88)
util rest of house	0.9735	0.9562	0.9270	0.8549	0.7249	0.5298	0.3629	0.4028	0.6426	0.8703	0.9536	0.9770	(89)
MIT 2	18.2107	18.5071	18.9067	19.4296	19.8102	20.0136	20.0563	20.0538	19.9496	19.4864	18.7899	18.1777	(90)
Living area fraction									fLA = Living area / (4) =			0.2335	(91)
MIT	18.4949	18.7768	19.1573	19.6567	20.0256	20.2267	20.2723	20.2685	20.1612	19.7090	19.0437	18.4623	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.3449	18.6268	19.0073	19.5067	19.8756	20.0767	20.1223	20.1185	20.0112	19.5590	18.8937	18.3123	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9625	0.9420	0.9100	0.8379	0.7151	0.5308	0.3687	0.4081	0.6386	0.8533	0.9392	0.9669	(94)
Useful gains	685.7603	760.9741	787.0500	781.1619	692.8625	506.2284	337.1335	353.1070	523.9862	641.1251	658.8389	661.3189	(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	1410.4265	1374.3675	1248.5958	1044.2252	802.7771	531.1893	341.6272	359.8349	576.0672	879.7016	1164.2063	1400.7807	(97)
Space heating kWh	539.1516	412.2003	343.3901	189.4055	81.7765	0.0000	0.0000	0.0000	0.0000	177.5009	363.8645	550.1596	(98a)
Space heating requirement - total per year (kWh/year)												2657.4490	
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	539.1516	412.2003	343.3901	189.4055	81.7765	0.0000	0.0000	0.0000	0.0000	177.5009	363.8645	550.1596	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2657.4490	
Space heating per m2											(98c) / (4) =	28.0026	(99)

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

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

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

Efficiency of main space heating system 1 (in %) 88.6000 (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	539.1516	412.2003	343.3901	189.4055	81.7765	0.0000	0.0000	0.0000	0.0000	177.5009	363.8645	550.1596	(98)
Space heating efficiency (main heating system 1)	88.6000	88.6000	88.6000	88.6000	88.6000	0.0000	0.0000	0.0000	0.0000	88.6000	88.6000	88.6000	(210)
Space heating fuel (main heating system)	608.5232	465.2374	387.5735	213.7760	92.2985	0.0000	0.0000	0.0000	0.0000	200.3396	410.6823	620.9476	(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	277.2314	245.1861	260.3309	228.3368	221.0128	198.7759	195.8136	203.7356	206.1518	230.3457	245.5350	274.1139	(64)
Efficiency of water heater												79.6000	(216)
(217)m	85.3240	85.0149	84.4811	83.4431	81.8454	79.6000	79.6000	79.6000	79.6000	83.2818	84.7396	85.3894	(217)
Fuel for water heating, kWh/month	324.9162	288.4036	308.1528	273.6436	270.0370	249.7184	245.9969	255.9492	258.9847	276.5858	289.7523	321.0165	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	27.3174	21.9151	19.7321	14.4566	11.1667	9.1233	10.1866	13.2409	17.1987	22.5656	25.4878	28.0767	(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 2999.3781 (211)

Space heating fuel - main system 2 0.0000 (213)

Space heating fuel - secondary 0.0000 (215)

Efficiency of water heater 79.6000

Water heating fuel used 3363.1570 (219)

Space cooling fuel 0.0000 (221)

Electricity for pumps and fans:

central heating pump 41.0000 (230c)

main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	86.0000	(231)
Electricity for lighting (calculated in Appendix L)	220.4673	(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	6669.0024	(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	2999.3781	0.2100	629.8694	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3363.1570	0.2100	706.2630	(264)
Space and water heating			1336.1324	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	220.4673	0.1443	31.8202	(268)
Total CO2, kg/year			1379.8819	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			14.5400	(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	2999.3781	1.1300	3389.2972	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3363.1570	1.1300	3800.3675	(278)
Space and water heating			7189.6647	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	220.4673	1.5338	338.1601	(282)
Total Primary energy kWh/year			7657.9256	(286)
Dwelling Primary energy Rate (DPER)			80.6900	(287)

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Main dwelling						
Ground floor	47.4500	(1b) x	2.3500	(2b) =	111.5075	(1b) - (3b)
First floor	47.4500	(1c) x	2.6500	(2c) =	125.7425	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	94.9000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		237.2500	(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) =	0.1264	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3764	(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) =	0.3482	(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	0.4440	0.4353	0.4266	0.3830	0.3743	0.3308	0.3308	0.3221	0.3482	0.3743	0.3917	0.4092	(22b)
Effective ac	0.5986	0.5947	0.5910	0.5734	0.5701	0.5547	0.5547	0.5519	0.5606	0.5701	0.5767	0.5837	(25)

3. Heat losses and heat loss parameter

Element	Gross	Openings	NetArea	U-value	A x U	K-value	A x K	
Main dwelling	m2	m2	m2	W/m2K	W/K	kJ/m2K	kJ/K	
TER Opaque door			2.3100	1.0000	2.3100			(26)
TER Opening Type			14.5800	1.1450	16.6947			(27)
Heatloss Floor 1			47.4500	0.1300	6.1685			(28a)
External Wall 1	98.2300	16.8900	81.3400	0.1800	14.6412			(29a)
External Roof 1	47.4500		47.4500	0.1100	5.2195			(30)
Total net area of external elements Aum(A, m2)			193.1300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		45.0339			(33)
Main dwelling								
Party Wall 1			42.8300	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 161.7841 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	11.9900	0.0500	0.5995
E3 Sill	9.3200	0.0500	0.4660
E4 Jamb	30.0000	0.0500	1.5000
E5 Ground floor (normal)	19.6500	0.1600	3.1440
E6 Intermediate floor within a dwelling	19.6500	0.0000	0.0000
E10 Eaves (insulation at ceiling level)	11.0800	0.0600	0.6648
E18 Party wall between dwellings	10.0000	0.0600	0.6000
P1 Party wall - Ground floor	8.6600	0.0800	0.6928
P2 Party wall - Intermediate floor within a dwelling	8.6600	0.0000	0.0000
P4 Party wall - Roof (insulation at ceiling level)	8.6600	0.1200	1.0392
E12 Gable (insulation at ceiling level)	8.5700	0.0600	0.5142
E16 Corner (normal)	10.0000	0.0900	0.9000

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 10.1205 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 55.1544 (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	46.8625	46.5629	46.2692	44.8897	44.6316	43.4301	43.4301	43.2076	43.8929	44.6316	45.1537	45.6996	(38)
Heat transfer coeff	102.0169	101.7172	101.4235	100.0440	99.7859	98.5844	98.5844	98.3619	99.0472	99.7859	100.3081	100.8539	(39)
Average = Sum(39)m / 12 =												100.0428	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0750	1.0718	1.0687	1.0542	1.0515	1.0388	1.0388	1.0365	1.0437	1.0515	1.0570	1.0627	(40)
HLP (average)												1.0542	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.6870 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	69.2725	68.2315	66.7145	63.8120	61.6700	59.2813	57.9236	59.4291	61.0794	63.6442	66.6090	69.0071	(42a)
Hot water usage for baths	29.9127	29.4684	28.8428	27.6893	26.8256	25.8679	25.3506	25.9718	26.6482	27.6730	28.8502	29.8115	(42b)
Hot water usage for other uses	42.1479	40.6153	39.0826	37.5500	36.0173	34.4847	34.4847	36.0173	37.5500	39.0826	40.6153	42.1479	(42c)
Average daily hot water use (litres/day)												129.9169	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	141.3331	138.3151	134.6399	129.0513	124.5130	119.6339	117.7589	121.4183	125.2776	130.3998	136.0745	140.9665	(44)
Energy conte	223.8370	196.9589	206.9365	176.6648	167.6184	147.1039	142.4192	150.3412	154.4798	176.9513	193.8630	220.7195	(45)
Energy content (annual)										Total = Sum(45)m =		2157.8934	
Distribution loss (46)m = 0.15 x (45)m	33.5756	29.5438	31.0405	26.4997	25.1428	22.0656	21.3629	22.5512	23.1720	26.5427	29.0795	33.1079	(46)
Water storage loss:													
Store volume												250.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.8903	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.0208	(55)
Total storage loss	31.6444	28.5820	31.6444	30.6236	31.6444	30.6236	31.6444	31.6444	30.6236	31.6444	30.6236	31.6444	(56)
If cylinder contains dedicated solar storage	31.6444	28.5820	31.6444	30.6236	31.6444	30.6236	31.6444	31.6444	30.6236	31.6444	30.6236	31.6444	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	278.7438	246.5521	261.8433	229.8004	222.5252	200.2395	197.3260	205.2479	207.6154	231.8581	246.9986	275.6263	(62)
WWHRS	-31.6685	-28.0079	-29.3282	-24.2849	-22.6327	-19.3669	-18.1534	-19.3043	-20.0378	-23.6223	-26.7613	-31.0820	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	247.0753	218.5443	232.5151	205.5154	199.8925	180.8725	179.1725	185.9436	187.5776	208.2357	220.2374	244.5443	(64)
										Total per year (kWh/year) = Sum(64)m =		2510.1262	(64)
12Total per year (kWh/year)												2510	(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	118.3512	105.1634	112.7318	101.2495	99.6586	91.4205	91.2798	93.9139	93.8730	102.7617	106.9679	117.3147	(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	134.3517	134.3517	134.3517	134.3517	134.3517	134.3517	134.3517	134.3517	134.3517	134.3517	134.3517	134.3517	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	131.4727	145.5591	131.4727	135.8551	131.4727	135.8551	131.4727	131.4727	135.8551	131.4727	135.8551	131.4727	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	247.8096	250.3811	243.9010	230.1057	212.6916	196.3248	185.3908	182.8193	189.2994	203.0947	220.5088	236.8756	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.4352	36.4352	36.4352	36.4352	36.4352	36.4352	36.4352	36.4352	36.4352	36.4352	36.4352	36.4352	(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)	-107.4813	-107.4813	-107.4813	-107.4813	-107.4813	-107.4813	-107.4813	-107.4813	-107.4813	-107.4813	-107.4813	-107.4813	(71)
Water heating gains (Table 5)	159.0742	156.4932	151.5213	140.6243	133.9497	126.9729	122.6879	126.2283	130.3792	138.1206	148.5666	157.6810	(72)

Total internal gains

	604.6620	618.7388	593.2005	572.8907	544.4195	522.4584	502.8569	503.8259	518.8392	538.9935	571.2360	592.3348 (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	6.8600	10.6334	0.6300	0.7000	0.7700	22.2930	(74)
East	2.7900	19.6403	0.6300	0.7000	0.7700	16.7465	(76)
South	4.9300	46.7521	0.6300	0.7000	0.7700	70.4400	(78)

Solar gains	109.4795	190.7253	273.2949	361.0522	426.1446	432.9620	413.2771	362.9783	303.2946	214.0148	131.8776	93.2227	(83)
Total gains	714.1415	809.4641	866.4954	933.9429	970.5641	955.4204	916.1340	866.8041	822.1338	753.0083	703.1136	685.5574	(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	41.8049	41.9281	42.0495	42.6293	42.7396	43.2605	43.2605	43.3583	43.0583	42.7396	42.5171	42.2870	
alpha	3.7870	3.7952	3.8033	3.8420	3.8493	3.8840	3.8840	3.8906	3.8706	3.8493	3.8345	3.8191	
util living area	0.9781	0.9639	0.9404	0.8821	0.7756	0.6088	0.4595	0.5012	0.7157	0.8988	0.9627	0.9810	(86)
MIT	19.3949	19.6297	19.9511	20.3791	20.7185	20.9206	20.9793	20.9710	20.8470	20.4201	19.8491	19.3631	(87)
Th 2	20.0213	20.0239	20.0264	20.0384	20.0406	20.0511	20.0511	20.0530	20.0471	20.0406	20.0361	20.0314	(88)
util rest of house	0.9735	0.9566	0.9279	0.8571	0.7288	0.5345	0.3663	0.4065	0.6469	0.8721	0.9539	0.9770	(89)
MIT 2	18.1596	18.4571	18.8610	19.3918	19.7832	19.9957	20.0416	20.0387	19.9289	19.4524	18.7456	18.1262	(90)
Living area fraction										fLA = Living area / (4) =		0.2335	(91)
MIT	18.4480	18.7309	19.1155	19.6224	20.0016	20.2117	20.2606	20.2564	20.1433	19.6784	19.0033	18.4150	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4480	18.7309	19.1155	19.6224	20.0016	20.2117	20.2606	20.2564	20.1433	19.6784	19.0033	18.4150	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9636	0.9439	0.9134	0.8445	0.7268	0.5477	0.3874	0.4276	0.6544	0.8600	0.9415	0.9679	(94)
Useful gains	688.1254	764.0722	791.4378	788.7432	705.3619	523.2551	354.9440	370.6051	538.0038	647.6208	661.9894	663.5532	(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	1443.3368	1406.8404	1279.5092	1072.7103	828.3820	553.2268	360.8734	379.3223	598.5673	905.8934	1193.9961	1433.6416	(97)
Space heating kWh	561.8773	431.9403	363.1251	204.4564	91.5270	0.0000	0.0000	0.0000	0.0000	192.1548	383.0448	572.9458	(98a)
Space heating requirement - total per year (kWh/year)												2801.0714	
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	561.8773	431.9403	363.1251	204.4564	91.5270	0.0000	0.0000	0.0000	0.0000	192.1548	383.0448	572.9458	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2801.0714	
Space heating per m2											(98c) / (4) =	29.5160	(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	561.8773	431.9403	363.1251	204.4564	91.5270	0.0000	0.0000	0.0000	0.0000	192.1548	383.0448	572.9458	(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)	608.7511	467.9743	393.4183	221.5128	99.1625	0.0000	0.0000	0.0000	0.0000	208.1851	414.9998	620.7430	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	247.0753	218.5443	232.5151	205.5154	199.8925	180.8725	179.1725	185.9436	187.5776	208.2357	220.2374	244.5443	(64)
Efficiency of water heater												79.8000	(216)
(217)m	85.8430	85.5581	85.0554	84.0482	82.4237	79.8000	79.8000	79.8000	79.8000	83.8800	85.2884	85.9019	(217)
Fuel for water heating, kWh/month	287.8223	255.4338	273.3691	244.5209	242.5183	226.6573	224.5270	233.0120	235.0597	248.2544	258.2265	284.6786	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	27.3174	21.9151	19.7321	14.4566	11.1667	9.1233	10.1866	13.2409	17.1987	22.5656	25.4878	28.0767	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-43.6487	-61.1527	-87.3472	-97.5522	-104.6143	-97.4074	-96.1715	-91.0575	-81.9671	-69.5916	-47.8382	-37.7794	(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	-25.8274	-54.2004	-107.5010	-161.1467	-212.7952	-213.7380	-211.2517	-179.0175	-131.3959	-77.4406	-34.4570	-20.4360	(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	3034.7469	(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	3014.0800	(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)	220.4673	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-2345.3352	(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	4009.9591	(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	3034.7469	0.2100	637.2969	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3014.0800	0.2100	632.9568	(264)
Space and water heating			1270.2537	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	220.4673	0.1443	31.8202	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-916.1277	0.1347	-123.4308	
PV Unit electricity exported	-1429.2074	0.1259	-180.0084	
Total			-303.4392	(269)
Total CO2, kg/year			1010.5640	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			10.6500	(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	3034.7469	1.1300	3429.2640	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3014.0800	1.1300	3405.9104	(278)
Space and water heating			6835.1744	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	220.4673	1.5338	338.1601	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-916.1277	1.4980	-1372.3144	
PV Unit electricity exported	-1429.2074	0.4623	-660.7579	
Total			-2033.0723	(283)
Total Primary energy kWh/year			5270.3631	(286)
Target Primary Energy Rate (TPER)			55.5400	(287)

Building Regulations England Part L (BREL) Compliance Report

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

Date: Fri 14 Mar 2025 09:30:51

Project Information			
Assessed By	Richard Millard	Building Type	House, Mid-terrace
OCDEA Registration	EES/025661	Assessment Date	2025-03-14

Dwelling Details			
Assessment Type	As designed	Total Floor Area	95 m^2
Site Reference	A3 Mid	Plot Reference	Proposed
Address	37, BS37 7ND		

Client Details	
Name	Ian White
Company	Cotswold Homes Ltd
Address	West House, Yate, Bristol, BS37 5NG

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

1a Target emission rate and dwelling emission rate		
Fuel for main heating system	Electricity	
Target carbon dioxide emission rate	*9.44 $kgCO_2/m^2$*	
Dwelling carbon dioxide emission rate	2.7 $kgCO_2/m^2$	OK
1b Target primary energy rate and dwelling primary energy		
Target primary energy	*49.09 kWh_{PE}/m^2*	
Dwelling primary energy	32.07 kWh_{PE}/m^2	OK
1c Target fabric energy efficiency and dwelling fabric energy efficiency		
Target fabric energy efficiency	*30.2 kWh/m^2*	
Dwelling fabric energy efficiency	28.0 kWh/m^2	OK

2a Fabric U-values				
Element	***Maximum permitted average U-Value [W/m^2K]***	**Dwelling average U-Value [W/m^2K]**	**Element with highest individual U-Value**	
External walls	*0.26*	0.18	Walls (1) (0.18)	OK
Party walls	*0.2*	0	Party Wall (1) (0)	**N/A**
Curtain walls	*1.6*	0	N/A	**N/A**
Floors	*0.18*	0.12	Heatloss Floor 1 (0.12)	OK
Roofs	*0.16*	0.11	Roof (1) (0.11)	OK
Windows, doors, and roof windows	*1.6*	1.08	PL-W01 (1.1)	OK
Rooflights	*2.2*	N/A	N/A	**N/A**

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))		
Name	**Net area [m^2]**	**U-Value [W/m^2K]**
Exposed wall: Walls (1)	41.3	0.18
Party wall: Party Wall (1)	80.6	0 **(!)**
Ground floor: Heatloss Floor 1, Heatloss Floor 1	47.45	0.12
Exposed roof: Roof (1)	47.45	0.11

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	**Area [m^2]**	**Orientation**	**Frame factor**	**U-Value [W/m^2K]**
PL-W01, Windows	1.44	North	0.7	1.1 **(!)**
PL-ED01, Solid Doors	2.31	North	N/A	1 **(!)**
PL-ED02, Windows	3.31	South	0.7	1.1 **(!)**
PL-W04, Windows	1.62	South	0.7	1.1 **(!)**
PL-W05, Windows	1.1	North	0.7	1.1 **(!)**
PL-W06, Windows	1.44	North	0.7	1.1 **(!)**
PL-W08, Windows	1.44	North	0.7	1.1 **(!)**
PL-W09, Windows	1.44	North	0.7	1.1 **(!)**

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))
Building part **1**: Thermal bridging calculated from linear thermal transmittances for each junction

Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E1: Steel lintel with perforated steel base plate	Not government-approved scheme	0.241	EMPF125E101
External wall	E3: Sill	Not government-approved scheme	0.026 **(!)**	EMPF125E301
External wall	E4: Jamb	Not government-approved scheme	0.02 **(!)**	EMPF125E401
External wall	E5: Ground floor (normal)	Not government-approved scheme	0.045	EMPF125E504
External wall	E6: Intermediate floor within a dwelling	Not government-approved scheme	0.002 **(!)**	EMPF125E601
External wall	E10: Eaves (insulation at ceiling level)	Not government-approved scheme	0.05	EMPF125E1001
External wall	E18: Party wall between dwellings	Not government-approved scheme	0.06	EMPF125E21802
Party wall	P1: Ground floor	Not government-approved scheme	0.043	MCPF-P1-04
Party wall	P2: Intermediate floor within a dwelling	SAP table default	0 **(!)**	
Party wall	P4: Roof (insulation at ceiling level)	Not government-approved scheme	0.033 **(!)**	MCPF-P4-01

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

4 Space heating	
Main heating system 1: Heat pump with radiators or underfloor heating - Electricity	
Efficiency	237.5%
Emitter type	Radiators
Flow temperature	55°C
System type	Heat Pump
Manufacturer	Daikin Europe NV
Model	EDLA08EV3
Commissioning	
Secondary heating system: N/A	
Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water	
Cylinder/store - type: Cylinder	
Capacity	210 litres
Declared heat loss	1.7 kWh/day
Primary pipework insulated	Yes
Manufacturer	
Model	
Commissioning	
Waste water heat recovery system 1 - type: N/A	
Efficiency	
Manufacturer	
Model	

6 Controls	
Main heating 1 - type: Time and temperature zone control by arrangement of plumbing and electrical services	
Function	
Ecodesign class	
Manufacturer	
Model	
Water heating - type: Cylinder thermostat and HW separately timed	
Manufacturer	
Model	

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

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

9 Local generation	
Technology type: **Photovoltaic system (1)**	
Peak power	1.34 kWp
Orientation	South
Pitch	30°
Overshading	None or very little
Manufacturer	
MCS certificate	

10 Heat networks
N/A

11 Supporting documentary evidence
N/A

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

Full SAP Calculation Printout

Property Reference	A3 Mid	**Issued on Date**	14/03/2025
Assessment Reference	Proposed	**Prop Type Ref**	Proposed 37
Property	37, BS37 7ND		

SAP Rating	87 B	**DER**	2.70	**TER**	9.44
Environmental	98 A	**% DER < TER**			71.40
CO_2 Emissions (t/year)	0.22	**DFEE**	28.01	**TFEE**	30.20
Compliance Check	See BREL	**% DFEE < TFEE**			7.26
% DPER < TPER	34.66	**DPER**	32.07	**TPER**	49.09

Assessor Details	Mr. Richard Millard	**Assessor ID**	U367-0001
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)	
Main dwelling						
Ground floor	47.4500 (1b)	x	2.3500 (2b)	=	111.5075	(1b) - (3b)
First floor	47.4500 (1c)	x	2.6500 (2c)	=	125.7425	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	94.9000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	237.2500	(5)

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2. Ventilation rate

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			m3 per hour	
Number of open chimneys		0 * 80 =	0.0000	(6a)
Number of open flues		0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire		0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler		0 * 20 =	0.0000	(6d)
Number of flues attached to other heater		0 * 35 =	0.0000	(6e)
Number of blocked chimneys		0 * 20 =	0.0000	(6f)
Number of intermittent extract fans		3 * 10 =	30.0000	(7a)
Number of passive vents		0 * 10 =	0.0000	(7b)
Number of flueless gas fires		0 * 40 =	0.0000	(7c)
		Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =		30.0000 / (5) =	0.1264	(8)
Pressure test			Yes	
Pressure Test Method			Blower Door	
Measured/design AP50			5.0000	(17)
Infiltration rate			0.3764	(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) =	0.3482	(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	0.4440	0.4353	0.4266	0.3830	0.3743	0.3308	0.3308	0.3221	0.3482	0.3743	0.3917	0.4092	(22b)
Effective ac	0.5986	0.5947	0.5910	0.5734	0.5701	0.5547	0.5547	0.5519	0.5606	0.5701	0.5767	0.5837	(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	
Main dwelling								
Solid Doors			2.3100	1.0000	2.3100			(26)
Windows			11.7900	1.0536	12.4224			(27)
Heatloss Floor 1			47.4500	0.1200	5.6940	75.0000	3558.7500	(28a)
External Wall 1	55.4000	14.1000	41.3000	0.1800	7.4340	60.0000	2478.0001	(29a)
External Roof 1	47.4500		47.4500	0.1100	5.2195	9.0000	427.0500	(30)
Total net area of external elements Aum(A, m2)			150.3000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		33.0799			(33)
Main dwelling								
Party Wall 1			80.6000	0.0000	0.0000	45.0000	3626.9999	(32)
Internal Wall 1			26.0400			75.0000	1953.0001	(32c)
Internal Wall 2			147.2900			9.0000	1325.6099	(32c)
Internal Floor 1			47.4500			18.0000	854.1000	(32d)
Internal Ceiling 1			47.4500			9.0000	427.0500	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	14650.5600 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		154.3789 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	9.5000	0.2410	2.2895

E3 Sill	6.9200	0.0260	0.1799	
E4 Jamb	22.5000	0.0200	0.4500	
E5 Ground floor (normal)	11.0800	0.0450	0.4986	
E6 Intermediate floor within a dwelling	11.0800	0.0020	0.0222	
E10 Eaves (insulation at ceiling level)	11.0800	0.0500	0.5540	
E18 Party wall between dwellings	20.0000	0.0600	1.2000	
P1 Party wall - Ground floor	16.1200	0.0430	0.6932	
P2 Party wall - Intermediate floor within a dwelling	16.1200	0.0000	0.0000	
P4 Party wall - Roof (insulation at ceiling level)	16.1200	0.0330	0.5320	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 6.4193 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 39.4992 (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	46.8625	46.5629	46.2692	44.8897	44.6316	43.4301	43.4301	43.2076	43.8929	44.6316	45.1537	45.6996	(38)
Heat transfer coeff	86.3617	86.0621	85.7684	84.3889	84.1308	82.9293	82.9293	82.7068	83.3921	84.1308	84.6529	85.1988	(39)

Average = Sum(39)m / 12 = 84.3877

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9100	0.9069	0.9038	0.8892	0.8865	0.8739	0.8739	0.8715	0.8787	0.8865	0.8920	0.8978	(40)
HLP (average)												0.8892	
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 2.6870 (42)

Hot water usage for mixer showers

69.2725	68.2315	66.7145	63.8120	61.6700	59.2813	57.9236	59.4291	61.0794	63.6442	66.6090	69.0071	(42a)

Hot water usage for baths

29.9127	29.4684	28.8428	27.6893	26.8256	25.8679	25.3506	25.9718	26.6482	27.6730	28.8502	29.8115	(42b)

Hot water usage for other uses

42.1479	40.6153	39.0826	37.5500	36.0173	34.4847	34.4847	36.0173	37.5500	39.0826	40.6153	42.1479	(42c)

Average daily hot water use (litres/day) 129.9169 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	141.3331	138.3151	134.6399	129.0513	124.5130	119.6339	117.7589	121.4183	125.2776	130.3998	136.0745	140.9665	(44)
Energy conte	223.8370	196.9589	206.9365	176.6648	167.6184	147.1039	142.4192	150.3412	154.4798	176.9513	193.8630	220.7195	(45)
Energy content (annual)										Total = Sum(45)m =		2157.8934	
Distribution loss (46)m = 0.15 x (45)m	33.5756	29.5438	31.0405	26.4997	25.1428	22.0656	21.3629	22.5512	23.1720	26.5427	29.0795	33.1079	(46)

Water storage loss:

Store volume 210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.7000 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 0.9180 (55)

Total storage loss

28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(56)

If cylinder contains dedicated solar storage

28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(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

275.5574	243.6741	258.6569	226.7168	219.3388	197.1559	194.1396	202.0616	204.5318	228.6717	243.9150	272.4399	(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

275.5574	243.6741	258.6569	226.7168	219.3388	197.1559	194.1396	202.0616	204.5318	228.6717	243.9150	272.4399	(64)
									Total per year (kWh/year) = Sum(64)m =		2766.8594	(64)

12Total per year (kWh/year) 2767 (64)

Electric shower(s)

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

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

Heat gains from water heating, kWh/month

115.8021	102.8610	110.1827	98.7826	97.1094	88.9536	88.7307	91.3648	91.4061	100.2126	104.5011	114.7656	(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	134.3517	134.3517	134.3517	134.3517	134.3517	134.3517	134.3517	134.3517	134.3517	134.3517	134.3517	134.3517	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	137.6732	152.4239	137.6732	142.2623	137.6732	142.2623	137.6732	137.6732	142.2623	137.6732	142.2623	137.6732	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	247.8096	250.3811	243.9010	230.1057	212.6916	196.3248	185.3908	182.8193	189.2994	203.0947	220.5088	236.8756	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.4352	36.4352	36.4352	36.4352	36.4352	36.4352	36.4352	36.4352	36.4352	36.4352	36.4352	36.4352	(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)	-107.4813	-107.4813	-107.4813	-107.4813	-107.4813	-107.4813	-107.4813	-107.4813	-107.4813	-107.4813	-107.4813	-107.4813	(71)
Water heating gains (Table 5)	155.6480	153.0670	148.0950	137.1981	130.5234	123.5467	119.2617	122.8021	126.9530	134.6944	145.1404	154.2548	(72)
Total internal gains	604.4363	619.1774	592.9747	572.8716	544.1938	525.4394	505.6312	506.6001	521.8202	538.7678	571.2170	592.1090	(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	6.8600	10.6334	0.6300	0.7000	0.7700	22.2930	(74)
South	4.9300	46.7521	0.6300	0.7000	0.7700	70.4400	(78)

Solar gains 92.7330	157.9656	219.3444	282.3687	329.7149	334.2491	319.2984	282.2519	240.5479	175.1427	110.9967	79.4512	(83)
Total gains 697.1693	777.1430	812.3192	855.2403	873.9087	859.6884	824.9296	788.8521	762.3681	713.9105	682.2137	671.5602	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	47.1227	47.2868	47.4487	48.2244	48.3723	49.0731	49.0731	49.2051	48.8008	48.3723	48.0739	47.7659	
alpha	4.1415	4.1525	4.1632	4.2150	4.2248	4.2715	4.2715	4.2803	4.2534	4.2248	4.2049	4.1844	
util living area	0.9739	0.9581	0.9338	0.8724	0.7614	0.5847	0.4347	0.4710	0.6823	0.8809	0.9549	0.9772	(86)
Living	19.6816	19.8917	20.1605	20.5223	20.7966	20.9510	20.9890	20.9845	20.9037	20.5722	20.0881	19.6565	
Non living	18.6207	18.8865	19.2240	19.6734	19.9893	20.1542	20.1843	20.1836	20.1094	19.7415	19.1456	18.5965	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	20.3255	19.8917	20.1605	20.5223	20.7966	20.9510	20.9890	20.9845	20.9037	20.5722	20.0881	19.8444	(87)
Th 2	20.1590	20.1617	20.1643	20.1767	20.1790	20.1898	20.1898	20.1918	20.1856	20.1790	20.1743	20.1694	(88)
util rest of house	0.9691	0.9505	0.9214	0.8488	0.7190	0.5207	0.3579	0.3929	0.6210	0.8542	0.9455	0.9729	(89)
MIT 2	19.5457	18.8865	19.2240	19.6734	19.9893	20.1542	20.1843	20.1836	20.1094	19.7415	19.1456	18.8799	(90)
Living area fraction										fLA = Living area / (4) =		0.2335	(91)
MIT	19.7278	19.1212	19.4427	19.8716	20.1778	20.3403	20.3722	20.3706	20.2949	19.9355	19.3657	19.1051	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.7278	19.1212	19.4427	19.8716	20.1778	20.3403	20.3722	20.3706	20.2949	19.9355	19.3657	19.1051	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9662	0.9387	0.9087	0.8389	0.7189	0.5330	0.3754	0.4105	0.6297	0.8451	0.9339	0.9660	(94)
Useful gains	673.5918	729.5272	738.1581	717.4515	628.2586	458.2363	309.7188	323.8468	480.0571	603.3262	637.1429	648.7159	(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	1332.3729	1223.9082	1110.0763	925.8845	713.2427	476.0364	312.8237	328.3941	516.6065	785.4006	1038.3252	1269.8993	(97)
Space heating kWh	490.1331	332.2240	276.7072	150.0717	63.2282	0.0000	0.0000	0.0000	0.0000	135.4633	288.8513	462.1604	(98a)
Space heating requirement - total per year (kWh/year)												2198.8392	
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	490.1331	332.2240	276.7072	150.0717	63.2282	0.0000	0.0000	0.0000	0.0000	135.4633	288.8513	462.1604	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2198.8392	
Space heating per m2											(98c) / (4) =	23.1701	(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 %) 237.5263 (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	490.1331	332.2240	276.7072	150.0717	63.2282	0.0000	0.0000	0.0000	0.0000	135.4633	288.8513	462.1604	(98)
Space heating efficiency (main heating system 1)	237.5263	237.5263	237.5263	237.5263	237.5263	0.0000	0.0000	0.0000	0.0000	237.5263	237.5263	237.5263	(210)
Space heating fuel (main heating system)	206.3489	139.8683	116.4954	63.1811	26.6194	0.0000	0.0000	0.0000	0.0000	57.0309	121.6081	194.5723	(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	275.5574	243.6741	258.6569	226.7168	219.3388	197.1559	194.1396	202.0616	204.5318	228.6717	243.9150	272.4399	(64)
Efficiency of water heater												170.7976	(216)
(217)m	170.7976	170.7976	170.7976	170.7976	170.7976	170.7976	170.7976	170.7976	170.7976	170.7976	170.7976	170.7976	(217)
Fuel for water heating, kWh/month	161.3357	142.6684	151.4406	132.7401	128.4203	115.4325	113.6665	118.3047	119.7510	133.8846	142.8094	159.5104	(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	28.6058	22.9486	20.6627	15.1384	11.6933	9.5535	10.6670	13.8654	18.0098	23.6298	26.6898	29.4008	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-26.9528	-40.9485	-63.3428	-75.6327	-84.7490	-79.0776	-77.9935	-71.6056	-60.6135	-48.0912	-30.3991	-22.9019	(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	-6.6051	-15.0501	-32.0292	-52.1846	-73.1584	-76.1706	-75.2030	-62.2429	-44.2167	-23.4956	-9.4055	-5.1804	(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												925.7244	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												170.7976	
Water heating fuel used												1619.9642	(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)	230.8650	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-1157.2504	(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	1619.3032	(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	925.7244	0.1558	144.2206	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1619.9642	0.1409	228.3297	(264)
Space and water heating			372.5503	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	230.8650	0.1443	33.3209	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-682.3082	0.1335	-91.0638	
PV Unit electricity exported	-474.9422	0.1235	-58.6786	
Total			-149.7424	(269)
Total CO2, kg/year			256.1289	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			2.7000	(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	925.7244	1.5767	1459.6299	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1619.9642	1.5212	2464.2487	(278)
Space and water heating			3923.8786	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	230.8650	1.5338	354.1084	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-682.3082	1.4932	-1018.8256	
PV Unit electricity exported	-474.9422	0.4534	-215.3310	
Total			-1234.1565	(283)
Total Primary energy kWh/year			3043.8305	(286)
Dwelling Primary energy Rate (DPER)			32.0700	(287)

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Main dwelling						
Ground floor	47.4500	(1b)	x 2.3500	(2b) =	111.5075	(1b) - (3b)
First floor	47.4500	(1c)	x 2.6500	(2c) =	125.7425	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	94.9000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		237.2500	(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) =	0.1264	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3764	(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) =	0.3482	(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	0.4440	0.4353	0.4266	0.3830	0.3743	0.3308	0.3308	0.3221	0.3482	0.3743	0.3917	0.4092	(22b)
Effective ac	0.5986	0.5947	0.5910	0.5734	0.5701	0.5547	0.5547	0.5519	0.5606	0.5701	0.5767	0.5837	(25)

3. Heat losses and heat loss parameter

Element	Gross	Openings	NetArea	U-value	A x U	K-value	A x K	
Main dwelling	m2	m2	m2	W/m2K	W/K	kJ/m2K	kJ/K	
TER Opaque door			2.3100	1.0000	2.3100			(26)
TER Opening Type			11.7900	1.1450	13.5000			(27)
Heatloss Floor 1			47.4500	0.1300	6.1685			(28a)
External Wall 1	55.4000	14.1000	41.3000	0.1800	7.4340			(29a)
External Roof 1	47.4500		47.4500	0.1100	5.2195			(30)
Total net area of external elements Aum(A, m2)			150.3000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	34.6320			(33)
Main dwelling								
Party Wall 1			80.6000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 154.3789 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	9.5000	0.0500	0.4750
E3 Sill	6.9200	0.0500	0.3460
E4 Jamb	22.5000	0.0500	1.1250
E5 Ground floor (normal)	11.0800	0.1600	1.7728
E6 Intermediate floor within a dwelling	11.0800	0.0000	0.0000
E10 Eaves (insulation at ceiling level)	11.0800	0.0600	0.6648
E18 Party wall between dwellings	20.0000	0.0600	1.2000
P1 Party wall - Ground floor	16.1200	0.0800	1.2896
P2 Party wall - Intermediate floor within a dwelling	16.1200	0.0000	0.0000
P4 Party wall - Roof (insulation at ceiling level)	16.1200	0.1200	1.9344

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 8.8076 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 43.4396 (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	46.8625	46.5629	46.2692	44.8897	44.6316	43.4301	43.4301	43.2076	43.8929	44.6316	45.1537	45.6996	(38)
Heat transfer coeff	90.3021	90.0025	89.7088	88.3293	88.0712	86.8697	86.8697	86.6472	87.3325	88.0712	88.5933	89.1392	(39)
Average = Sum(39)m / 12 =												88.3280	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9516	0.9484	0.9453	0.9308	0.9280	0.9154	0.9154	0.9130	0.9203	0.9280	0.9335	0.9393	(40)
HLP (average)												0.9307	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.6870 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	69.2725	68.2315	66.7145	63.8120	61.6700	59.2813	57.9236	59.4291	61.0794	63.6442	66.6090	69.0071	(42a)
Hot water usage for baths	29.9127	29.4684	28.8428	27.6893	26.8256	25.8679	25.3506	25.9718	26.6482	27.6730	28.8502	29.8115	(42b)
Hot water usage for other uses	42.1479	40.6153	39.0826	37.5500	36.0173	34.4847	34.4847	36.0173	37.5500	39.0826	40.6153	42.1479	(42c)
Average daily hot water use (litres/day)												129.9169	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	141.3331	138.3151	134.6399	129.0513	124.5130	119.6339	117.7589	121.4183	125.2776	130.3998	136.0745	140.9665	(44)
Energy conte	223.8370	196.9589	206.9365	176.6648	167.6184	147.1039	142.4192	150.3412	154.4798	176.9513	193.8630	220.7195	(45)
Energy content (annual)										Total = Sum(45)m =		2157.8934	
Distribution loss (46)m = 0.15 x (45)m	33.5756	29.5438	31.0405	26.4997	25.1428	22.0656	21.3629	22.5512	23.1720	26.5427	29.0795	33.1079	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7016	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9188	(55)
Total storage loss	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(56)
If cylinder contains dedicated solar storage	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(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	275.5836	243.6978	258.6831	226.7421	219.3650	197.1812	194.1658	202.0877	204.5572	228.6979	243.9404	272.4661	(62)
WWHRS	-31.6685	-28.0079	-29.3282	-24.2849	-22.6327	-19.3669	-18.1534	-19.3043	-20.0378	-23.6223	-26.7613	-31.0820	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	243.9151	215.6899	229.3549	202.4572	196.7323	177.8143	176.0123	182.7834	184.5194	205.0755	217.1791	241.3841	(64)
										Total per year (kWh/year) = Sum(64)m =		2472.9174	(64)
12Total per year (kWh/year)												2473	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000	(64a)
Heat gains from water heating, kWh/month	115.8231	102.8799	110.2037	98.8029	97.1304	88.9739	88.7516	91.3857	91.4264	100.2336	104.5213	114.7865	(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	134.3517	134.3517	134.3517	134.3517	134.3517	134.3517	134.3517	134.3517	134.3517	134.3517	134.3517	134.3517	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	137.6732	152.4239	137.6732	142.2623	137.6732	142.2623	137.6732	137.6732	142.2623	137.6732	142.2623	137.6732	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													

	247.8096	250.3811	243.9010	230.1057	212.6916	196.3248	185.3908	182.8193	189.2994	203.0947	220.5088	236.8756 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	36.4352	36.4352	36.4352	36.4352	36.4352	36.4352	36.4352	36.4352	36.4352	36.4352	36.4352	36.4352 (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)												
	-107.4813	-107.4813	-107.4813	-107.4813	-107.4813	-107.4813	-107.4813	-107.4813	-107.4813	-107.4813	-107.4813	-107.4813 (71)
Water heating gains (Table 5)												
	155.6762	153.0951	148.1232	137.2263	130.5516	123.5749	119.2898	122.8303	126.9811	134.7225	145.1685	154.2829 (72)
Total internal gains												
	607.4645	622.2056	596.0029	575.8998	547.2219	525.4675	505.6594	506.6283	521.8483	541.7959	574.2451	595.1372 (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	6.8600	10.6334	0.6300	0.7000	0.7700	22.2930	(74)
South	4.9300	46.7521	0.6300	0.7000	0.7700	70.4400	(78)

Solar gains	92.7330	157.9656	219.3444	282.3687	329.7149	334.2491	319.2984	282.2519	240.5479	175.1427	110.9967	79.4512 (83)
Total gains	700.1975	780.1712	815.3473	858.2685	876.9369	859.7166	824.9578	788.8802	762.3963	716.9386	685.2418	674.5884 (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	45.0665	45.2165	45.3646	46.0731	46.2081	46.8472	46.8472	46.9675	46.5989	46.2081	45.9357	45.6545	
alpha	4.0044	4.0144	4.0243	4.0715	4.0805	4.1231	4.1231	4.1312	4.1066	4.0805	4.0624	4.0436	
util living area													
	0.9746	0.9598	0.9370	0.8799	0.7748	0.6043	0.4527	0.4899	0.7002	0.8877	0.9568	0.9777	(86)
MIT	19.5902	19.8032	20.0818	20.4614	20.7601	20.9371	20.9849	20.9791	20.8816	20.5196	20.0118	19.5642	(87)
Th 2	20.1239	20.1266	20.1292	20.1414	20.1437	20.1544	20.1544	20.1564	20.1503	20.1437	20.1391	20.1342	(88)
util rest of house													
	0.9698	0.9523	0.9250	0.8566	0.7321	0.5372	0.3702	0.4063	0.6373	0.8614	0.9475	0.9735	(89)
MIT 2	18.4808	18.7504	19.1008	19.5734	19.9195	20.1088	20.1470	20.1454	20.0563	19.6519	19.0250	18.4553	(90)
Living area fraction									fLA = Living area / (4) =			0.2335	(91)
MIT	18.7399	18.9963	19.3299	19.7807	20.1158	20.3022	20.3426	20.3401	20.2490	19.8545	19.2554	18.7142	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7399	18.9963	19.3299	19.7807	20.1158	20.3022	20.3426	20.3401	20.2490	19.8545	19.2554	18.7142	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9598	0.9401	0.9115	0.8454	0.7305	0.5494	0.3889	0.4249	0.6451	0.8510	0.9355	0.9643	(94)
Useful gains	672.0629	733.4322	743.2076	725.6101	640.6382	472.3658	320.8468	335.2262	491.8158	610.1425	641.0388	650.4919	(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													
	1303.9494	1268.6976	1150.9541	961.0885	741.1863	495.3481	325.1204	341.3957	537.0097	815.0582	1076.8909	1293.7849	(97)
Space heating kWh													
	470.1236	359.6983	303.3635	169.5444	74.8078	0.0000	0.0000	0.0000	0.0000	152.4573	313.8136	478.6100	(98a)
Space heating requirement - total per year (kWh/year)												2322.4185	
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													
	470.1236	359.6983	303.3635	169.5444	74.8078	0.0000	0.0000	0.0000	0.0000	152.4573	313.8136	478.6100	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2322.4185	
Space heating per m2											(98c) / (4) =	24.4723	(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													
	470.1236	359.6983	303.3635	169.5444	74.8078	0.0000	0.0000	0.0000	0.0000	152.4573	313.8136	478.6100	(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)													
	509.3430	389.7057	328.6711	183.6885	81.0485	0.0000	0.0000	0.0000	0.0000	165.1758	339.9930	518.5373	(211)
Space heating efficiency (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	243.9151	215.6899	229.3549	202.4572	196.7323	177.8143	176.0123	182.7834	184.5194	205.0755	217.1791	241.3841	(64)
Efficiency of water heater												79.8000	(216)
(217)m	85.5058	85.1980	84.6878	83.6647	82.0922	79.8000	79.8000	79.8000	79.8000	83.4046	84.8844	85.5647	(217)
Fuel for water heating, kWh/month													
	285.2615	253.1629	270.8239	241.9865	239.6481	222.8249	220.5668	229.0519	231.2273	245.8805	255.8528	282.1070	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	28.6058	22.9486	20.6627	15.1384	11.6933	9.5535	10.6670	13.8654	18.0098	23.6298	26.6898	29.4008	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-43.6894	-61.2218	-87.4525	-97.6678	-104.7287	-97.5090	-96.2850	-91.1880	-82.0994	-69.6949	-47.8936	-37.8143	(233a)

Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233b)m	-25.7868	-54.1313	-107.3957	-161.0310	-212.6807	-213.6365	-211.1382	-178.8870	-131.2636	-77.3373	-34.4016	-20.4012 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235b)m	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	(235d)

Annual totals kWh/year		
Space heating fuel - main system 1	2516.1630	(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	2978.3942	(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)	230.8650	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-2345.3352	(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	3466.0870	(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	2516.1630	0.2100	528.3942	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2978.3942	0.2100	625.4628	(264)
Space and water heating			1153.8570	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	230.8650	0.1443	33.3209	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-917.2443	0.1347	-123.5798	
PV Unit electricity exported	-1428.0909	0.1259	-179.8581	
Total			-303.4379	(269)
Total CO2, kg/year			895.6693	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			9.4400	(273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2516.1630	1.1300	2843.2642	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2978.3942	1.1300	3365.5854	(278)
Space and water heating			6208.8496	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	230.8650	1.5338	354.1084	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-917.2443	1.4979	-1373.9819	
PV Unit electricity exported	-1428.0909	0.4623	-660.2055	
Total			-2034.1874	(283)
Total Primary energy kWh/year			4658.8714	(286)
Target Primary Energy Rate (TPER)			49.0900	(287)

Building Regulations England Part L (BREL) Compliance Report

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

Date: Fri 14 Mar 2025 09:30:53

Project Information			
Assessed By	Richard Millard	Building Type	House, Mid-terrace
OCDEA Registration	EES/025661	Assessment Date	2025-03-14

Dwelling Details			
Assessment Type	As designed	Total Floor Area	95 m^2
Site Reference	A3 Mid	Plot Reference	Regulated (Baseline)
Address	37, BS37 7ND		

Client Details	
Name	Ian White
Company	Cotswold Homes Ltd
Address	West House, Yate, Bristol, BS37 5NG

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

1a Target emission rate and dwelling emission rate		
Fuel for main heating system	Mains gas	
Target carbon dioxide emission rate	*9.51 $kgCO_2/m^2$*	
Dwelling carbon dioxide emission rate	13.14 $kgCO_2/m^2$	**FAIL**
1b Target primary energy rate and dwelling primary energy		
Target primary energy	*49.5 kWh_{PE}/m^2*	
Dwelling primary energy	73.24 kWh_{PE}/m^2	**FAIL**
1c Target fabric energy efficiency and dwelling fabric energy efficiency		
Target fabric energy efficiency	*30.2 kWh/m^2*	
Dwelling fabric energy efficiency	28.2 kWh/m^2	**OK**

2a Fabric U-values				
Element	***Maximum permitted average U-Value [W/m^2K]***	**Dwelling average U-Value [W/m^2K]**	**Element with highest individual U-Value**	
External walls	*0.26*	0.18	Walls (1) (0.18)	**OK**
Party walls	*0.2*	0	Party Wall (1) (0)	**N/A**
Curtain walls	*1.6*	0	N/A	**N/A**
Floors	*0.18*	0.13	Heatloss Floor 1 (0.13)	**OK**
Roofs	*0.16*	0.11	Roof (1) (0.11)	**OK**
Windows, doors, and roof windows	*1.6*	1.08	PL-W01 (1.1)	**OK**
Rooflights	*2.2*	N/A	N/A	**N/A**

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))		
Name	**Net area [m^2]**	**U-Value [W/m^2K]**
Exposed wall: Walls (1)	41.3	0.18
Party wall: Party Wall (1)	80.6	0 **(!)**
Ground floor: Heatloss Floor 1, Heatloss Floor 1	47.45	0.13
Exposed roof: Roof (1)	47.45	0.11

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	**Area [m^2]**	**Orientation**	**Frame factor**	**U-Value [W/m^2K]**
PL-W01, Windows	1.44	North	0.7	1.1 **(!)**
PL-ED01, Solid Doors	2.31	North	N/A	1 **(!)**
PL-ED02, Windows	3.31	South	0.7	1.1 **(!)**
PL-W04, Windows	1.62	South	0.7	1.1 **(!)**
PL-W05, Windows	1.1	North	0.7	1.1 **(!)**
PL-W06, Windows	1.44	North	0.7	1.1 **(!)**
PL-W08, Windows	1.44	North	0.7	1.1 **(!)**
PL-W09, Windows	1.44	North	0.7	1.1 **(!)**

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))
Building part **1**: Thermal bridging calculated from linear thermal transmittances for each junction

Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E2: Other lintels (including other steel lintels)	Not government-approved scheme	0.05	MCPF-125-E2-01
External wall	E3: Sill	Not government-approved scheme	0.05	MCPF-125-E3-01
External wall	E4: Jamb	Not government-approved scheme	0 **(!)**	MCPF-125-E4-01
External wall	E5: Ground floor (normal)	Not government-approved scheme	0.16	MCPF-125-E5-04
External wall	E6: Intermediate floor within a dwelling	Not government-approved scheme	0.001 **(!)**	MCPF-125-E6-01
External wall	E10: Eaves (insulation at ceiling level)	Not government-approved scheme	0.06	MCPF-125-E10-01
External wall	E18: Party wall between dwellings	Not government-approved scheme	0.09	MCPF-125-E18-01
Party wall	P1: Ground floor	Not government-approved scheme	0.043	MCPF-P1-04
Party wall	P2: Intermediate floor within a dwelling	SAP table default	0 **(!)**	
Party wall	P4: Roof (insulation at ceiling level)	Not government-approved scheme	0.033 **(!)**	MCPF-P4-01

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

4 Space heating	
Main heating system 1: Boiler with radiators or underfloor heating - Mains gas	
Efficiency	88.6%
Emitter type	Radiators
Flow temperature	55°C
System type	Regular boiler
Manufacturer	Bosch Thermotechnology
Model	Greenstar 8000 Life
Commissioning	
Secondary heating system: N/A	
Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water	
Cylinder/store - type: Cylinder	
Capacity	250 litres
Declared heat loss	1.8 kWh/day
Primary pipework insulated	Yes
Manufacturer	
Model	
Commissioning	
Waste water heat recovery system 1 - type: N/A	
Efficiency	
Manufacturer	
Model	

6 Controls	
Main heating 1 - type: Time and temperature zone control by arrangement of plumbing and electrical services	
Function	
Ecodesign class	
Manufacturer	
Model	
Water heating - type: Cylinder thermostat and HW separately timed	
Manufacturer	
Model	

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

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

9 Local generation
N/A

10 Heat networks
N/A

11 Supporting documentary evidence
N/A

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

Full SAP Calculation Printout

Property Reference	A3 Mid	**Issued on Date**	14/03/2025
Assessment Reference	Regulated (Baseline)	**Prop Type Ref**	Proposed 37
Property	37, BS37 7ND		

SAP Rating	86 B	**DER**	13.14	**TER**	9.51
Environmental	88 B	**% DER < TER**			-38.17
CO_2 Emissions (t/year)	1.17	**DFEE**	28.20	**TFEE**	30.20
Compliance Check	See BREL	**% DFEE < TFEE**			6.62
% DPER < TPER	-47.97	**DPER**	73.24	**TPER**	49.50

Assessor Details	Mr. Richard Millard	**Assessor ID**	U367-0001
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)	
Main dwelling						
Ground floor	47.4500 (1b)	x	2.3500 (2b)	=	111.5075	(1b) - (3b)
First floor	47.4500 (1c)	x	2.6500 (2c)	=	125.7425	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	94.9000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	237.2500	(5)

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2. Ventilation rate

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			m3 per hour	
Number of open chimneys		0 * 80 =	0.0000	(6a)
Number of open flues		0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire		0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler		0 * 20 =	0.0000	(6d)
Number of flues attached to other heater		0 * 35 =	0.0000	(6e)
Number of blocked chimneys		0 * 20 =	0.0000	(6f)
Number of intermittent extract fans		3 * 10 =	30.0000	(7a)
Number of passive vents		0 * 10 =	0.0000	(7b)
Number of flueless gas fires		0 * 40 =	0.0000	(7c)
			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =		30.0000 / (5) =	0.1264	(8)
Pressure test			Yes	
Pressure Test Method			Blower Door	
Measured/design AP50			5.0000	(17)
Infiltration rate			0.3764	(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) =	0.3482	(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	0.4440	0.4353	0.4266	0.3830	0.3743	0.3308	0.3308	0.3221	0.3482	0.3743	0.3917	0.4092	(22b)
Effective ac	0.5986	0.5947	0.5910	0.5734	0.5701	0.5547	0.5547	0.5519	0.5606	0.5701	0.5767	0.5837	(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	
Main dwelling								
Solid Doors			2.3100	1.0000	2.3100			(26)
Windows			11.7900	1.0536	12.4224			(27)
Heatloss Floor 1			47.4500	0.1300	6.1685	75.0000	3558.7500	(28a)
External Wall 1	55.4000	14.1000	41.3000	0.1800	7.4340	60.0000	2478.0001	(29a)
External Roof 1	47.4500		47.4500	0.1100	5.2195	9.0000	427.0500	(30)
Total net area of external elements Aum(A, m2)			150.3000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		33.5544			(33)
Main dwelling								
Party Wall 1			80.6000	0.0000	0.0000	45.0000	3626.9999	(32)
Internal Wall 1			26.0400			75.0000	1953.0001	(32c)
Internal Wall 2			147.2900			9.0000	1325.6099	(32c)
Internal Floor 1			47.4500			18.0000	854.1000	(32d)
Internal Ceiling 1			47.4500			9.0000	427.0500	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	14650.5600 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		154.3789 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	9.5000	0.0500	0.4750

E3 Sill	6.9200	0.0500	0.3460	
E4 Jamb	22.5000	0.0000	0.0000	
E5 Ground floor (normal)	11.0800	0.1600	1.7728	
E6 Intermediate floor within a dwelling	11.0800	0.0010	0.0111	
E10 Eaves (insulation at ceiling level)	11.0800	0.0600	0.6648	
E18 Party wall between dwellings	20.0000	0.0900	1.8000	
P1 Party wall - Ground floor	16.1200	0.0430	0.6932	
P2 Party wall - Intermediate floor within a dwelling	16.1200	0.0000	0.0000	
P4 Party wall - Roof (insulation at ceiling level)	16.1200	0.0330	0.5320	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 6.2948 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 39.8492 (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	46.8625	46.5629	46.2692	44.8897	44.6316	43.4301	43.4301	43.2076	43.8929	44.6316	45.1537	45.6996	(38)
Heat transfer coeff	86.7117	86.4121	86.1184	84.7389	84.4808	83.2793	83.2793	83.0568	83.7421	84.4808	85.0029	85.5488	(39)
Average = Sum(39)m / 12 =												84.7377	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9137	0.9106	0.9075	0.8929	0.8902	0.8775	0.8775	0.8752	0.8824	0.8902	0.8957	0.9015	(40)
HLP (average)												0.8929	
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 2.6870 (42)
Hot water usage for mixer showers

69.2725	68.2315	66.7145	63.8120	61.6700	59.2813	57.9236	59.4291	61.0794	63.6442	66.6090	69.0071	(42a)

Hot water usage for baths

29.9127	29.4684	28.8428	27.6893	26.8256	25.8679	25.3506	25.9718	26.6482	27.6730	28.8502	29.8115	(42b)

Hot water usage for other uses

42.1479	40.6153	39.0826	37.5500	36.0173	34.4847	34.4847	36.0173	37.5500	39.0826	40.6153	42.1479	(42c)

Average daily hot water use (litres/day) 129.9169 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	141.3331	138.3151	134.6399	129.0513	124.5130	119.6339	117.7589	121.4183	125.2776	130.3998	136.0745	140.9665	(44)
Energy conte	223.8370	196.9589	206.9365	176.6648	167.6184	147.1039	142.4192	150.3412	154.4798	176.9513	193.8630	220.7195	(45)
Energy content (annual)										Total = Sum(45)m =		2157.8934	
Distribution loss (46)m = 0.15 x (45)m	33.5756	29.5438	31.0405	26.4997	25.1428	22.0656	21.3629	22.5512	23.1720	26.5427	29.0795	33.1079	(46)
Water storage loss:													
Store volume												250.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.8000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9720	(55)
Total storage loss	30.1320	27.2160	30.1320	29.1600	30.1320	29.1600	30.1320	30.1320	29.1600	30.1320	29.1600	30.1320	(56)
If cylinder contains dedicated solar storage	30.1320	27.2160	30.1320	29.1600	30.1320	29.1600	30.1320	30.1320	29.1600	30.1320	29.1600	30.1320	(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	277.2314	245.1861	260.3309	228.3368	221.0128	198.7759	195.8136	203.7356	206.1518	230.3457	245.5350	274.1139	(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	277.2314	245.1861	260.3309	228.3368	221.0128	198.7759	195.8136	203.7356	206.1518	230.3457	245.5350	274.1139	(64)
										Total per year (kWh/year) = Sum(64)m =		2786.5694	(64)
12Total per year (kWh/year)												2787	(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	117.1413	104.0706	111.5219	100.0786	98.4486	90.2496	90.0699	92.7040	92.7021	101.5518	105.7971	116.1048	(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	134.3517	134.3517	134.3517	134.3517	134.3517	134.3517	134.3517	134.3517	134.3517	134.3517	134.3517	134.3517	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	137.6732	152.4239	137.6732	142.2623	137.6732	142.2623	137.6732	137.6732	142.2623	137.6732	142.2623	137.6732	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	247.8096	250.3811	243.9010	230.1057	212.6916	196.3248	185.3908	182.8193	189.2994	203.0947	220.5088	236.8756	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.4352	36.4352	36.4352	36.4352	36.4352	36.4352	36.4352	36.4352	36.4352	36.4352	36.4352	36.4352	(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)	-107.4813	-107.4813	-107.4813	-107.4813	-107.4813	-107.4813	-107.4813	-107.4813	-107.4813	-107.4813	-107.4813	-107.4813	(71)
Water heating gains (Table 5)	157.4480	154.8670	149.8950	138.9981	132.3234	125.3467	121.0617	124.6021	128.7530	136.4944	146.9404	156.0548	(72)
Total internal gains	609.2363	623.9774	597.7747	577.6716	548.9938	527.2394	507.4312	508.4001	523.6202	543.5678	576.0170	596.9090	(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	6.8600	10.6334	0.6300	0.7000	0.7700	22.2930	(74)
South	4.9300	46.7521	0.6300	0.7000	0.7700	70.4400	(78)

Solar gains	92.7330	157.9656	219.3444	282.3687	329.7149	334.2491	319.2984	282.2519	240.5479	175.1427	110.9967	79.4512	(83)
Total gains	701.9693	781.9430	817.1192	860.0403	878.7087	861.4884	826.7296	790.6521	764.1681	718.7105	687.0137	676.3602	(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	46.9325	47.0953	47.2559	48.0252	48.1719	48.8669	48.8669	48.9978	48.5968	48.1719	47.8760	47.5705	
alpha	4.1288	4.1397	4.1504	4.2017	4.2115	4.2578	4.2578	4.2665	4.2398	4.2115	4.1917	4.1714	
util living area	0.9734	0.9575	0.9330	0.8715	0.7604	0.5855	0.4354	0.4718	0.6828	0.8797	0.9541	0.9767	(86)
MIT	19.6803	19.8902	20.1593	20.5212	20.7959	20.9501	20.9887	20.9842	20.9025	20.5720	20.0877	19.6553	(87)
Th 2	20.1559	20.1585	20.1612	20.1735	20.1758	20.1866	20.1866	20.1886	20.1825	20.1758	20.1711	20.1663	(88)
util rest of house	0.9685	0.9498	0.9206	0.8477	0.7178	0.5213	0.3583	0.3933	0.6213	0.8527	0.9446	0.9724	(89)
MIT 2	18.6169	18.8823	19.2201	19.6695	19.9856	20.1505	20.1810	20.1802	20.1053	19.7387	19.1426	18.5927	(90)
Living area fraction									fLA = Living area / (4) =			0.2335	(91)
MIT	18.8652	19.1177	19.4394	19.8684	20.1748	20.3372	20.3696	20.3680	20.2915	19.9333	19.3633	18.8408	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.7152	18.9677	19.2894	19.7184	20.0248	20.1872	20.2196	20.2180	20.1415	19.7833	19.2133	18.6908	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9573	0.9359	0.9048	0.8326	0.7093	0.5213	0.3614	0.3962	0.6180	0.8377	0.9305	0.9621	(94)
Useful gains	671.9969	731.8521	739.3129	716.0930	623.2465	449.1279	298.8160	313.2244	472.2935	602.0512	639.2399	650.6938	(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	1249.9651	1215.6174	1101.4007	916.7409	703.2890	465.2984	301.4389	317.1084	505.9237	775.8094	1029.6665	1239.6706	(97)
Space heating kWh	430.0084	325.0903	269.3933	144.4665	59.5516	0.0000	0.0000	0.0000	0.0000	129.2761	281.1072	438.1987	(98a)
Space heating requirement - total per year (kWh/year)												2077.0921	
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	430.0084	325.0903	269.3933	144.4665	59.5516	0.0000	0.0000	0.0000	0.0000	129.2761	281.1072	438.1987	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2077.0921	
Space heating per m2										(98c) / (4) =		21.8872	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 88.6000 (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	430.0084	325.0903	269.3933	144.4665	59.5516	0.0000	0.0000	0.0000	0.0000	129.2761	281.1072	438.1987	(98)
Space heating efficiency (main heating system 1)	88.6000	88.6000	88.6000	88.6000	88.6000	0.0000	0.0000	0.0000	0.0000	88.6000	88.6000	88.6000	(210)
Space heating fuel (main heating system)	485.3368	366.9191	304.0556	163.0547	67.2140	0.0000	0.0000	0.0000	0.0000	145.9099	317.2768	494.5810	(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	277.2314	245.1861	260.3309	228.3368	221.0128	198.7759	195.8136	203.7356	206.1518	230.3457	245.5350	274.1139	(64)
Efficiency of water heater												79.6000	(216)
(217)m	84.8399	84.4927	83.9360	82.8617	81.3541	79.6000	79.6000	79.6000	79.6000	82.6168	84.1634	84.9057	(217)
Fuel for water heating, kWh/month	326.7703	290.1862	310.1539	275.5636	271.6678	249.7184	245.9969	255.9492	258.9847	278.8121	291.7361	322.8449	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	28.6058	22.9486	20.6627	15.1384	11.6933	9.5535	10.6670	13.8654	18.0098	23.6298	26.6898	29.4008	(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 2344.3477 (211)
Space heating fuel - main system 2 0.0000 (213)
Space heating fuel - secondary 0.0000 (215)
Efficiency of water heater 79.6000
Water heating fuel used 3378.3841 (219)
Space cooling fuel 0.0000 (221)

Electricity for pumps and fans:
central heating pump 41.0000 (230c)
main heating flue fan 45.0000 (230e)
Total electricity for the above, kWh/year 86.0000 (231)
Electricity for lighting (calculated in Appendix L) 230.8650 (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	6039.5968	(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	2344.3477	0.2100	492.3130	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3378.3841	0.2100	709.4607	(264)
Space and water heating			1201.7737	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	230.8650	0.1443	33.3209	(268)
Total CO2, kg/year			1247.0239	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			13.1400	(273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2344.3477	1.1300	2649.1129	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3378.3841	1.1300	3817.5740	(278)
Space and water heating			6466.6870	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	230.8650	1.5338	354.1084	(282)
Total Primary energy kWh/year			6950.8962	(286)
Dwelling Primary energy Rate (DPER)			73.2400	(287)

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Main dwelling						
Ground floor	47.4500 (1b)	x	2.3500 (2b)	=	111.5075 (1b) - (3b)	
First floor	47.4500 (1c)	x	2.6500 (2c)	=	125.7425 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	94.9000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	237.2500	(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) =	0.1264	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3764	(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) =	0.3482	(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	0.4440	0.4353	0.4266	0.3830	0.3743	0.3308	0.3308	0.3221	0.3482	0.3743	0.3917	0.4092	(22b)
Effective ac	0.5986	0.5947	0.5910	0.5734	0.5701	0.5547	0.5547	0.5519	0.5606	0.5701	0.5767	0.5837	(25)

3. Heat losses and heat loss parameter

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

TER Opaque door			2.3100	1.0000	2.3100	(26)
TER Opening Type			11.7900	1.1450	13.5000	(27)
Heatloss Floor 1			47.4500	0.1300	6.1685	(28a)
External Wall 1	55.4000	14.1000	41.3000	0.1800	7.4340	(29a)
External Roof 1	47.4500		47.4500	0.1100	5.2195	(30)
Total net area of external elements Aum(A, m2)			150.3000			(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		34.6320	(33)
Main dwelling						
Party Wall 1			80.6000	0.0000	0.0000	(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 154.3789 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	9.5000	0.0500	0.4750
E3 Sill	6.9200	0.0500	0.3460
E4 Jamb	22.5000	0.0500	1.1250
E5 Ground floor (normal)	11.0800	0.1600	1.7728
E6 Intermediate floor within a dwelling	11.0800	0.0000	0.0000
E10 Eaves (insulation at ceiling level)	11.0800	0.0600	0.6648
E18 Party wall between dwellings	20.0000	0.0600	1.2000
P1 Party wall - Ground floor	16.1200	0.0800	1.2896
P2 Party wall - Intermediate floor within a dwelling	16.1200	0.0000	0.0000
P4 Party wall - Roof (insulation at ceiling level)	16.1200	0.1200	1.9344

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		8.8076 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	43.4396 (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	46.8625	46.5629	46.2692	44.8897	44.6316	43.4301	43.4301	43.2076	43.8929	44.6316	45.1537	45.6996	(38)
Heat transfer coeff	90.3021	90.0025	89.7088	88.3293	88.0712	86.8697	86.8697	86.6472	87.3325	88.0712	88.5933	89.1392	(39)
Average = Sum(39)m / 12 =												88.3280	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9516	0.9484	0.9453	0.9308	0.9280	0.9154	0.9154	0.9130	0.9203	0.9280	0.9335	0.9393	(40)
HLP (average)												0.9307	
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												2.6870 (42)
Hot water usage for mixer showers	69.2725	68.2315	66.7145	63.8120	61.6700	59.2813	57.9236	59.4291	61.0794	63.6442	66.6090	69.0071 (42a)
Hot water usage for baths	29.9127	29.4684	28.8428	27.6893	26.8256	25.8679	25.3506	25.9718	26.6482	27.6730	28.8502	29.8115 (42b)
Hot water usage for other uses	42.1479	40.6153	39.0826	37.5500	36.0173	34.4847	34.4847	36.0173	37.5500	39.0826	40.6153	42.1479 (42c)
Average daily hot water use (litres/day)												129.9169 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	141.3331	138.3151	134.6399	129.0513	124.5130	119.6339	117.7589	121.4183	125.2776	130.3998	136.0745	140.9665	(44)
Energy conte	223.8370	196.9589	206.9365	176.6648	167.6184	147.1039	142.4192	150.3412	154.4798	176.9513	193.8630	220.7195	(45)
Energy content (annual)										Total = Sum(45)m =		2157.8934	
Distribution loss (46)m = 0.15 x (45)m	33.5756	29.5438	31.0405	26.4997	25.1428	22.0656	21.3629	22.5512	23.1720	26.5427	29.0795	33.1079	(46)
Water storage loss:													
Store volume												250.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.8903	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.0208	(55)
Total storage loss	31.6444	28.5820	31.6444	30.6236	31.6444	30.6236	31.6444	31.6444	30.6236	31.6444	30.6236	31.6444	(56)
If cylinder contains dedicated solar storage	31.6444	28.5820	31.6444	30.6236	31.6444	30.6236	31.6444	31.6444	30.6236	31.6444	30.6236	31.6444	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	278.7438	246.5521	261.8433	229.8004	222.5252	200.2395	197.3260	205.2479	207.6154	231.8581	246.9986	275.6263	(62)
WWHRS	-31.6685	-28.0079	-29.3282	-24.2849	-22.6327	-19.3669	-18.1534	-19.3043	-20.0378	-23.6223	-26.7613	-31.0820	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	247.0753	218.5443	232.5151	205.5154	199.8925	180.8725	179.1725	185.9436	187.5776	208.2357	220.2374	244.5443	(64)
										Total per year (kWh/year) = Sum(64)m =		2510.1262	(64)
12Total per year (kWh/year)												2510	(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	118.3512	105.1634	112.7318	101.2495	99.6586	91.4205	91.2798	93.9139	93.8730	102.7617	106.9679	117.3147	(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	134.3517	134.3517	134.3517	134.3517	134.3517	134.3517	134.3517	134.3517	134.3517	134.3517	134.3517	134.3517	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	137.6732	152.4239	137.6732	142.2623	137.6732	142.2623	137.6732	137.6732	142.2623	137.6732	142.2623	137.6732	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	247.8096	250.3811	243.9010	230.1057	212.6916	196.3248	185.3908	182.8193	189.2994	203.0947	220.5088	236.8756	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.4352	36.4352	36.4352	36.4352	36.4352	36.4352	36.4352	36.4352	36.4352	36.4352	36.4352	36.4352	(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)	-107.4813	-107.4813	-107.4813	-107.4813	-107.4813	-107.4813	-107.4813	-107.4813	-107.4813	-107.4813	-107.4813	-107.4813	(71)
Water heating gains (Table 5)	159.0742	156.4932	151.5213	140.6243	133.9497	126.9729	122.6879	126.2283	130.3792	138.1206	148.5666	157.6810	(72)
Total internal gains	610.8625	625.6037	599.4010	579.2979	550.6200	528.8656	509.0574	510.0264	525.2464	545.1940	577.6432	598.5353	(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	6.8600	10.6334	0.6300	0.7000	0.7700	22.2930	(74)
South	4.9300	46.7521	0.6300	0.7000	0.7700	70.4400	(78)

Solar gains	92.7330	157.9656	219.3444	282.3687	329.7149	334.2491	319.2984	282.2519	240.5479	175.1427	110.9967	79.4512	(83)
Total gains	703.5955	783.5693	818.7454	861.6665	880.3349	863.1146	828.3558	792.2783	765.7943	720.3367	688.6399	677.9865	(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	45.0665	45.2165	45.3646	46.0731	46.2081	46.8472	46.8472	46.9675	46.5989	46.2081	45.9357	45.6545	
alpha	4.0044	4.0144	4.0243	4.0715	4.0805	4.1231	4.1231	4.1312	4.1066	4.0805	4.0624	4.0436	
util living area	0.9742	0.9592	0.9363	0.8787	0.7732	0.6024	0.4510	0.4880	0.6981	0.8863	0.9561	0.9774	(86)
MIT	19.5953	19.8080	20.0862	20.4648	20.7621	20.9378	20.9851	20.9794	20.8829	20.5231	20.0166	19.5695	(87)
Th 2	20.1239	20.1266	20.1292	20.1414	20.1437	20.1544	20.1544	20.1564	20.1503	20.1437	20.1391	20.1342	(88)
util rest of house	0.9694	0.9517	0.9241	0.8553	0.7303	0.5354	0.3687	0.4046	0.6351	0.8598	0.9467	0.9731	(89)
MIT 2	18.4873	18.7565	19.1062	19.5773	19.9215	20.1093	20.1471	20.1456	20.0575	19.6559	19.0309	18.4619	(90)
Living area fraction									fLA = Living area / (4) =			0.2335	(91)
MIT	18.7460	19.0020	19.3350	19.7845	20.1178	20.3028	20.3428	20.3403	20.2502	19.8584	19.2611	18.7205	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7460	19.0020	19.3350	19.7845	20.1178	20.3028	20.3428	20.3403	20.2502	19.8584	19.2611	18.7205	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9593	0.9394	0.9106	0.8442	0.7289	0.5477	0.3874	0.4233	0.6430	0.8496	0.9347	0.9638	(94)
Useful gains	674.9381	736.0885	745.5735	727.3918	641.6604	472.6863	320.9189	335.3323	492.4373	611.9658	643.6403	653.4162	(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	1304.5083	1269.2147	1151.4128	961.4223	741.3666	495.4000	325.1318	341.4125	537.1141	815.3993	1077.3911	1294.3468	(97)
Space heating kWh	468.4002	358.2608	301.9444	168.5019	74.1814	0.0000	0.0000	0.0000	0.0000	151.3545	312.3006	476.8524	(98a)
Space heating requirement - total per year (kWh/year)												2311.7962	
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	468.4002	358.2608	301.9444	168.5019	74.1814	0.0000	0.0000	0.0000	0.0000	151.3545	312.3006	476.8524	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2311.7962	
Space heating per m2										(98c) / (4) =		24.3603	(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	468.4002	358.2608	301.9444	168.5019	74.1814	0.0000	0.0000	0.0000	0.0000	151.3545	312.3006	476.8524	(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)	507.4759	388.1482	327.1337	182.5590	80.3699	0.0000	0.0000	0.0000	0.0000	163.9811	338.3538	516.6331	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	247.0753	218.5443	232.5151	205.5154	199.8925	180.8725	179.1725	185.9436	187.5776	208.2357	220.2374	244.5443	(64)
Efficiency of water heater												79.8000	(216)
(217)m	85.4712	85.1609	84.6468	83.6181	82.0508	79.8000	79.8000	79.8000	79.8000	83.3559	84.8427	85.5300	(217)
Fuel for water heating, kWh/month	289.0745	256.6250	274.6887	245.7788	243.6204	226.6573	224.5270	233.0120	235.0597	249.8151	259.5831	285.9162	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	28.6058	22.9486	20.6627	15.1384	11.6933	9.5535	10.6670	13.8654	18.0098	23.6298	26.6898	29.4008	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-43.6894	-61.2218	-87.4525	-97.6678	-104.7287	-97.5090	-96.2850	-91.1880	-82.0994	-69.6949	-47.8936	-37.8143	(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	-25.7868	-54.1313	-107.3957	-161.0310	-212.6807	-213.6365	-211.1382	-178.8870	-131.2636	-77.3373	-34.4016	-20.4012	(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	(235d)

Annual totals kWh/year		
Space heating fuel - main system 1	2504.6546	(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	3024.3577	(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)	230.8650	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-2345.3352	(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	3500.5421	(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	2504.6546	0.2100	525.9775	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3024.3577	0.2100	635.1151	(264)
Space and water heating			1161.0926	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	230.8650	0.1443	33.3209	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-917.2443	0.1347	-123.5798	
PV Unit electricity exported	-1428.0909	0.1259	-179.8581	
Total			-303.4379	(269)
Total CO2, kg/year			902.9049	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			9.5100	(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	2504.6546	1.1300	2830.2597	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3024.3577	1.1300	3417.5242	(278)
Space and water heating			6247.7840	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	230.8650	1.5338	354.1084	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-917.2443	1.4979	-1373.9819	
PV Unit electricity exported	-1428.0909	0.4623	-660.2055	
Total			-2034.1874	(283)
Total Primary energy kWh/year			4697.8057	(286)
Target Primary Energy Rate (TPER)			49.5000	(287)

Building Regulations England Part L (BREL) Compliance Report

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

Date: Fri 14 Mar 2025 09:30:59

Project Information			
Assessed By	Richard Millard	Building Type	Bungalow, Semi-detached
OCDEA Registration	EES/025661	Assessment Date	2025-03-14

Dwelling Details			
Assessment Type	As designed	Total Floor Area	58 m^2
Site Reference	AF2 Bungalow	Plot Reference	Baseline
Address	AF2 Bungalow		

Client Details	
Name	Tim Hayman
Company	Cotswold Homes
Address	West House , Great Western Business Park , Yate , BS37 5NG

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

1a Target emission rate and dwelling emission rate		
Fuel for main heating system	Mains gas	
Target carbon dioxide emission rate	*11.18 $kgCO_2/m^2$*	
Dwelling carbon dioxide emission rate	16.41 $kgCO_2/m^2$	**FAIL**
1b Target primary energy rate and dwelling primary energy		
Target primary energy	*59.97 kWh_{PE}/m^2*	
Dwelling primary energy	87.35 kWh_{PE}/m^2	**FAIL**
1c Target fabric energy efficiency and dwelling fabric energy efficiency		
Target fabric energy efficiency	*41.2 kWh/m^2*	
Dwelling fabric energy efficiency	40.3 kWh/m^2	**OK**

2a Fabric U-values				
Element	***Maximum permitted average U-Value [W/m^2K]***	**Dwelling average U-Value [W/m^2K]**	**Element with highest individual U-Value**	
External walls	*0.26*	0.18	Walls (1) (0.18)	**OK**
Party walls	*0.2*	0	Party Wall (1) (0)	**N/A**
Curtain walls	*1.6*	0	N/A	**N/A**
Floors	*0.18*	0.12	Heatloss Floor 1 (0.12)	**OK**
Roofs	*0.16*	0.11	Roof (1) (0.11)	**OK**
Windows, doors, and roof windows	*1.6*	1.2	PL07-W01 (1.2)	**OK**
Rooflights	*2.2*	N/A	N/A	**N/A**

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))		
Name	**Net area [m^2]**	**U-Value [W/m^2K]**
Exposed wall: Walls (1)	46.4	0.18
Party wall: Party Wall (1)	18.1	0 **(!)**
Ground floor: Heatloss Floor 1, Heatloss Floor 1	57.75	0.12
Exposed roof: Roof (1)	57.75	0.11

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	**Area [m^2]**	**Orientation**	**Frame factor**	**U-Value [W/m^2K]**
PL07-W01, Windows	1.44	East	0.7	1.2
PL07-W02, Windows	0.66	East	0.7	1.2
PL07-W03, Windows	1.44	North	0.7	1.2
PL07-W04, Windows	1.44	West	0.7	1.2
PL07-ED02, Half Glazed Door	1.97	West	N/A	1.2

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))				
Building part **1**: Thermal bridging calculated from linear thermal transmittances for each junction				
Main element	**Junction detail**	**Source**	**Psi value [W/mK]**	**Drawing / reference**
External wall	E2: Other lintels (including other steel lintels)	Not government-approved scheme	0.05	

Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E3: Sill	Not government-approved scheme	0.05	
External wall	E4: Jamb	Not government-approved scheme	0.05	
External wall	E5: Ground floor (normal)	Not government-approved scheme	0.16	
External wall	E16: Corner (normal)	Not government-approved scheme	0.09	MCPF-125-E16-01
External wall	E25: Staggered party wall between dwellings	Not government-approved scheme	0.08	MCPF-125-E25-01
Party wall	P2: Intermediate floor within a dwelling	SAP table default	0 **(!)**	
External wall	E10: Eaves (insulation at ceiling level)	Not government-approved scheme	0.05	
External wall	E24: Eaves (insulation at ceiling level - inverted)	SAP table default	0.15	
Party wall	P1: Ground floor	Calculated by person with suitable expertise	0.08	

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

4 Space heating	
Main heating system 1: Boiler with radiators or underfloor heating - Mains gas	
Efficiency	88.8%
Emitter type	Radiators
Flow temperature	55°C
System type	Regular boiler
Manufacturer	Bosch Thermotechnology
Model	Greenstar 8000 Life
Commissioning	
Secondary heating system: N/A	
Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water	
Cylinder/store - type: Cylinder	
Capacity	210 litres
Declared heat loss	1.7 kWh/day
Primary pipework insulated	Yes
Manufacturer	
Model	
Commissioning	
Waste water heat recovery system 1 - type: N/A	
Efficiency	
Manufacturer	
Model	

6 Controls	
Main heating 1 - type: Time and temperature zone control by arrangement of plumbing and electrical services	
Function	
Ecodesign class	
Manufacturer	
Model	
Water heating - type: Cylinder thermostat and HW separately timed	
Manufacturer	
Model	

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

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

9 Local generation	
Technology type: **Photovoltaic system (1)**	
Peak power	1.34 kWp
Orientation	East
Pitch	30°
Overshading	None or very little
Manufacturer	
MCS certificate	

10 Heat networks
N/A

11 Supporting documentary evidence
N/A

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

Full SAP Calculation Printout

Property Reference	AF2 Bungalow	**Issued on Date**	14/03/2025
Assessment Reference	Baseline	**Prop Type Ref**	AF2 Bungalow
Property	AF2 Bungalow		

SAP Rating	88 B	**DER**	16.41	**TER**	11.18
Environmental	88 B	**% DER < TER**			-46.78
CO_2 Emissions (t/year)	0.88	**DFEE**	40.30	**TFEE**	41.18
Compliance Check	See BREL	**% DFEE < TFEE**			2.15
% DPER < TPER	-45.66	**DPER**	87.35	**TPER**	59.97

Assessor Details	Mr. Richard Millard	**Assessor ID**	U367-0001
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)	
Main dwelling							
Ground floor		57.7500	(1b)	x 2.3500	(2b) =	135.7125	(1b) - (3b) (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	57.7500						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		135.7125	(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) =	0.1474	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3974	(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) =	0.3676	(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	0.4686	0.4595	0.4503	0.4043	0.3951	0.3492	0.3492	0.3400	0.3676	0.3951	0.4135	0.4319	(22b)
Effective ac	0.6098	0.6056	0.6014	0.5817	0.5781	0.5610	0.5610	0.5578	0.5676	0.5781	0.5855	0.5933	(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	
Main dwelling								
Windows			4.9800	1.1450	5.7023			(27)
Half Glazed Door			1.9700	1.2000	2.3640			(26a)
Heatloss Floor 1			57.7500	0.1200	6.9300	75.0000	4331.2500	(28a)
External Wall 1	53.3500	6.9500	46.4000	0.1800	8.3520	60.0000	2783.9999	(29a)
External Roof 1	57.7500		57.7500	0.1100	6.3525	9.0000	519.7500	(30)
Total net area of external elements Aum(A, m2)			168.8500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		29.7008			(33)
Main dwelling								
Party Wall 1			18.1000	0.0000	0.0000	45.0000	814.5000	(32)
Internal Wall			121.2600			9.0000	1091.3400	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	9540.8399 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		165.2093 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	6.1300	0.0500	0.3065
E3 Sill	4.2300	0.0500	0.2115
E4 Jamb	16.8600	0.0500	0.8430
E5 Ground floor (normal)	22.7000	0.1600	3.6320
E16 Corner (normal)	4.7000	0.0900	0.4230

E25 Staggered party wall between dwellings	7.7000	0.0800	0.6160		
P2 Party wall - Intermediate floor within a dwelling	7.7000	0.0000	0.0000		
E10 Eaves (insulation at ceiling level)	22.7000	0.0500	1.1350		
E24 Eaves (insulation at ceiling level - inverted)	7.7000	0.1500	1.1550		
P1 Party wall - Ground floor	7.7000	0.0800	0.6160		
Thermal bridges (Sum(L x Psi) calculated using Appendix K)				8.9380	(36)
Point Thermal bridges			(36a) =	0.0000	
Total fabric heat loss			(33) + (36) + (36a) =	38.6388	(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	27.3107	27.1197	26.9325	26.0533	25.8888	25.1230	25.1230	24.9811	25.4179	25.8888	26.2215	26.5695	(38)
Heat transfer coeff	65.9495	65.7585	65.5713	64.6920	64.5275	63.7617	63.7617	63.6199	64.0567	64.5275	64.8603	65.2082	(39)
Average = Sum(39)m / 12 =												64.6913	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1420	1.1387	1.1354	1.1202	1.1174	1.1041	1.1041	1.1016	1.1092	1.1174	1.1231	1.1291	(40)
HLP (average)												1.1202	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 1.9174 (42)

Hot water usage for mixer showers

56.3673	55.5202	54.2858	51.9241	50.1812	48.2375	47.1327	48.3577	49.7006	51.7875	54.2000	56.1514	(42a)

Hot water usage for baths

24.3630	24.0012	23.4917	22.5522	21.8487	21.0687	20.6474	21.1533	21.7042	22.5389	23.4977	24.2807	(42b)

Hot water usage for other uses

34.2656	33.0196	31.7736	30.5276	29.2816	28.0355	28.0355	29.2816	30.5276	31.7736	33.0196	34.2656	(42c)

Average daily hot water use (litres/day) 105.7077 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.9960	112.5410	109.5511	105.0039	101.3115	97.3417	95.8156	98.7926	101.9324	106.1000	110.7173	114.6977	(44)
Energy conte	182.1255	160.2569	168.3760	143.7450	136.3847	119.6930	115.8806	122.3259	125.6928	143.9767	157.7372	179.5888	(45)
Energy content (annual)										Total = Sum(45)m =		1755.7832	
Distribution loss (46)m = 0.15 x (45)m	27.3188	24.0385	25.2564	21.5618	20.4577	17.9539	17.3821	18.3489	18.8539	21.5965	23.6606	26.9383	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9180	(55)
Total storage loss	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(56)
If cylinder contains dedicated solar storage	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(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	233.8459	206.9721	220.0964	193.7970	188.1051	169.7450	167.6010	174.0463	175.7448	195.6971	207.7892	231.3092	(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	233.8459	206.9721	220.0964	193.7970	188.1051	169.7450	167.6010	174.0463	175.7448	195.6971	207.7892	231.3092	(64)
										Total per year (kWh/year) = Sum(64)m =		2364.7492	(64)
12Total per year (kWh/year)												2365	(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

101.9331	90.6576	97.3613	87.8368	86.7242	79.8395	79.9066	82.0497	81.8345	89.2486	92.4892	101.0896	(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	95.8678	95.8678	95.8678	95.8678	95.8678	95.8678	95.8678	95.8678	95.8678	95.8678	95.8678	95.8678	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	100.3762	111.1308	100.3762	103.7220	100.3762	103.7220	100.3762	100.3762	103.7220	100.3762	103.7220	100.3762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	167.2389	168.9743	164.6011	155.2911	143.5389	132.4934	125.1144	123.3790	127.7522	137.0622	148.8144	159.8598	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.5868	32.5868	32.5868	32.5868	32.5868	32.5868	32.5868	32.5868	32.5868	32.5868	32.5868	32.5868	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-76.6943	-76.6943	-76.6943	-76.6943	-76.6943	-76.6943	-76.6943	-76.6943	-76.6943	-76.6943	-76.6943	-76.6943	(71)
Water heating gains (Table 5)	137.0068	134.9071	130.8620	121.9956	116.5648	110.8882	107.4014	110.2818	113.6590	119.9578	128.4572	135.8731	(72)
Total internal gains	459.3822	469.7725	450.5996	435.7691	415.2402	398.8641	384.6523	385.7973	396.8936	412.1565	435.7540	450.8695	(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	1.4400	10.6334	0.6300	0.7000	0.7700	4.6796	(74)
East	2.1000	19.6403	0.6300	0.7000	0.7700	12.6049	(76)
West	1.4400	19.6403	0.6300	0.7000	0.7700	8.6433	(80)

Solar gains	25.9278	50.5089	83.6495	124.2440	155.2327	160.4488	152.1057	128.5002	97.8847	59.9669	32.2669	21.3746	(83)
Total gains	485.3100	520.2814	534.2491	560.0131	570.4729	559.3129	536.7580	514.2976	494.7783	472.1234	468.0209	472.2441	(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	40.1858	40.3025	40.4176	40.9669	41.0714	41.5646	41.5646	41.6573	41.3732	41.0714	40.8606	40.6426	
alpha	3.6791	3.6868	3.6945	3.7311	3.7381	3.7710	3.7710	3.7772	3.7582	3.7381	3.7240	3.7095	
util living area	0.9720	0.9616	0.9442	0.8974	0.8084	0.6523	0.5001	0.5378	0.7432	0.9018	0.9562	0.9744	(86)
MIT	19.3998	19.5797	19.8638	20.2840	20.6448	20.8891	20.9688	20.9587	20.8097	20.3727	19.8407	19.3802	(87)
Th 2	19.9667	19.9694	19.9720	19.9844	19.9867	19.9975	19.9975	19.9995	19.9933	19.9867	19.9820	19.9771	(88)
util rest of house	0.9661	0.9536	0.9319	0.8737	0.7627	0.5732	0.3956	0.4334	0.6726	0.8746	0.9457	0.9691	(89)
MIT 2	18.1264	18.3545	18.7128	19.2375	19.6598	19.9200	19.9834	19.9794	19.8463	19.3541	18.6946	18.1086	(90)
Living area fraction										fLA = Living area / (4) =		0.4480	(91)
MIT	18.6968	18.9033	19.2284	19.7063	20.1010	20.3542	20.4248	20.4181	20.2778	19.8104	19.2080	18.6783	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.5468	18.7533	19.0784	19.5563	19.9510	20.2042	20.2748	20.2681	20.1278	19.6604	19.0580	18.5283	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9554	0.9414	0.9186	0.8619	0.7609	0.5906	0.4255	0.4626	0.6830	0.8641	0.9334	0.9590	(94)
Useful gains	463.6810	489.7795	490.7566	482.6960	434.0715	330.3251	228.4046	237.9173	337.9135	407.9502	436.8653	452.8809	(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	939.5720	910.9737	824.7849	689.3771	532.4199	357.3307	234.3148	246.0872	386.1243	584.6461	775.5988	934.3208	(97)
Space heating kWh	354.0629	283.0425	248.5170	148.8104	73.1713	0.0000	0.0000	0.0000	0.0000	131.4618	243.8881	358.1912	(98a)
Space heating requirement - total per year (kWh/year)												1841.1452	
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	354.0629	283.0425	248.5170	148.8104	73.1713	0.0000	0.0000	0.0000	0.0000	131.4618	243.8881	358.1912	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1841.1452	
Space heating per m2											(98c) / (4) =	31.8813	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 88.8000 (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	354.0629	283.0425	248.5170	148.8104	73.1713	0.0000	0.0000	0.0000	0.0000	131.4618	243.8881	358.1912	(98)
Space heating efficiency (main heating system 1)	88.8000	88.8000	88.8000	88.8000	88.8000	0.0000	0.0000	0.0000	0.0000	88.8000	88.8000	88.8000	(210)
Space heating fuel (main heating system)	398.7195	318.7415	279.8615	167.5793	82.4001	0.0000	0.0000	0.0000	0.0000	148.0426	274.6488	403.3685	(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	233.8459	206.9721	220.0964	193.7970	188.1051	169.7450	167.6010	174.0463	175.7448	195.6971	207.7892	231.3092	(64)
Efficiency of water heater												79.8000	(216)
(217)m	84.9875	84.7622	84.3328	83.4747	82.1312	79.8000	79.8000	79.8000	79.8000	83.1879	84.4199	85.0368	(217)
Fuel for water heating, kWh/month	275.1535	244.1798	260.9855	232.1626	229.0300	212.7130	210.0264	218.1031	220.2316	235.2471	246.1375	272.0107	(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	20.8562	16.7316	15.0650	11.0372	8.5255	6.9654	7.7772	10.1091	13.1308	17.2283	19.4593	21.4358	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-15.6608	-25.0630	-41.2071	-51.6657	-59.2863	-56.5694	-55.6132	-50.4989	-41.6778	-30.6668	-18.0506	-13.0902	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-5.5603	-13.6880	-32.9238	-58.2757	-84.8453	-88.3226	-86.0330	-67.8851	-43.4841	-21.1530	-7.7969	-4.2021	(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 2073.3617 (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 2855.9807 (219)
Space cooling fuel 0.0000 (221)

Electricity for pumps and fans:
central heating pump 41.0000 (230c)
main heating flue fan 45.0000 (230e)
Total electricity for the above, kWh/year 86.0000 (231)
Electricity for lighting (calculated in Appendix L) 168.3214 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV generation -973.2197 (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	4210.4441	(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	2073.3617	0.2100	435.4060	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2855.9807	0.2100	599.7560	(264)
Space and water heating			1035.1619	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	168.3214	0.1443	24.2940	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-459.0498	0.1325	-60.8134	
PV Unit electricity exported	-514.1700	0.1220	-62.7518	
Total			-123.5653	(269)
Total CO2, kg/year			947.8198	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			16.4100	(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	2073.3617	1.1300	2342.8987	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2855.9807	1.1300	3227.2582	(278)
Space and water heating			5570.1569	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	168.3214	1.5338	258.1769	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-459.0498	1.4895	-683.7535	
PV Unit electricity exported	-514.1700	0.4478	-230.2453	
Total			-913.9988	(283)
Total Primary energy kWh/year			5044.4359	(286)
Dwelling Primary energy Rate (DPER)			87.3500	(287)

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Main dwelling						
Ground floor	57.7500	(1b) x	2.3500	(2b) =	135.7125	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	57.7500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		135.7125	(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) =	0.1474	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3974	(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) =	0.3676	(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	0.4686	0.4595	0.4503	0.4043	0.3951	0.3492	0.3492	0.3400	0.3676	0.3951	0.4135	0.4319	(22b)
Effective ac	0.6098	0.6056	0.6014	0.5817	0.5781	0.5610	0.5610	0.5578	0.5676	0.5781	0.5855	0.5933	(25)

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3. Heat losses and heat loss parameter

Element	Gross	Openings	NetArea	U-value	A x U	K-value	A x K	
Main dwelling	m2	m2	m2	W/m2K	W/K	kJ/m2K	kJ/K	
TER Semi-glazed door			1.9700	1.0000	1.9700			(26a)
TER Opening Type			4.9800	1.1450	5.7023			(27)
Heatloss Floor 1			57.7500	0.1300	7.5075			(28a)
External Wall 1	53.3500	6.9500	46.4000	0.1800	8.3520			(29a)
External Roof 1	57.7500		57.7500	0.1100	6.3525			(30)
Total net area of external elements Aum(A, m2)			168.8500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	29.8843			(33)
Main dwelling								
Party Wall 1			18.1000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 165.2093 (35)

List of Thermal Bridges

	Length	Psi-value	Total	
K1 Element				
E2 Other lintels (including other steel lintels)	6.1300	0.0500	0.3065	
E3 Sill	4.2300	0.0500	0.2115	
E4 Jamb	16.8600	0.0500	0.8430	
E5 Ground floor (normal)	22.7000	0.1600	3.6320	
E16 Corner (normal)	4.7000	0.0900	0.4230	
E25 Staggered party wall between dwellings	7.7000	0.0600	0.4620	
P2 Party wall - Intermediate floor within a dwelling	7.7000	0.0000	0.0000	
E10 Eaves (insulation at ceiling level)	22.7000	0.0600	1.3620	
E24 Eaves (insulation at ceiling level - inverted)	7.7000	0.2400	1.8480	
P1 Party wall - Ground floor	7.7000	0.0800	0.6160	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 9.7040 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 39.5883 (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	27.3107	27.1197	26.9325	26.0533	25.8888	25.1230	25.1230	24.9811	25.4179	25.8888	26.2215	26.5695	(38)
Heat transfer coeff	66.8990	66.7080	66.5208	65.6415	65.4770	64.7112	64.7112	64.5694	65.0062	65.4770	65.8098	66.1577	(39)

Average = Sum(39)m / 12 = 65.6408

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1584	1.1551	1.1519	1.1367	1.1338	1.1205	1.1205	1.1181	1.1256	1.1338	1.1396	1.1456	(40)
HLP (average)												1.1366	
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 1.9174 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	56.3673	55.5202	54.2858	51.9241	50.1812	48.2375	47.1327	48.3577	49.7006	51.7875	54.2000	56.1514	(42a)
Hot water usage for baths	24.3630	24.0012	23.4917	22.5522	21.8487	21.0687	20.6474	21.1533	21.7042	22.5389	23.4977	24.2807	(42b)
Hot water usage for other uses	34.2656	33.0196	31.7736	30.5276	29.2816	28.0355	28.0355	29.2816	30.5276	31.7736	33.0196	34.2656	(42c)

Average daily hot water use (litres/day) 105.7077 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.9960	112.5410	109.5511	105.0039	101.3115	97.3417	95.8156	98.7926	101.9324	106.1000	110.7173	114.6977	(44)
Energy conte	182.1255	160.2569	168.3760	143.7450	136.3847	119.6930	115.8806	122.3259	125.6928	143.9767	157.7372	179.5888	(45)
Energy content (annual)										Total = Sum(45)m =		1755.7832	
Distribution loss (46)m = 0.15 x (45)m	27.3188	24.0385	25.2564	21.5618	20.4577	17.9539	17.3821	18.3489	18.8539	21.5965	23.6606	26.9383	(46)

Water storage loss:

Store volume 210.0000 (47)

a) If manufacturer declared loss factor is known (kWh/day): 1.7016 (48)

Temperature factor from Table 2b 0.5400 (49)

Enter (49) or (54) in (55) 0.9188 (55)

Total storage loss	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(56)
If cylinder contains dedicated solar storage	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(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	233.8721	206.9958	220.1226	193.8224	188.1313	169.7703	167.6272	174.0725	175.7702	195.7233	207.8145	231.3354	(62)
WWHRS	-25.7688	-22.7901	-23.8645	-19.7608	-18.4163	-15.7590	-14.7715	-15.7080	-16.3048	-19.2216	-21.7757	-25.2916	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	208.1033	184.2057	196.2581	174.0616	169.7150	154.0114	152.8557	158.3644	159.4653	176.5017	186.0388	206.0438	(64)
									Total per year (kWh/year) = Sum(64)m =			2125.6248	(64)
12Total per year (kWh/year)												2126	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
									Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =			0.0000	(64a)
Heat gains from water heating, kWh/month	101.9540	90.6765	97.3823	87.8571	86.7452	79.8598	79.9276	82.0706	81.8547	89.2695	92.5095	101.1106	(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	95.8678	95.8678	95.8678	95.8678	95.8678	95.8678	95.8678	95.8678	95.8678	95.8678	95.8678	95.8678	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	100.3762	111.1308	100.3762	103.7220	100.3762	103.7220	100.3762	100.3762	103.7220	100.3762	103.7220	100.3762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	167.2389	168.9743	164.6011	155.2911	143.5389	132.4934	125.1144	123.3790	127.7522	137.0622	148.8144	159.8598	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.5868	32.5868	32.5868	32.5868	32.5868	32.5868	32.5868	32.5868	32.5868	32.5868	32.5868	32.5868	(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)	-76.6943	-76.6943	-76.6943	-76.6943	-76.6943	-76.6943	-76.6943	-76.6943	-76.6943	-76.6943	-76.6943	-76.6943	(71)
Water heating gains (Table 5)													

	137.0350	134.9353	130.8902	122.0238	116.5930	110.9164	107.4296	110.3100	113.6871	119.9859	128.4854	135.9013	(72)
Total internal gains	459.4104	469.8007	450.6278	435.7972	415.2684	398.8922	384.6805	385.8255	396.9217	412.1847	435.7822	450.8976	(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	1.4400	10.6334	0.6300	0.7000	0.7700	4.6796	(74)
East	2.1000	19.6403	0.6300	0.7000	0.7700	12.6049	(76)
West	1.4400	19.6403	0.6300	0.7000	0.7700	8.6433	(80)

Solar gains	25.9278	50.5089	83.6495	124.2440	155.2327	160.4488	152.1057	128.5002	97.8847	59.9669	32.2669	21.3746	(83)
Total gains	485.3381	520.3096	534.2773	560.0412	570.5011	559.3411	536.7862	514.3258	494.8065	472.1516	468.0491	472.2723	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	39.6155	39.7289	39.8407	40.3743	40.4758	40.9548	40.9548	41.0447	40.7689	40.4758	40.2711	40.0593	
alpha	3.6410	3.6486	3.6560	3.6916	3.6984	3.7303	3.7303	3.7363	3.7179	3.6984	3.6847	3.6706	
util living area	0.9722	0.9621	0.9450	0.8993	0.8120	0.6579	0.5058	0.5436	0.7478	0.9036	0.9568	0.9747	(86)
MIT	19.3667	19.5475	19.8348	20.2604	20.6291	20.8820	20.9662	20.9555	20.7996	20.3524	19.8127	19.3467	(87)
Th 2	19.9534	19.9561	19.9587	19.9710	19.9733	19.9841	19.9841	19.9861	19.9799	19.9733	19.9687	19.9638	(88)
util rest of house	0.9664	0.9541	0.9329	0.8757	0.7663	0.5779	0.3993	0.4374	0.6769	0.8765	0.9464	0.9694	(89)
MIT 2	18.0758	18.3051	18.6677	19.1995	19.6318	19.9016	19.9689	19.9644	19.8251	19.3202	18.6506	18.0575	(90)
Living area fraction										fLA = Living area / (4) =		0.4480	(91)
MIT	18.6540	18.8617	19.1905	19.6748	20.0785	20.3408	20.4157	20.4084	20.2616	19.7826	19.1712	18.6351	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6540	18.8617	19.1905	19.6748	20.0785	20.3408	20.4157	20.4084	20.2616	19.7826	19.1712	18.6351	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9570	0.9435	0.9218	0.8678	0.7715	0.6075	0.4459	0.4832	0.6981	0.8706	0.9362	0.9604	(94)
Useful gains	464.4470	490.8999	492.4784	486.0307	440.1364	339.8136	239.3640	248.5389	345.4327	411.0594	438.1660	453.5699	(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	960.2707	931.3544	844.1811	707.2716	548.6009	371.4944	246.9161	258.8181	400.5433	601.2473	794.4010	954.9906	(97)
Space heating kWh	368.8928	295.9854	261.6668	159.2934	80.6976	0.0000	0.0000	0.0000	0.0000	141.4998	256.4892	373.0570	(98a)
Space heating requirement - total per year (kWh/year)												1937.5819	
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	368.8928	295.9854	261.6668	159.2934	80.6976	0.0000	0.0000	0.0000	0.0000	141.4998	256.4892	373.0570	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1937.5819	
Space heating per m2											(98c) / (4) =	33.5512	(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	368.8928	295.9854	261.6668	159.2934	80.6976	0.0000	0.0000	0.0000	0.0000	141.4998	256.4892	373.0570	(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)	399.6672	320.6775	283.4960	172.5823	87.4297	0.0000	0.0000	0.0000	0.0000	153.3042	277.8865	404.1787	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	208.1033	184.2057	196.2581	174.0616	169.7150	154.0114	152.8557	158.3644	159.4653	176.5017	186.0388	206.0438	(64)
Efficiency of water heater												79.8000	(216)
(217)m	85.3291	85.1175	84.7056	83.8615	82.4944	79.8000	79.8000	79.8000	79.8000	83.5688	84.7803	85.3741	(217)
Fuel for water heating, kWh/month	243.8832	216.4135	231.6942	207.5585	205.7291	192.9967	191.5485	198.4517	199.8313	211.2053	219.4364	241.3422	(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	20.8562	16.7316	15.0650	11.0372	8.5255	6.9654	7.7772	10.1091	13.1308	17.2283	19.4593	21.4358	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-45.6789	-60.5325	-81.8476	-86.4268	-88.8031	-81.4555	-80.5495	-78.2141	-73.4227	-66.6109	-48.8810	-39.9749	(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	-38.8784	-79.8604	-155.2965	-228.4280	-297.5066	-297.2304	-293.6063	-250.4863	-186.2551	-112.3376	-51.2781	-30.8774 (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	2099.2220	(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	2560.0907	(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)	168.3214	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-2854.4384	(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	2059.1956	(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	2099.2220	0.2100	440.8366	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2560.0907	0.2100	537.6190	(264)
Space and water heating			978.4557	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	168.3214	0.1443	24.2940	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-832.3975	0.1359	-113.1238	
PV Unit electricity exported	-2022.0410	0.1265	-255.8513	
Total			-368.9751	(269)
Total CO2, kg/year			645.7038	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			11.1800	(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	2099.2220	1.1300	2372.1208	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2560.0907	1.1300	2892.9025	(278)
Space and water heating			5265.0233	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	168.3214	1.5338	258.1769	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-832.3975	1.5023	-1250.5434	
PV Unit electricity exported	-2022.0410	0.4645	-939.2086	
Total			-2189.7520	(283)
Total Primary energy kWh/year			3463.5490	(286)
Target Primary Energy Rate (TPER)			59.9700	(287)

Building Regulations England Part L (BREL) Compliance Report

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

Date: Fri 14 Mar 2025 09:30:59

Project Information			
Assessed By	Richard Millard	Building Type	Bungalow, Semi-detached
OCDEA Registration	EES/025661	Assessment Date	2025-03-14

Dwelling Details			
Assessment Type	As designed	Total Floor Area	58 m^2
Site Reference	AF2 Bungalow	Plot Reference	Proposed
Address	AF2 Bungalow		

Client Details	
Name	Tim Hayman
Company	Cotswold Homes
Address	West House , Great Western Business Park , Yate , BS37 5NG

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

1a Target emission rate and dwelling emission rate		
Fuel for main heating system	Electricity	
Target carbon dioxide emission rate	*11.18 kgCO_2/m^2*	
Dwelling carbon dioxide emission rate	3.63 kgCO_2/m^2	OK
1b Target primary energy rate and dwelling primary energy		
Target primary energy	*59.97 kWh$_{PE}$/m^2*	
Dwelling primary energy	43.69 kWh$_{PE}$/m^2	OK
1c Target fabric energy efficiency and dwelling fabric energy efficiency		
Target fabric energy efficiency	*41.2 kWh/m^2*	
Dwelling fabric energy efficiency	36.4 kWh/m^2	OK

2a Fabric U-values				
Element	***Maximum permitted average U-Value [W/m^2K]***	**Dwelling average U-Value [W/m^2K]**	**Element with highest individual U-Value**	
External walls	*0.26*	0.18	Walls (1) (0.18)	OK
Party walls	*0.2*	0	Party Wall (1) (0)	**N/A**
Curtain walls	*1.6*	0	N/A	**N/A**
Floors	*0.18*	0.12	Heatloss Floor 1 (0.12)	OK
Roofs	*0.16*	0.11	Roof (1) (0.11)	OK
Windows, doors, and roof windows	*1.6*	1.2	PL07-W01 (1.2)	OK
Rooflights	*2.2*	N/A	N/A	**N/A**

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))		
Name	**Net area [m^2]**	**U-Value [W/m^2K]**
Exposed wall: Walls (1)	46.4	0.18
Party wall: Party Wall (1)	18.1	0 **(!)**
Ground floor: Heatloss Floor 1, Heatloss Floor 1	57.75	0.12
Exposed roof: Roof (1)	57.75	0.11

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	**Area [m^2]**	**Orientation**	**Frame factor**	**U-Value [W/m^2K]**
PL07-W01, Windows	1.44	East	0.7	1.2
PL07-W02, Windows	0.66	East	0.7	1.2
PL07-W03, Windows	1.44	North	0.7	1.2
PL07-W04, Windows	1.44	West	0.7	1.2
PL07-ED02, Half Glazed Door	1.97	West	N/A	1.2

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))				
Building part **1**: Thermal bridging calculated from linear thermal transmittances for each junction				
Main element	**Junction detail**	**Source**	**Psi value [W/mK]**	**Drawing / reference**
External wall	E2: Other lintels (including other steel lintels)	Not government-approved scheme	0.027 **(!)**	MCPF-125-E2-01
External wall	E3: Sill	Not government-approved	0.027 **(!)**	MCPF-125-E3-

Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
		scheme		01
External wall	E4: Jamb	Not government-approved scheme	0.022 **(!)**	MCPF-125-E3-01
External wall	E5: Ground floor (normal)	Not government-approved scheme	0.045	MCPF-125-E5-04
External wall	E16: Corner (normal)	Not government-approved scheme	0.034 **(!)**	MCPF-125-E16-01
External wall	E25: Staggered party wall between dwellings	Not government-approved scheme	0.034 **(!)**	MCPF-125-E25-01
Party wall	P2: Intermediate floor within a dwelling	SAP table default	0 **(!)**	
External wall	E10: Eaves (insulation at ceiling level)	Not government-approved scheme	0.054	MCPF-125-E10
External wall	E24: Eaves (insulation at ceiling level - inverted)	SAP table default	0.15	
Party wall	P1: Ground floor	Calculated by person with suitable expertise	0.043	

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

4 Space heating	
Main heating system 1: Heat pump with radiators or underfloor heating - Electricity	
Efficiency	232.4%
Emitter type	Radiators
Flow temperature	55°C
System type	Heat Pump
Manufacturer	Daikin Europe NV
Model	EDLA08EV3
Commissioning	
Secondary heating system: N/A	
Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water	
Cylinder/store - type: Cylinder	
Capacity	210 litres
Declared heat loss	1.7 kWh/day
Primary pipework insulated	Yes
Manufacturer	
Model	
Commissioning	
Waste water heat recovery system 1 - type: N/A	
Efficiency	
Manufacturer	
Model	

6 Controls	
Main heating 1 - type: Time and temperature zone control by arrangement of plumbing and electrical services	
Function	
Ecodesign class	
Manufacturer	
Model	
Water heating - type: Cylinder thermostat and HW separately timed	
Manufacturer	
Model	

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

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

9 Local generation	
Technology type: **Photovoltaic system (1)**	
Peak power	1.34 kWp
Orientation	East
Pitch	30°
Overshading	None or very little
Manufacturer	
MCS certificate	

10 Heat networks
N/A

11 Supporting documentary evidence
N/A

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

Full SAP Calculation Printout

Property Reference	AF2 Bungalow	**Issued on Date**	14/03/2025
Assessment Reference	Proposed	**Prop Type Ref**	AF2 Bungalow
Property	AF2 Bungalow		

SAP Rating	85 B	**DER**	3.63	**TER**	11.18
Environmental	97 A	**% DER < TER**			67.53
CO_2 Emissions (t/year)	0.18	**DFEE**	36.41	**TFEE**	41.18
Compliance Check	See BREL	**% DFEE < TFEE**			11.59
% DPER < TPER	27.14	**DPER**	43.69	**TPER**	59.97

Assessor Details	Mr. Richard Millard	**Assessor ID**	U367-0001
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)	
Main dwelling						
Ground floor	57.7500	(1b)	x 2.3500	(2b) =	135.7125	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	57.7500					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	135.7125	(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) =	0.1474 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.3974 (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) =	0.3676 (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	0.4686	0.4595	0.4503	0.4043	0.3951	0.3492	0.3492	0.3400	0.3676	0.3951	0.4135	0.4319	(22b)
Effective ac	0.6098	0.6056	0.6014	0.5817	0.5781	0.5610	0.5610	0.5578	0.5676	0.5781	0.5855	0.5933	(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	
Main dwelling								
Windows			4.9800	1.1450	5.7023			(27)
Half Glazed Door			1.9700	1.2000	2.3640			(26a)
Heatloss Floor 1			57.7500	0.1200	6.9300	75.0000	4331.2500	(28a)
External Wall 1	53.3500	6.9500	46.4000	0.1800	8.3520	60.0000	2783.9999	(29a)
External Roof 1	57.7500		57.7500	0.1100	6.3525	9.0000	519.7500	(30)
Total net area of external elements Aum(A, m2)			168.8500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	29.7008			(33)
Main dwelling								
Party Wall 1			18.1000	0.0000	0.0000	45.0000	814.5000	(32)
Internal Wall			121.2600			9.0000	1091.3400	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	9540.8399 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		165.2093 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	6.1300	0.0270	0.1655
E3 Sill	4.2300	0.0270	0.1142
E4 Jamb	16.8600	0.0220	0.3709
E5 Ground floor (normal)	22.7000	0.0450	1.0215
E16 Corner (normal)	4.7000	0.0340	0.1598

E25 Staggered party wall between dwellings	7.7000	0.0340	0.2618	
P2 Party wall - Intermediate floor within a dwelling	7.7000	0.0000	0.0000	
E10 Eaves (insulation at ceiling level)	22.7000	0.0540	1.2258	
E24 Eaves (insulation at ceiling level - inverted)	7.7000	0.1500	1.1550	
P1 Party wall - Ground floor	7.7000	0.0430	0.3311	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)				4.8056 (36)
Point Thermal bridges			(36a) =	0.0000
Total fabric heat loss			(33) + (36) + (36a) =	34.5064 (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	27.3107	27.1197	26.9325	26.0533	25.8888	25.1230	25.1230	24.9811	25.4179	25.8888	26.2215	26.5695	(38)
Heat transfer coeff	61.8171	61.6261	61.4389	60.5597	60.3952	59.6294	59.6294	59.4876	59.9244	60.3952	60.7280	61.0759	(39)
Average = Sum(39)m / 12 =												60.5589	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0704	1.0671	1.0639	1.0487	1.0458	1.0325	1.0325	1.0301	1.0377	1.0458	1.0516	1.0576	(40)
HLP (average)												1.0486	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 1.9174 (42)

Hot water usage for mixer showers

56.3673	55.5202	54.2858	51.9241	50.1812	48.2375	47.1327	48.3577	49.7006	51.7875	54.2000	56.1514	(42a)

Hot water usage for baths

24.3630	24.0012	23.4917	22.5522	21.8487	21.0687	20.6474	21.1533	21.7042	22.5389	23.4977	24.2807	(42b)

Hot water usage for other uses

34.2656	33.0196	31.7736	30.5276	29.2816	28.0355	28.0355	29.2816	30.5276	31.7736	33.0196	34.2656	(42c)

Average daily hot water use (litres/day) 105.7077 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.9960	112.5410	109.5511	105.0039	101.3115	97.3417	95.8156	98.7926	101.9324	106.1000	110.7173	114.6977	(44)
Energy conte	182.1255	160.2569	168.3760	143.7450	136.3847	119.6930	115.8806	122.3259	125.6928	143.9767	157.7372	179.5888	(45)
Energy content (annual)										Total = Sum(45)m =		1755.7832	
Distribution loss (46)m = 0.15 x (45)m	27.3188	24.0385	25.2564	21.5618	20.4577	17.9539	17.3821	18.3489	18.8539	21.5965	23.6606	26.9383	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9180	(55)
Total storage loss	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(56)
If cylinder contains dedicated solar storage	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(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	233.8459	206.9721	220.0964	193.7970	188.1051	169.7450	167.6010	174.0463	175.7448	195.6971	207.7892	231.3092	(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	233.8459	206.9721	220.0964	193.7970	188.1051	169.7450	167.6010	174.0463	175.7448	195.6971	207.7892	231.3092	(64)
										Total per year (kWh/year) = Sum(64)m =		2364.7492	(64)
12Total per year (kWh/year)												2365	(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

101.9331	90.6576	97.3613	87.8368	86.7242	79.8395	79.9066	82.0497	81.8345	89.2486	92.4892	101.0896	(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	95.8678	95.8678	95.8678	95.8678	95.8678	95.8678	95.8678	95.8678	95.8678	95.8678	95.8678	95.8678	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	100.3762	111.1308	100.3762	103.7220	100.3762	103.7220	100.3762	100.3762	103.7220	100.3762	103.7220	100.3762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	167.2389	168.9743	164.6011	155.2911	143.5389	132.4934	125.1144	123.3790	127.7522	137.0622	148.8144	159.8598	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.5868	32.5868	32.5868	32.5868	32.5868	32.5868	32.5868	32.5868	32.5868	32.5868	32.5868	32.5868	(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)	-76.6943	-76.6943	-76.6943	-76.6943	-76.6943	-76.6943	-76.6943	-76.6943	-76.6943	-76.6943	-76.6943	-76.6943	(71)
Water heating gains (Table 5)	137.0068	134.9071	130.8620	121.9956	116.5648	110.8882	107.4014	110.2818	113.6590	119.9578	128.4572	135.8731	(72)
Total internal gains	456.3822	466.7725	447.5996	432.7691	412.2402	398.8641	384.6523	385.7973	396.8936	409.1565	432.7540	447.8695	(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	1.4400	10.6334	0.6300	0.7000	0.7700	4.6796	(74)
East	2.1000	19.6403	0.6300	0.7000	0.7700	12.6049	(76)
West	1.4400	19.6403	0.6300	0.7000	0.7700	8.6433	(80)

Solar gains	25.9278	50.5089	83.6495	124.2440	155.2327	160.4488	152.1057	128.5002	97.8847	59.9669	32.2669	21.3746	(83)
Total gains	482.3100	517.2814	531.2491	557.0131	567.4729	559.3129	536.7580	514.2976	494.7783	469.1234	465.0209	469.2441	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	42.8722	43.0050	43.1361	43.7623	43.8815	44.4451	44.4451	44.5510	44.2263	43.8815	43.6411	43.3925	
alpha	3.8581	3.8670	3.8757	3.9175	3.9254	3.9630	3.9630	3.9701	3.9484	3.9254	3.9094	3.8928	
util living area	0.9710	0.9597	0.9408	0.8894	0.7929	0.6263	0.4737	0.5108	0.7209	0.8944	0.9539	0.9736	(86)
Living	19.5406	19.7162	19.9864	20.3824	20.7090	20.9181	20.9789	20.9714	20.8518	20.4571	19.9586	19.5224	
Non living	18.3431	18.5656	18.9058	19.3990	19.7781	19.9991	20.0466	20.0443	19.9379	19.4978	18.8821	18.3273	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	20.2534	19.7162	19.9864	20.3824	20.7090	20.9181	20.9789	20.9714	20.8518	20.4571	19.9586	19.7290	(87)
Th 2	20.0251	20.0278	20.0304	20.0430	20.0453	20.0563	20.0563	20.0583	20.0521	20.0453	20.0406	20.0356	(88)
util rest of house	0.9651	0.9516	0.9283	0.8652	0.7472	0.5512	0.3786	0.4150	0.6520	0.8667	0.9432	0.9683	(89)
MIT 2	19.3545	18.5656	18.9058	19.3990	19.7781	19.9991	20.0466	20.0443	19.9379	19.4978	18.8821	18.6352	(90)
Living area fraction										fLA = Living area / (4) =		0.4480	(91)
MIT	19.7572	19.0811	19.3899	19.8395	20.1951	20.4108	20.4642	20.4596	20.3473	19.9275	19.3643	19.1252	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.7572	19.0811	19.3899	19.8395	20.1951	20.4108	20.4642	20.4596	20.3473	19.9275	19.3643	19.1252	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9633	0.9418	0.9183	0.8593	0.7550	0.5805	0.4206	0.4569	0.6748	0.8627	0.9339	0.9619	(94)
Useful gains	464.5854	487.1504	487.8389	478.6591	428.4302	324.7043	225.7436	234.9738	333.8890	404.7300	434.2730	451.3840	(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	955.5187	873.9234	791.9422	662.4922	513.0643	346.4933	230.4220	241.4963	374.3649	563.3383	744.7870	911.5694	(97)
Space heating kWh	365.2544	259.9114	226.2528	132.3599	62.9678	0.0000	0.0000	0.0000	0.0000	118.0046	223.5701	342.3780	(98a)
Space heating requirement - total per year (kWh/year)												1730.6990	
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	365.2544	259.9114	226.2528	132.3599	62.9678	0.0000	0.0000	0.0000	0.0000	118.0046	223.5701	342.3780	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1730.6990	
Space heating per m2											(98c) / (4) =	29.9688	(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 %) 232.4072 (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	365.2544	259.9114	226.2528	132.3599	62.9678	0.0000	0.0000	0.0000	0.0000	118.0046	223.5701	342.3780	(98)
Space heating efficiency (main heating system 1)	232.4072	232.4072	232.4072	232.4072	232.4072	0.0000	0.0000	0.0000	0.0000	232.4072	232.4072	232.4072	(210)
Space heating fuel (main heating system)	157.1614	111.8345	97.3519	56.9517	27.0937	0.0000	0.0000	0.0000	0.0000	50.7749	96.1976	147.3181	(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	233.8459	206.9721	220.0964	193.7970	188.1051	169.7450	167.6010	174.0463	175.7448	195.6971	207.7892	231.3092	(64)
Efficiency of water heater												171.9349	(216)
(217)m	171.9349	171.9349	171.9349	171.9349	171.9349	171.9349	171.9349	171.9349	171.9349	171.9349	171.9349	171.9349	(217)
Fuel for water heating, kWh/month	136.0084	120.3782	128.0115	112.7154	109.4048	98.7263	97.4794	101.2280	102.2159	113.8205	120.8534	134.5330	(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	20.8562	16.7316	15.0650	11.0372	8.5255	6.9654	7.7772	10.1091	13.1308	17.2283	19.4593	21.4358	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-17.3549	-28.7306	-49.0160	-62.9472	-72.8306	-68.0178	-66.7470	-59.9162	-48.0960	-35.1956	-20.1400	-14.3770	(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	-3.8662	-10.0203	-25.1150	-46.9942	-71.3010	-76.8742	-74.8992	-58.4678	-37.0659	-16.6242	-5.7075	-2.9154	(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 1 744.6838 (211)

Space heating fuel - main system 2 0.0000 (213)

Space heating fuel - secondary 0.0000 (215)

Efficiency of water heater 171.9349

Water heating fuel used 1375.3749 (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) 168.3214 (232)

Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-973.2197	(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	1315.1604	(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	744.6838	0.1552	115.5702	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1375.3749	0.1408	193.7080	(264)
Space and water heating			309.2782	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	168.3214	0.1443	24.2940	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-543.3690	0.1323	-71.8609	
PV Unit electricity exported	-429.8508	0.1206	-51.8319	
Total			-123.6927	(269)
Total CO2, kg/year			209.8794	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			3.6300	(273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	744.6838	1.5745	1172.5367	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1375.3749	1.5208	2091.6328	(278)
Space and water heating			3264.1695	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	168.3214	1.5338	258.1769	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-543.3690	1.4887	-808.8886	
PV Unit electricity exported	-429.8508	0.4423	-190.1301	
Total			-999.0187	(283)
Total Primary energy kWh/year			2523.3278	(286)
Dwelling Primary energy Rate (DPER)			43.6900	(287)

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Main dwelling						
Ground floor	57.7500 (1b)	x	2.3500 (2b)	=	135.7125	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	57.7500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	135.7125	(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) =	0.1474	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3974	(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) =	0.3676	(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	0.4686	0.4595	0.4503	0.4043	0.3951	0.3492	0.3492	0.3400	0.3676	0.3951	0.4135	0.4319	(22b)
Effective ac	0.6098	0.6056	0.6014	0.5817	0.5781	0.5610	0.5610	0.5578	0.5676	0.5781	0.5855	0.5933	(25)

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3. Heat losses and heat loss parameter

Element	Gross	Openings	NetArea	U-value	A x U	K-value	A x K	
	m2	m2	m2	W/m2K	W/K	kJ/m2K	kJ/K	
Main dwelling								
TER Semi-glazed door			1.9700	1.0000	1.9700			(26a)
TER Opening Type			4.9800	1.1450	5.7023			(27)
Heatloss Floor 1			57.7500	0.1300	7.5075			(28a)
External Wall 1	53.3500	6.9500	46.4000	0.1800	8.3520			(29a)
External Roof 1	57.7500		57.7500	0.1100	6.3525			(30)
Total net area of external elements Aum(A, m2)			168.8500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		29.8843			(33)
Main dwelling								
Party Wall 1			18.1000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 165.2093 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	6.1300	0.0500	0.3065
E3 Sill	4.2300	0.0500	0.2115
E4 Jamb	16.8600	0.0500	0.8430
E5 Ground floor (normal)	22.7000	0.1600	3.6320
E16 Corner (normal)	4.7000	0.0900	0.4230
E25 Staggered party wall between dwellings	7.7000	0.0600	0.4620
P2 Party wall - Intermediate floor within a dwelling	7.7000	0.0000	0.0000
E10 Eaves (insulation at ceiling level)	22.7000	0.0600	1.3620
E24 Eaves (insulation at ceiling level - inverted)	7.7000	0.2400	1.8480
P1 Party wall - Ground floor	7.7000	0.0800	0.6160

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 9.7040 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 39.5883 (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	27.3107	27.1197	26.9325	26.0533	25.8888	25.1230	25.1230	24.9811	25.4179	25.8888	26.2215	26.5695	(38)
Heat transfer coeff	66.8990	66.7080	66.5208	65.6415	65.4770	64.7112	64.7112	64.5694	65.0062	65.4770	65.8098	66.1577	(39)

Average = Sum(39)m / 12 = 65.6408

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1584	1.1551	1.1519	1.1367	1.1338	1.1205	1.1205	1.1181	1.1256	1.1338	1.1396	1.1456	(40)
HLP (average)												1.1366	
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 1.9174 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	56.3673	55.5202	54.2858	51.9241	50.1812	48.2375	47.1327	48.3577	49.7006	51.7875	54.2000	56.1514	(42a)
Hot water usage for baths	24.3630	24.0012	23.4917	22.5522	21.8487	21.0687	20.6474	21.1533	21.7042	22.5389	23.4977	24.2807	(42b)
Hot water usage for other uses	34.2656	33.0196	31.7736	30.5276	29.2816	28.0355	28.0355	29.2816	30.5276	31.7736	33.0196	34.2656	(42c)

Average daily hot water use (litres/day) 105.7077 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.9960	112.5410	109.5511	105.0039	101.3115	97.3417	95.8156	98.7926	101.9324	106.1000	110.7173	114.6977	(44)
Energy conte	182.1255	160.2569	168.3760	143.7450	136.3847	119.6930	115.8806	122.3259	125.6928	143.9767	157.7372	179.5888	(45)

Energy content (annual) Total = Sum(45)m = 1755.7832

Distribution loss (46)m = 0.15 x (45)m	27.3188	24.0385	25.2564	21.5618	20.4577	17.9539	17.3821	18.3489	18.8539	21.5965	23.6606	26.9383	(46)

Water storage loss:

Store volume 210.0000 (47)

a) If manufacturer declared loss factor is known (kWh/day): 1.7016 (48)

Temperature factor from Table 2b 0.5400 (49)

Enter (49) or (54) in (55) 0.9188 (55)

Total storage loss	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(56)
If cylinder contains dedicated solar storage	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(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	233.8721	206.9958	220.1226	193.8224	188.1313	169.7703	167.6272	174.0725	175.7702	195.7233	207.8145	231.3354	(62)
WWHRS	-25.7688	-22.7901	-23.8645	-19.7608	-18.4163	-15.7590	-14.7715	-15.7080	-16.3048	-19.2216	-21.7757	-25.2916	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	208.1033	184.2057	196.2581	174.0616	169.7150	154.0114	152.8557	158.3644	159.4653	176.5017	186.0388	206.0438	(64)

Total per year (kWh/year) = Sum(64)m = 2125.6248 (64)

12Total per year (kWh/year) 2126 (64)

Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)

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

Heat gains from water heating, kWh/month	101.9540	90.6765	97.3823	87.8571	86.7452	79.8598	79.9276	82.0706	81.8547	89.2695	92.5095	101.1106	(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	95.8678	95.8678	95.8678	95.8678	95.8678	95.8678	95.8678	95.8678	95.8678	95.8678	95.8678	95.8678	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	100.3762	111.1308	100.3762	103.7220	100.3762	103.7220	100.3762	100.3762	103.7220	100.3762	103.7220	100.3762	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	167.2389	168.9743	164.6011	155.2911	143.5389	132.4934	125.1144	123.3790	127.7522	137.0622	148.8144	159.8598	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.5868	32.5868	32.5868	32.5868	32.5868	32.5868	32.5868	32.5868	32.5868	32.5868	32.5868	32.5868	(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)													
	-76.6943	-76.6943	-76.6943	-76.6943	-76.6943	-76.6943	-76.6943	-76.6943	-76.6943	-76.6943	-76.6943	-76.6943	(71)
Water heating gains (Table 5)													
	137.0350	134.9353	130.8902	122.0238	116.5930	110.9164	107.4296	110.3100	113.6871	119.9859	128.4854	135.9013	(72)
Total internal gains													
	459.4104	469.8007	450.6278	435.7972	415.2684	398.8922	384.6805	385.8255	396.9217	412.1847	435.7822	450.8976	(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	1.4400	10.6334	0.6300	0.7000	0.7700	4.6796	(74)
East	2.1000	19.6403	0.6300	0.7000	0.7700	12.6049	(76)
West	1.4400	19.6403	0.6300	0.7000	0.7700	8.6433	(80)

Solar gains	25.9278	50.5089	83.6495	124.2440	155.2327	160.4488	152.1057	128.5002	97.8847	59.9669	32.2669	21.3746	(83)
Total gains	485.3381	520.3096	534.2773	560.0412	570.5011	559.3411	536.7862	514.3258	494.8065	472.1516	468.0491	472.2723	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	39.6155	39.7289	39.8407	40.3743	40.4758	40.9548	40.9548	41.0447	40.7689	40.4758	40.2711	40.0593	
alpha	3.6410	3.6486	3.6560	3.6916	3.6984	3.7303	3.7303	3.7363	3.7179	3.6984	3.6847	3.6706	
util living area													
	0.9722	0.9621	0.9450	0.8993	0.8120	0.6579	0.5058	0.5436	0.7478	0.9036	0.9568	0.9747	(86)
MIT	19.3667	19.5475	19.8348	20.2604	20.6291	20.8820	20.9662	20.9555	20.7996	20.3524	19.8127	19.3467	(87)
Th 2	19.9534	19.9561	19.9587	19.9710	19.9733	19.9841	19.9841	19.9861	19.9799	19.9733	19.9687	19.9638	(88)
util rest of house													
	0.9664	0.9541	0.9329	0.8757	0.7663	0.5779	0.3993	0.4374	0.6769	0.8765	0.9464	0.9694	(89)
MIT 2	18.0758	18.3051	18.6677	19.1995	19.6318	19.9016	19.9689	19.9644	19.8251	19.3202	18.6506	18.0575	(90)
Living area fraction										fLA = Living area / (4) =		0.4480	(91)
MIT	18.6540	18.8617	19.1905	19.6748	20.0785	20.3408	20.4157	20.4084	20.2616	19.7826	19.1712	18.6351	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6540	18.8617	19.1905	19.6748	20.0785	20.3408	20.4157	20.4084	20.2616	19.7826	19.1712	18.6351	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9570	0.9435	0.9218	0.8678	0.7715	0.6075	0.4459	0.4832	0.6981	0.8706	0.9362	0.9604	(94)
Useful gains	464.4470	490.8999	492.4784	486.0307	440.1364	339.8136	239.3640	248.5389	345.4327	411.0594	438.1660	453.5699	(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													
	960.2707	931.3544	844.1811	707.2716	548.6009	371.4944	246.9161	258.8181	400.5433	601.2473	794.4010	954.9906	(97)
Space heating kWh													
	368.8928	295.9854	261.6668	159.2934	80.6976	0.0000	0.0000	0.0000	0.0000	141.4998	256.4892	373.0570	(98a)
Space heating requirement - total per year (kWh/year)												1937.5819	
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													
	368.8928	295.9854	261.6668	159.2934	80.6976	0.0000	0.0000	0.0000	0.0000	141.4998	256.4892	373.0570	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1937.5819	
Space heating per m2											(98c) / (4) =	33.5512	(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													
	368.8928	295.9854	261.6668	159.2934	80.6976	0.0000	0.0000	0.0000	0.0000	141.4998	256.4892	373.0570	(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)													
	399.6672	320.6775	283.4960	172.5823	87.4297	0.0000	0.0000	0.0000	0.0000	153.3042	277.8865	404.1787	(211)
Space heating efficiency (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	208.1033	184.2057	196.2581	174.0616	169.7150	154.0114	152.8557	158.3644	159.4653	176.5017	186.0388	206.0438	(64)
Efficiency of water heater												79.8000	(216)
(217)m	85.3291	85.1175	84.7056	83.8615	82.4944	79.8000	79.8000	79.8000	79.8000	83.5688	84.7803	85.3741	(217)
Fuel for water heating, kWh/month													
	243.8832	216.4135	231.6942	207.5585	205.7291	192.9967	191.5485	198.4517	199.8313	211.2053	219.4364	241.3422	(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	20.8562	16.7316	15.0650	11.0372	8.5255	6.9654	7.7772	10.1091	13.1308	17.2283	19.4593	21.4358	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-45.6789	-60.5325	-81.8476	-86.4268	-88.8031	-81.4555	-80.5495	-78.2141	-73.4227	-66.6109	-48.8810	-39.9749	(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	-38.8784	-79.8604	-155.2965	-228.4280	-297.5066	-297.2304	-293.6063	-250.4863	-186.2551	-112.3376	-51.2781	-30.8774	(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	2099.2220	(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	2560.0907	(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)	168.3214	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-2854.4384	(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	2059.1956	(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	2099.2220	0.2100	440.8366	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2560.0907	0.2100	537.6190	(264)
Space and water heating			978.4557	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	168.3214	0.1443	24.2940	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-832.3975	0.1359	-113.1238	
PV Unit electricity exported	-2022.0410	0.1265	-255.8513	
Total			-368.9751	(269)
Total CO2, kg/year			645.7038	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			11.1800	(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	2099.2220	1.1300	2372.1208	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2560.0907	1.1300	2892.9025	(278)
Space and water heating			5265.0233	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	168.3214	1.5338	258.1769	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-832.3975	1.5023	-1250.5434	
PV Unit electricity exported	-2022.0410	0.4645	-939.2086	
Total			-2189.7520	(283)
Total Primary energy kWh/year			3463.5490	(286)
Target Primary Energy Rate (TPER)			59.9700	(287)

Building Regulations England Part L (BREL) Compliance Report

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

Date: Fri 14 Mar 2025 09:30:50

Project Information			
Assessed By	Richard Millard	Building Type	House, Detached
OCDEA Registration	EES/025661	Assessment Date	2025-03-14

Dwelling Details			
Assessment Type	As designed	Total Floor Area	117 m^2
Site Reference	B	Plot Reference	Proposed
Address	33		

Client Details	
Name	Ian White
Company	Cotswold Homes Ltd
Address	West House, Yate, Bristol, BS37 5NG

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

1a Target emission rate and dwelling emission rate		
Fuel for main heating system	Electricity	
Target carbon dioxide emission rate	*10.31 $kgCO_2/m^2$*	
Dwelling carbon dioxide emission rate	2.66 $kgCO_2/m^2$	OK
1b Target primary energy rate and dwelling primary energy		
Target primary energy	*53.85 kWh_{PE}/m^2*	
Dwelling primary energy	32.7 kWh_{PE}/m^2	OK
1c Target fabric energy efficiency and dwelling fabric energy efficiency		
Target fabric energy efficiency	*40.0 kWh/m^2*	
Dwelling fabric energy efficiency	38.8 kWh/m^2	OK

2a Fabric U-values				
Element	***Maximum permitted average U-Value [W/m^2K]***	**Dwelling average U-Value [W/m^2K]**	**Element with highest individual U-Value**	
External walls	*0.26*	0.18	Walls (1) (0.18)	OK
Party walls	*0.2*	N/A	N/A	**N/A**
Curtain walls	*1.6*	N/A	N/A	**N/A**
Floors	*0.18*	0.12	Heatloss Floor 1 (0.12)	OK
Roofs	*0.16*	0.11	Roof (2) (0.13)	OK
Windows, doors, and roof windows	*1.6*	1.2	WG01 (1.2)	OK
Rooflights	*2.2*	N/A	N/A	**N/A**

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))		
Name	**Net area [m^2]**	**U-Value [W/m^2K]**
Exposed wall: Walls (1)	130.63	0.18
Ground floor: Heatloss Floor 1, Heatloss Floor 1	57.93	0.12
Exposed roof: Roof (1)	57.93	0.11
Exposed roof: Roof (2)	1.62	0.13

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	**Area [m^2]**	**Orientation**	**Frame factor**	**U-Value [W/m^2K]**
WG01, Windows	1.33	West	0.7	1.2
WG02, Windows	2.62	South	0.7	1.2
WG03, Windows	1.33	East	0.7	1.2
FG01, Windows	1.45	South	0.7	1.2
FG02, Windows	0.96	South	0.7	1.2
FG03, Windows	1.45	South	0.7	1.2
FG04, Windows	1.34	North	0.7	1.2
FG05, Windows	0.54	North	0.7	1.2
FG06, Windows	1.32	North	0.7	1.2
ED01, Doors	3.21	South	N/A	1.2
ED02, Doors	2.06	North	N/A	1.2
ED03, Glazed Doors	3.8	North	0.7	1.2
WG04, Windows	1.62	South	0.7	1.2

Name	Area [m^2]	Orientation	Frame factor	U-Value [W/m^2K]
WG05, Windows	2.09	North	0.7	1.2
WG06, Windows	1.45	West	0.7	1.2

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))

Building part **1**: Thermal bridging calculated from linear thermal transmittances for each junction

Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E1: Steel lintel with perforated steel base plate	Calculated by person with suitable expertise	0.241	EMPF125E101
External wall	E3: Sill	Calculated by person with suitable expertise	0.026 **(!)**	EMPF125E301
External wall	E4: Jamb	Calculated by person with suitable expertise	0.02 **(!)**	EMPF125E401
External wall	E5: Ground floor (normal)	Calculated by person with suitable expertise	0.045	EMPF125E504
External wall	E6: Intermediate floor within a dwelling	Calculated by person with suitable expertise	0.002 **(!)**	EMPF125E601
External wall	E10: Eaves (insulation at ceiling level)	Calculated by person with suitable expertise	0.05	EMPF125E1001
External wall	E12: Gable (insulation at ceiling level)	Calculated by person with suitable expertise	0.031 **(!)**	EMPF125E1201
External wall	E16: Corner (normal)	Calculated by person with suitable expertise	0.037 **(!)**	EMPF125E21601
External wall	E17: Corner (inverted - internal area greater than external area)	Calculated by person with suitable expertise	-0.09	EMPF125E21701

3 Air permeability (better than typically expected values are flagged with a subsequent (!))

Maximum permitted air permeability at 50Pa	*8 m^3/hm^2*	
Dwelling air permeability at 50Pa	5 m^3/hm^2, Design value	OK
Air permeability test certificate reference		

4 Space heating

Main heating system 1: Heat pump with radiators or underfloor heating - Electricity	
Efficiency	241.1%
Emitter type	Radiators
Flow temperature	55°C
System type	Heat Pump
Manufacturer	Daikin Europe NV
Model	EDLA08EV3
Commissioning	
Secondary heating system: N/A	
Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water

Cylinder/store - type: Cylinder	
Capacity	210 litres
Declared heat loss	1.7 kWh/day
Primary pipework insulated	Yes
Manufacturer	
Model	
Commissioning	
Waste water heat recovery system 1 - type: N/A	
Efficiency	
Manufacturer	
Model	

6 Controls

Main heating 1 - type: Time and temperature zone control by arrangement of plumbing and electrical services	
Function	
Ecodesign class	
Manufacturer	
Model	

Water heating - type: Cylinder thermostat and HW separately timed	
Manufacturer	
Model	

7 Lighting		
Minimum permitted light source efficacy	*75 lm/W*	
Lowest light source efficacy	85 lm/W	**OK**
External lights control	N/A	

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

9 Local generation	
Technology type: **Photovoltaic system (1)**	
Peak power	2.01 kWp
Orientation	South
Pitch	30°
Overshading	None or very little
Manufacturer	
MCS certificate	

10 Heat networks
N/A

11 Supporting documentary evidence
N/A

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

Full SAP Calculation Printout

Property Reference	B	**Issued on Date**	14/03/2025
Assessment Reference	Proposed	**Prop Type Ref**	Proposed 33
Property	33		

SAP Rating	86 B	**DER**	2.66	**TER**	10.31
Environmental	98 A	**% DER < TER**			74.20
CO_2 Emissions (t/year)	0.27	**DFEE**	38.77	**TFEE**	39.98
Compliance Check	See BREL	**% DFEE < TFEE**			3.01
% DPER < TPER	39.27	**DPER**	32.70	**TPER**	53.85

Assessor Details	Mr. Richard Millard	**Assessor ID**	U367-0001
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)	
Main dwelling						
Ground floor	59.5500 (1b)	x	2.4000 (2b)	=	142.9200	(1b) - (3b)
First floor	57.9300 (1c)	x	2.6000 (2c)	=	150.6180	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	117.4800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	293.5380	(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		5 * 10 =	50.0000	(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) =		50.0000 / (5) =	0.1703	(8)
Pressure test			Yes	
Pressure Test Method			Blower Door	
Measured/design AP50			5.0000	(17)
Infiltration rate			0.4203	(18)
Number of sides sheltered			3	(19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor		(21) = (18) x (20) =	0.3258	(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	0.4153	0.4072	0.3991	0.3583	0.3502	0.3095	0.3095	0.3013	0.3258	0.3502	0.3665	0.3828	(22b)
Effective ac	0.5863	0.5829	0.5796	0.5642	0.5613	0.5479	0.5479	0.5454	0.5531	0.5613	0.5672	0.5733	(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	
Main dwelling								
Windows			17.5000	1.1450	20.0382			(27)
Glazed Doors			3.8000	1.1450	4.3511			(27)
Doors			5.2700	1.2000	6.3240			(26a)
Heatloss Floor 1			57.9300	0.1200	6.9516	75.0000	4344.7500	(28a)
Cavity Wall	157.2000	26.5700	130.6300	0.1800	23.5134	60.0000	7837.7998	(29a)
External Roof 1	57.9300		57.9300	0.1100	6.3723	9.0000	521.3700	(30)
External Roof 2	1.6200		1.6200	0.1300	0.2106	9.0000	14.5800	(30)
Total net area of external elements Aum(A, m2)			274.6800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		67.7612			(33)
Main dwelling								
Internal Wall 1 - Block			55.9700			75.0000	4197.7501	(32c)
Internal Wall 2 - Stud			47.9000			9.0000	431.1000	(32c)
Internal Wall 3 - Up			158.0000			9.0000	1422.0000	(32c)
Internal Floor 1			57.9300			18.0000	1042.7400	(32d)
Internal Ceiling 1			57.9300			9.0000	521.3700	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		20333.4599	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							173.0802	(35)
List of Thermal Bridges								

	Length	Psi-value	Total	
K1 Element				
E1 Steel lintel with perforated steel base plate	20.1600	0.2410	4.8586	
E3 Sill	14.9000	0.0260	0.3874	
E4 Jamb	39.2100	0.0200	0.7842	
E5 Ground floor (normal)	32.3800	0.0450	1.4571	
E6 Intermediate floor within a dwelling	30.5700	0.0020	0.0611	
E10 Eaves (insulation at ceiling level)	18.4700	0.0500	0.9235	
E12 Gable (insulation at ceiling level)	15.7000	0.0310	0.4867	
E16 Corner (normal)	24.8000	0.0370	0.9176	
E17 Corner (inverted - internal area greater than external area)	4.8000	-0.0900	-0.4320	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			9.4442	(36)
Point Thermal bridges		(36a) =	0.0000	
Total fabric heat loss		(33) + (36) + (36a) =	77.2054	(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	56.7891	56.4647	56.1466	54.6529	54.3734	53.0724	53.0724	52.8315	53.5735	54.3734	54.9388	55.5299	(38)
Heat transfer coeff	133.9945	133.6701	133.3521	131.8583	131.5788	130.2778	130.2778	130.0369	130.7790	131.5788	132.1442	132.7353	(39)
Average = Sum(39)m / 12 =												131.8570	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1406	1.1378	1.1351	1.1224	1.1200	1.1089	1.1089	1.1069	1.1132	1.1200	1.1248	1.1299	(40)
HLP (average)												1.1224	
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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Assumed occupancy												2.8530	(42)
Hot water usage for mixer showers	72.0557	70.9729	69.3949	66.3758	64.1478	61.6632	60.2509	61.8169	63.5335	66.2013	69.2852	71.7797	(42a)
Hot water usage for baths	31.1095	30.6475	29.9969	28.7973	27.8990	26.9030	26.3650	27.0110	27.7145	28.7803	30.0046	31.0044	(42b)
Hot water usage for other uses	43.8479	42.2534	40.6589	39.0645	37.4700	35.8755	35.8755	37.4700	39.0645	40.6589	42.2534	43.8479	(42c)
Average daily hot water use (litres/day)												135.1381	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	147.0131	143.8738	140.0508	134.2376	129.5168	124.4417	122.4914	126.2979	130.3124	135.6405	141.5432	146.6319	(44)
Energy conte	232.8329	204.8744	215.2528	183.7645	174.3545	153.0155	148.1427	156.3832	160.6883	184.0628	201.6543	229.5901	(45)
Energy content (annual)											Total = Sum(45)m =	2244.6160	
Distribution loss (46)m = 0.15 x (45)m	34.9249	30.7312	32.2879	27.5647	26.1532	22.9523	22.2214	23.4575	24.1032	27.6094	30.2481	34.4385	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9180	(55)
Total storage loss	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(56)
If cylinder contains dedicated solar storage	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(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	284.5533	251.5896	266.9732	233.8165	226.0749	203.0675	199.8631	208.1036	210.7403	235.7832	251.7063	281.3105	(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	284.5533	251.5896	266.9732	233.8165	226.0749	203.0675	199.8631	208.1036	210.7403	235.7832	251.7063	281.3105	(64)
										Total per year (kWh/year) = Sum(64)m =		2853.5820	(64)
12Total per year (kWh/year)												2854	(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	118.7933	105.4929	112.9479	101.1433	99.3492	90.9193	90.6338	93.3737	93.4704	102.5772	107.0916	117.7150	(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	142.6514	142.6514	142.6514	142.6514	142.6514	142.6514	142.6514	142.6514	142.6514	142.6514	142.6514	142.6514	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	145.0542	160.5957	145.0542	149.8893	145.0542	149.8893	145.0542	145.0542	149.8893	145.0542	149.8893	145.0542	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	281.8953	284.8205	277.4491	261.7563	241.9469	223.3289	210.8909	207.9657	215.3371	231.0299	250.8393	269.4573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.2651	37.2651	37.2651	37.2651	37.2651	37.2651	37.2651	37.2651	37.2651	37.2651	37.2651	37.2651	(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)	-114.1211	-114.1211	-114.1211	-114.1211	-114.1211	-114.1211	-114.1211	-114.1211	-114.1211	-114.1211	-114.1211	-114.1211	(71)
Water heating gains (Table 5)	159.6683	156.9835	151.8117	140.4768	133.5339	126.2768	121.8196	125.5023	129.8201	137.8726	148.7384	158.2191	(72)
Total internal gains	652.4132	668.1950	640.1103	617.9178	586.3304	565.2904	543.5601	544.3177	560.8419	579.7521	615.2624	638.5260	(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	5.2900	10.6334	0.6300	0.7000	0.7700	17.1909	(74)
East	1.3300	19.6403	0.6300	0.7000	0.7700	7.9831	(76)
South	8.1000	46.7521	0.6300	0.7000	0.7700	115.7331	(78)
West	2.7800	19.6403	0.6300	0.7000	0.7700	16.6864	(80)
North	3.8000	10.6334	0.6300	0.7000	0.7700	12.3489	(74)

Solar gains	169.9424	294.2519	416.8429	542.8732	633.9736	641.2742	613.2747	543.1699	459.9815	328.8998	204.3844	144.9169	(83)
Total gains	822.3556	962.4469	1056.9533	1160.7910	1220.3040	1206.5646	1156.8348	1087.4875	1020.8234	908.6519	819.6468	783.4429	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	42.1523	42.2547	42.3554	42.8352	42.9262	43.3549	43.3549	43.4352	43.1888	42.9262	42.7426	42.5522	
alpha	3.8102	3.8170	3.8237	3.8557	3.8617	3.8903	3.8903	3.8957	3.8793	3.8617	3.8495	3.8368	
util living area	0.9859	0.9738	0.9524	0.8984	0.7954	0.6304	0.4787	0.5246	0.7434	0.9199	0.9747	0.9882	(86)
Living	19.2756	19.5309	19.8783	20.3292	20.6927	20.9109	20.9763	20.9662	20.8254	20.3533	19.7409	19.2362	
Non living	17.9654	18.2898	18.7275	19.2871	19.7069	19.9333	19.9833	19.9794	19.8575	19.3286	18.5661	17.9211	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	20.1179	19.5309	19.8783	20.3292	20.6927	20.9109	20.9763	20.9662	20.8254	20.3533	19.7409	19.4829	(87)
Th 2	19.9678	19.9701	19.9723	19.9826	19.9845	19.9935	19.9935	19.9952	19.9901	19.9845	19.9806	19.9765	(88)
util rest of house	0.9827	0.9679	0.9413	0.8742	0.7473	0.5504	0.3765	0.4206	0.6714	0.8957	0.9680	0.9855	(89)
MIT 2	19.1695	18.2898	18.7275	19.2871	19.7069	19.9333	19.9833	19.9794	19.8575	19.3286	18.5661	18.2915	(90)
Living area fraction									fLA = Living area / (4) =			0.1409	(91)
MIT	19.3031	18.4646	18.8896	19.4339	19.8457	20.0710	20.1232	20.1184	19.9939	19.4729	18.7316	18.4593	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.3031	18.4646	18.8896	19.4339	19.8457	20.0710	20.1232	20.1184	19.9939	19.4729	18.7316	18.4593	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9801	0.9561	0.9262	0.8586	0.7399	0.5570	0.3901	0.4339	0.6717	0.8804	0.9564	0.9798	(94)
Useful gains	806.0102	920.1934	978.9002	996.6686	902.9017	672.0134	451.3194	471.8920	685.7076	800.0069	783.9487	767.6560	(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	2010.3388	1813.1857	1652.1816	1388.9839	1071.8075	712.7514	458.9971	483.5340	770.7965	1167.4881	1537.0463	1892.7171	(97)
Space heating kWh	896.0204	600.0908	500.9214	282.4671	125.6659	0.0000	0.0000	0.0000	0.0000	273.4060	542.2302	837.0455	(98a)
Space heating requirement - total per year (kWh/year)												4057.8473	
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	896.0204	600.0908	500.9214	282.4671	125.6659	0.0000	0.0000	0.0000	0.0000	273.4060	542.2302	837.0455	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4057.8473	
Space heating per m2											(98c) / (4) =	34.5407	(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 %)												241.1054	(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	896.0204	600.0908	500.9214	282.4671	125.6659	0.0000	0.0000	0.0000	0.0000	273.4060	542.2302	837.0455	(98)
Space heating efficiency (main heating system 1)	241.1054	241.1054	241.1054	241.1054	241.1054	0.0000	0.0000	0.0000	0.0000	241.1054	241.1054	241.1054	(210)
Space heating fuel (main heating system)	371.6301	248.8915	207.7603	117.1550	52.1207	0.0000	0.0000	0.0000	0.0000	113.3969	224.8934	347.1699	(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	284.5533	251.5896	266.9732	233.8165	226.0749	203.0675	199.8631	208.1036	210.7403	235.7832	251.7063	281.3105	(64)
Efficiency of water heater												166.9610	(216)
(217)m	166.9610	166.9610	166.9610	166.9610	166.9610	166.9610	166.9610	166.9610	166.9610	166.9610	166.9610	166.9610	(217)
Fuel for water heating, kWh/month	170.4310	150.6877	159.9016	140.0426	135.4059	121.6258	119.7065	124.6421	126.2213	141.2206	150.7575	168.4888	(219)
Space cooling fuel requirement	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)
(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	(231)
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	(232)
Lighting	29.5234	23.6847	21.3255	15.6240	12.0684	9.8600	11.0092	14.3102	18.5875	24.3878	27.5460	30.3439	(233a)
Electricity generated by PVs (Appendix M) (negative quantity)	-39.7980	-59.7104	-91.1071	-106.5373	-116.3497	-105.7009	-104.2120	-96.4466	-82.7246	-68.8728	-44.4986	-33.8242	(233a)
(233a)m													
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
(234a)m													
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
(235a)m													
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	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)
(235c)m													
Electricity generated by PVs (Appendix M) (negative quantity)	-10.5390	-24.2875	-51.9509	-85.1886	-120.5115	-127.1714	-125.5828	-104.3262	-74.5208	-38.5073	-15.2083	-8.2992	(233b)
(233b)m													
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
(234b)m													
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
(235b)m													
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	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)
(235d)m													

Annual totals kWh/year

Space heating fuel - main system 1	1683.0178	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)

Efficiency of water heater	166.9610	
Water heating fuel used	1709.1312	(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)	238.2704	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-1735.8756	(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	1894.5438	(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	1683.0178	0.1555	261.7883	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1709.1312	0.1410	240.9304	(264)
Space and water heating			502.7187	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	238.2704	0.1443	34.3898	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-949.7820	0.1341	-127.3185	
PV Unit electricity exported	-786.0936	0.1231	-96.8041	
Total			-224.1226	(269)
Total CO2, kg/year			312.9859	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			2.6600	(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	1683.0178	1.5758	2652.1477	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1709.1312	1.5212	2600.0100	(278)
Space and water heating			5252.1577	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	238.2704	1.5338	365.4671	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-949.7820	1.4954	-1420.3132	
PV Unit electricity exported	-786.0936	0.4519	-355.2129	
Total			-1775.5262	(283)
Total Primary energy kWh/year			3842.0986	(286)
Dwelling Primary energy Rate (DPER)			32.7000	(287)

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

1. Overall dwelling characteristics

		Area (m2)		Storey height (m)		Volume (m3)	
Main dwelling							
Ground floor		59.5500 (1b)	x	2.4000 (2b)	=	142.9200	(1b) - (3b)
First floor		57.9300 (1c)	x	2.6000 (2c)	=	150.6180	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	117.4800						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	293.5380	(5)

2. Ventilation rate

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	4 * 10 =	40.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1363	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3863	(18)
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2994	(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													
	0.3817	0.3742	0.3667	0.3293	0.3218	0.2844	0.2844	0.2769	0.2994	0.3218	0.3368	0.3517	(22b)
Effective ac	0.5728	0.5700	0.5672	0.5542	0.5518	0.5404	0.5404	0.5383	0.5448	0.5518	0.5567	0.5619	(25)

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3. Heat losses and heat loss parameter

Element	Gross	Openings	NetArea	U-value	A x U	K-value	A x K	
	m2	m2	m2	W/m2K	W/K	kJ/m2K	kJ/K	
Main dwelling								
TER Semi-glazed door			5.2700	1.0000	5.2700			(26a)
TER Opening Type			21.3000	1.1450	24.3893			(27)
Heatloss Floor 1			57.9300	0.1300	7.5309			(28a)
Cavity Wall	157.2000	26.5700	130.6300	0.1800	23.5134			(29a)
External Roof 1	57.9300		57.9300	0.1100	6.3723			(30)
External Roof 2	1.6200		1.6200	0.1100	0.1782			(30)
Total net area of external elements Aum(A, m2)			274.6800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		67.2541			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	173.0802	(35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	20.1600	0.0500	1.0080
E3 Sill	14.9000	0.0500	0.7450
E4 Jamb	39.2100	0.0500	1.9605
E5 Ground floor (normal)	32.3800	0.1600	5.1808
E6 Intermediate floor within a dwelling	30.5700	0.0000	0.0000
E10 Eaves (insulation at ceiling level)	18.4700	0.0600	1.1082
E12 Gable (insulation at ceiling level)	15.7000	0.0600	0.9420
E16 Corner (normal)	24.8000	0.0900	2.2320
E17 Corner (inverted - internal area greater than external area)	4.8000	-0.0900	-0.4320

Thermal bridges (Sum(L x Psi) calculated using Appendix K)	12.7445	(36)
Point Thermal bridges (36a) =	0.0000	
Total fabric heat loss (33) + (36) + (36a) =	79.9986	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	55.4896	55.2157	54.9471	53.6857	53.4497	52.3510	52.3510	52.1475	52.7742	53.4497	53.9271	54.4262	(38)
Heat transfer coeff													
	135.4883	135.2143	134.9457	133.6843	133.4483	132.3496	132.3496	132.1461	132.7728	133.4483	133.9257	134.4249	(39)
Average = Sum(39)m / 12 =												133.6831	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1533	1.1510	1.1487	1.1379	1.1359	1.1266	1.1266	1.1248	1.1302	1.1359	1.1400	1.1442	(40)
HLP (average)												1.1379	
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	2.8530	(42)

Hot water usage for mixer showers

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
72.0557	70.9729	69.3949	66.3758	64.1478	61.6632	60.2509	61.8169	63.5335	66.2013	69.2852	71.7797	(42a)

Hot water usage for baths

31.1095	30.6475	29.9969	28.7973	27.8990	26.9030	26.3650	27.0110	27.7145	28.7803	30.0046	31.0044	(42b)

Hot water usage for other uses

43.8479	42.2534	40.6589	39.0645	37.4700	35.8755	35.8755	37.4700	39.0645	40.6589	42.2534	43.8479	(42c)

Average daily hot water use (litres/day)	135.1381	(43)

Daily hot water use

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
147.0131	143.8738	140.0508	134.2376	129.5168	124.4417	122.4914	126.2979	130.3124	135.6405	141.5432	146.6319	(44)
Energy conte 232.8329	204.8744	215.2528	183.7645	174.3545	153.0155	148.1427	156.3832	160.6883	184.0628	201.6543	229.5901	(45)

Energy content (annual) Total = Sum(45)m =	2244.6160	

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

34.9249	30.7312	32.2879	27.5647	26.1532	22.9523	22.2214	23.4575	24.1032	27.6094	30.2481	34.4385	(46)

Water storage loss:		
Store volume	210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):	1.7016	(48)
Temperature factor from Table 2b	0.5400	(49)
Enter (49) or (54) in (55)	0.9188	(55)

Total storage loss

28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(56)

If cylinder contains dedicated solar storage

28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(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

284.5795	251.6132	266.9994	233.8419	226.1011	203.0929	199.8893	208.1298	210.7656	235.8094	251.7316	281.3367	(62)
WWHRS -32.9409	-29.1332	-30.5066	-25.2607	-23.5420	-20.1451	-18.8828	-20.0800	-20.8429	-24.5714	-27.8365	-32.3309	(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

251.6386	222.4800	236.4928	208.5812	202.5591	182.9478	181.0065	188.0498	189.9227	211.2380	223.8951	249.0058	(64)

Total per year (kWh/year) = Sum(64)m =	2547.8175	(64)
12Total per year (kWh/year)	2548	(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

118.8142	105.5118	112.9688	101.1636	99.3702	90.9395	90.6547	93.3947	93.4907	102.5982	107.1119	117.7360	(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 142.6514	142.6514	142.6514	142.6514	142.6514	142.6514	142.6514	142.6514	142.6514	142.6514	142.6514	142.6514	(66)

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

	145.0542	160.5957	145.0542	149.8893	145.0542	149.8893	145.0542	145.0542	149.8893	145.0542	149.8893	145.0542	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	281.8953	284.8205	277.4491	261.7563	241.9469	223.3289	210.8909	207.9657	215.3371	231.0299	250.8393	269.4573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.2651	37.2651	37.2651	37.2651	37.2651	37.2651	37.2651	37.2651	37.2651	37.2651	37.2651	37.2651	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-114.1211	-114.1211	-114.1211	-114.1211	-114.1211	-114.1211	-114.1211	-114.1211	-114.1211	-114.1211	-114.1211	-114.1211	(71)
Water heating gains (Table 5)													
	159.6965	157.0116	151.8398	140.5050	133.5620	126.3049	121.8477	125.5305	129.8482	137.9008	148.7666	158.2473	(72)
Total internal gains													
	655.4414	671.2232	643.1385	620.9460	589.3585	565.3186	543.5883	544.3458	560.8701	582.7803	618.2906	641.5542	(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	9.0900	10.6334	0.6300	0.7000	0.7700	29.5398	(74)
East	1.3300	19.6403	0.6300	0.7000	0.7700	7.9831	(76)
South	8.1000	46.7521	0.6300	0.7000	0.7700	115.7331	(78)
West	2.7800	19.6403	0.6300	0.7000	0.7700	16.6864	(80)

Solar gains	169.9424	294.2519	416.8429	542.8732	633.9736	641.2742	613.2747	543.1699	459.9815	328.8998	204.3844	144.9169	(83)
Total gains	825.3838	965.4751	1059.9814	1163.8191	1223.3321	1206.5927	1156.8630	1087.5157	1020.8516	911.6801	822.6749	786.4711	(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	41.6876	41.7721	41.8552	42.2502	42.3249	42.6762	42.6762	42.7419	42.5402	42.3249	42.1740	42.0174	
alpha	3.7792	3.7848	3.7903	3.8167	3.8217	3.8451	3.8451	3.8495	3.8360	3.8217	3.8116	3.8012	
util living area	0.9858	0.9738	0.9526	0.8996	0.7983	0.6366	0.4849	0.5310	0.7483	0.9207	0.9747	0.9881	(86)
MIT	19.2543	19.5091	19.8578	20.3100	20.6800	20.9042	20.9740	20.9632	20.8155	20.3364	19.7192	19.2115	(87)
Th 2	19.9576	19.9594	19.9613	19.9700	19.9716	19.9792	19.9792	19.9806	19.9763	19.9716	19.9683	19.9649	(88)
util rest of house	0.9826	0.9679	0.9415	0.8755	0.7500	0.5555	0.3804	0.4249	0.6760	0.8965	0.9679	0.9853	(89)
MIT 2	17.9317	18.2552	18.6944	19.2547	19.6824	19.9144	19.9680	19.9634	19.8361	19.2989	18.5304	17.8822	(90)
Living area fraction									fLA = Living area / (4) =			0.1409	(91)
MIT	18.1180	18.4318	18.8583	19.4033	19.8229	20.0539	20.1098	20.1042	19.9741	19.4450	18.6978	18.0694	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.1180	18.4318	18.8583	19.4033	19.8229	20.0539	20.1098	20.1042	19.9741	19.4450	18.6978	18.0694	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9742	0.9559	0.9262	0.8595	0.7422	0.5619	0.3942	0.4384	0.6758	0.8809	0.9562	0.9779	(94)
Useful gains	804.0677	922.9091	981.7345	1000.3224	907.9548	677.9592	456.0896	476.7763	689.8908	803.0868	786.6586	769.1015	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1872.1763	1829.6942	1667.7004	1404.1325	1083.9932	721.8180	464.5144	489.5005	779.9210	1180.3564	1553.2498	1864.3979	(97)
Space heating kWh	794.6728	609.3596	510.3586	290.7432	130.9726	0.0000	0.0000	0.0000	0.0000	280.6886	551.9457	814.9005	(98a)
Space heating requirement - total per year (kWh/year)												3983.6416	
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	794.6728	609.3596	510.3586	290.7432	130.9726	0.0000	0.0000	0.0000	0.0000	280.6886	551.9457	814.9005	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3983.6416	
Space heating per m2											(98c) / (4) =	33.9091	(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	794.6728	609.3596	510.3586	290.7432	130.9726	0.0000	0.0000	0.0000	0.0000	280.6886	551.9457	814.9005	(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)	860.9673	660.1946	552.9346	314.9981	141.8988	0.0000	0.0000	0.0000	0.0000	304.1047	597.9910	882.8824	(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	251.6386	222.4800	236.4928	208.5812	202.5591	182.9478	181.0065	188.0498	189.9227	211.2380	223.8951	249.0058	(64)
Efficiency of water heater												79.8000	(216)
(217)m	86.4550	86.1999	85.7381	84.8047	83.1076	79.8000	79.8000	79.8000	79.8000	84.6981	86.0009	86.5163	(217)
Fuel for water heating, kWh/month	291.0631	258.0979	275.8318	245.9548	243.7311	229.2579	226.8252	235.6514	237.9984	249.4011	260.3404	287.8139	(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	30.1394	24.1789	21.7705	15.9500	12.3202	10.0657	11.2389	14.6088	18.9753	24.8967	28.1207	30.9771	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-53.3382	-74.0106	-104.7052	-115.7733	-123.1634	-114.2903	-112.7884	-107.2344	-97.2721	-83.6142	-58.1798	-46.2469	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-33.8547	-70.7581	-139.8304	-208.8951	-275.1871	-276.1988	-273.0294	-231.7112	-170.4995	-100.9120	-45.1011	-26.8138	(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	4315.9714	(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	3041.9670	(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)	243.2421	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-2943.4079	(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	4743.7726	(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	4315.9714	0.2100	906.3540	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3041.9670	0.2100	638.8131	(264)
Space and water heating			1545.1671	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	243.2421	0.1443	35.1074	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1090.6168	0.1349	-147.1756	
PV Unit electricity exported	-1852.7911	0.1260	-233.5401	
Total			-380.7157	(269)
Total CO2, kg/year			1211.4880	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			10.3100	(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	4315.9714	1.1300	4877.0476	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3041.9670	1.1300	3437.4227	(278)
Space and water heating			8314.4704	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	243.2421	1.5338	373.0929	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1090.6168	1.4988	-1634.5750	
PV Unit electricity exported	-1852.7911	0.4627	-857.2645	
Total			-2491.8394	(283)
Total Primary energy kWh/year			6325.8247	(286)
Target Primary Energy Rate (TPER)			53.8500	(287)

Building Regulations England Part L (BREL) Compliance Report

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

Date: Fri 14 Mar 2025 09:30:53

Project Information			
Assessed By	Richard Millard	Building Type	House, Detached
OCDEA Registration	EES/025661	Assessment Date	2025-03-14

Dwelling Details			
Assessment Type	As designed	Total Floor Area	117 m^2
Site Reference	B	Plot Reference	Regulated (Baseline)
Address	33		

Client Details	
Name	Ian White
Company	Cotswold Homes Ltd
Address	West House, Yate, Bristol, BS37 5NG

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

1a Target emission rate and dwelling emission rate		
Fuel for main heating system	Mains gas	
Target carbon dioxide emission rate	*10.3 $kgCO_2/m^2$*	
Dwelling carbon dioxide emission rate	14.59 $kgCO_2/m^2$	**FAIL**
1b Target primary energy rate and dwelling primary energy		
Target primary energy	*53.76 kWh_{PE}/m^2*	
Dwelling primary energy	80.58 kWh_{PE}/m^2	**FAIL**
1c Target fabric energy efficiency and dwelling fabric energy efficiency		
Target fabric energy efficiency	*40.0 kWh/m^2*	
Dwelling fabric energy efficiency	40.0 kWh/m^2	**OK**

2a Fabric U-values				
Element	***Maximum permitted average U-Value [W/m^2K]***	**Dwelling average U-Value [W/m^2K]**	**Element with highest individual U-Value**	
External walls	*0.26*	0.18	Walls (1) (0.18)	**OK**
Party walls	*0.2*	N/A	N/A	**N/A**
Curtain walls	*1.6*	N/A	N/A	**N/A**
Floors	*0.18*	0.13	Heatloss Floor 1 (0.13)	**OK**
Roofs	*0.16*	0.11	Roof (1) (0.11)	**OK**
Windows, doors, and roof windows	*1.6*	1.2	WG01 (1.2)	**OK**
Rooflights	*2.2*	N/A	N/A	**N/A**

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))		
Name	**Net area [m^2]**	**U-Value [W/m^2K]**
Exposed wall: Walls (1)	130.63	0.18
Ground floor: Heatloss Floor 1, Heatloss Floor 1	57.93	0.13
Exposed roof: Roof (1)	57.93	0.11
Exposed roof: Roof (2)	1.62	0.11

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	**Area [m^2]**	**Orientation**	**Frame factor**	**U-Value [W/m^2K]**
WG01, Windows	1.33	West	0.7	1.2
WG02, Windows	2.62	South	0.7	1.2
WG03, Windows	1.33	East	0.7	1.2
FG01, Windows	1.45	South	0.7	1.2
FG02, Windows	0.96	South	0.7	1.2
FG03, Windows	1.45	South	0.7	1.2
FG04, Windows	1.34	North	0.7	1.2
FG05, Windows	0.54	North	0.7	1.2
FG06, Windows	1.32	North	0.7	1.2
ED01, Doors	3.21	South	N/A	1.2
ED02, Doors	2.06	North	N/A	1.2
ED03, Glazed Doors	3.8	North	0.7	1.2
WG04, Windows	1.62	South	0.7	1.2

Name	Area [m^2]	Orientation	Frame factor	U-Value [W/m^2K]
WG05, Windows	2.09	North	0.7	1.2
WG06, Windows	1.45	West	0.7	1.2

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))

Building part **1**: Thermal bridging calculated from linear thermal transmittances for each junction

Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E2: Other lintels (including other steel lintels)	Calculated by person with suitable expertise	0.05	mpf125e2-04
External wall	E3: Sill	Calculated by person with suitable expertise	0.05	mpf125e3-01
External wall	E4: Jamb	Calculated by person with suitable expertise	0.022 **(!)**	mpf125e4-01
External wall	E5: Ground floor (normal)	Calculated by person with suitable expertise	0.16	mpf125e5-04
External wall	E6: Intermediate floor within a dwelling	Calculated by person with suitable expertise	0.003 **(!)**	mpf125e6-01
External wall	E10: Eaves (insulation at ceiling level)	Calculated by person with suitable expertise	0.06	mpf125e10-01
External wall	E12: Gable (insulation at ceiling level)	Calculated by person with suitable expertise	0.06	mpf125e12-01
External wall	E16: Corner (normal)	Calculated by person with suitable expertise	0.09	mpf125e16-01
External wall	E17: Corner (inverted - internal area greater than external area)	Calculated by person with suitable expertise	-0.085	mpf125e17-01

3 Air permeability (better than typically expected values are flagged with a subsequent (!))

Maximum permitted air permeability at 50Pa	*8 m^3/hm^2*	
Dwelling air permeability at 50Pa	5 m^3/hm^2, Design value	OK
Air permeability test certificate reference		

4 Space heating

Main heating system 1: Boiler with radiators or underfloor heating - Mains gas	
Efficiency	88.6%
Emitter type	Radiators
Flow temperature	45°C
System type	Regular boiler
Manufacturer	Bosch Thermotechnology
Model	Greenstar 8000 Life
Commissioning	
Secondary heating system: N/A	
Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water

Cylinder/store - type: Cylinder	
Capacity	200 litres
Declared heat loss	2.09 kWh/day
Primary pipework insulated	Yes
Manufacturer	
Model	
Commissioning	
Waste water heat recovery system 1 - type: N/A	
Efficiency	
Manufacturer	
Model	

6 Controls

Main heating 1 - type: Time and temperature zone control by arrangement of plumbing and electrical services	
Function	
Ecodesign class	
Manufacturer	
Model	

Water heating - type: Cylinder thermostat and HW separately timed	
Manufacturer	
Model	

7 Lighting		
Minimum permitted light source efficacy	*75 lm/W*	
Lowest light source efficacy	85 lm/W	**OK**
External lights control	N/A	

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

9 Local generation
N/A

10 Heat networks
N/A

11 Supporting documentary evidence
N/A

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

Full SAP Calculation Printout

Property Reference	B	**Issued on Date**	14/03/2025
Assessment Reference	Regulated (Baseline)	**Prop Type Ref**	Proposed 33
Property	33		

SAP Rating	85 B	**DER**	14.59	**TER**	10.30
Environmental	86 B	**% DER < TER**			-41.65
CO_2 Emissions (t/year)	1.6	**DFEE**	40.01	**TFEE**	39.98
Compliance Check	See BREL	**% DFEE < TFEE**			-0.08
% DPER < TPER	-49.89	**DPER**	80.58	**TPER**	53.76

Assessor Details	Mr. Richard Millard	**Assessor ID**	U367-0001
Client			

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Main dwelling						
Ground floor	59.5500 (1b)	x	2.4000 (2b)	=	142.9200	(1b) - (3b)
First floor	57.9300 (1c)	x	2.6000 (2c)	=	150.6180	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	117.4800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	293.5380	(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	5 * 10 =	50.0000	(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) =	50.0000 / (5) =	0.1703	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.4203	(18)
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3258	(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	0.4153	0.4072	0.3991	0.3583	0.3502	0.3095	0.3095	0.3013	0.3258	0.3502	0.3665	0.3828	(22b)
Effective ac	0.5863	0.5829	0.5796	0.5642	0.5613	0.5479	0.5479	0.5454	0.5531	0.5613	0.5672	0.5733	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Main dwelling								
Windows			17.5000	1.1450	20.0382			(27)
Glazed Doors			3.8000	1.1450	4.3511			(27)
Doors			5.2700	1.2000	6.3240			(26a)
Heatloss Floor 1			57.9300	0.1300	7.5309	75.0000	4344.7500	(28a)
Cavity Wall	157.2000	26.5700	130.6300	0.1800	23.5134	60.0000	7837.8000	(29a)
External Roof 1	57.9300		57.9300	0.1100	6.3723	9.0000	521.3700	(30)
External Roof 2	1.6200		1.6200	0.1100	0.1782	9.0000	14.5800	(30)
Total net area of external elements Aum(A, m2)			274.6800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		68.3081			(33)
Main dwelling								
Internal Wall 1 - Block			55.9700			75.0000	4197.7500	(32c)
Internal Wall 2 - Stud			47.9000			9.0000	431.1000	(32c)
Internal Wall 3 - Up			158.0000			9.0000	1422.0000	(32c)
Internal Floor 1			57.9300			18.0000	1042.7400	(32d)
Internal Ceiling 1			57.9300			9.0000	521.3700	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		20333.4600	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							173.0802	(35)
List of Thermal Bridges								

	Length	Psi-value	Total	
K1 Element				
E2 Other lintels (including other steel lintels)	20.1600	0.0500	1.0080	
E3 Sill	14.9000	0.0500	0.7450	
E4 Jamb	39.2100	0.0220	0.8626	
E5 Ground floor (normal)	32.3800	0.1600	5.1808	
E6 Intermediate floor within a dwelling	30.5700	0.0030	0.0917	
E10 Eaves (insulation at ceiling level)	18.4700	0.0600	1.1082	
E12 Gable (insulation at ceiling level)	15.7000	0.0600	0.9420	
E16 Corner (normal)	24.8000	0.0900	2.2320	
E17 Corner (inverted - internal area greater than external area)	4.8000	-0.0850	-0.4080	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			11.7623	(36)
Point Thermal bridges		(36a) =	0.0000	
Total fabric heat loss		(33) + (36) + (36a) =	80.0704	(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	56.7891	56.4647	56.1466	54.6529	54.3734	53.0724	53.0724	52.8315	53.5735	54.3734	54.9388	55.5299	(38)
Heat transfer coeff	136.8596	136.5351	136.2171	134.7233	134.4439	133.1429	133.1429	132.9019	133.6440	134.4439	135.0092	135.6003	(39)
Average = Sum(39)m / 12 =												134.7220	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1650	1.1622	1.1595	1.1468	1.1444	1.1333	1.1333	1.1313	1.1376	1.1444	1.1492	1.1542	(40)
HLP (average)												1.1468	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.8530 (42)

Hot water usage for mixer showers

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
72.0557	70.9729	69.3949	66.3758	64.1478	61.6632	60.2509	61.8169	63.5335	66.2013	69.2852	71.7797	(42a)

Hot water usage for baths

31.1095	30.6475	29.9969	28.7973	27.8990	26.9030	26.3650	27.0110	27.7145	28.7803	30.0046	31.0044	(42b)

Hot water usage for other uses

43.8479	42.2534	40.6589	39.0645	37.4700	35.8755	35.8755	37.4700	39.0645	40.6589	42.2534	43.8479	(42c)

Average daily hot water use (litres/day) 135.1381 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	147.0131	143.8738	140.0508	134.2376	129.5168	124.4417	122.4914	126.2979	130.3124	135.6405	141.5432	146.6319	(44)
Energy conte	232.8329	204.8744	215.2528	183.7645	174.3545	153.0155	148.1427	156.3832	160.6883	184.0628	201.6543	229.5901	(45)
Energy content (annual)										Total = Sum(45)m =		2244.6160	

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

34.9249	30.7312	32.2879	27.5647	26.1532	22.9523	22.2214	23.4575	24.1032	27.6094	30.2481	34.4385	(46)

Water storage loss:

Store volume 200.0000 (47)

a) If manufacturer declared loss factor is known (kWh/day): 2.0900 (48)

Temperature factor from Table 2b 0.5400 (49)

Enter (49) or (54) in (55) 1.1286 (55)

Total storage loss

34.9866	31.6008	34.9866	33.8580	34.9866	33.8580	34.9866	34.9866	33.8580	34.9866	33.8580	34.9866	(56)

If cylinder contains dedicated solar storage

34.9866	31.6008	34.9866	33.8580	34.9866	33.8580	34.9866	34.9866	33.8580	34.9866	33.8580	34.9866	(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

291.0819	257.4864	273.5018	240.1345	232.6035	209.3855	206.3917	214.6322	217.0583	242.3118	258.0243	287.8391	(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													
291.0819	257.4864	273.5018	240.1345	232.6035	209.3855	206.3917	214.6322	217.0583	242.3118	258.0243	287.8391	(64)
									Total per year (kWh/year) = Sum(64)m =		2930.4510	(64)
12Total per year (kWh/year)											2930	(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

124.0161	110.2103	118.1708	106.1977	104.5721	95.9737	95.8566	98.5966	98.5248	107.8001	112.1460	122.9379	(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	142.6514	142.6514	142.6514	142.6514	142.6514	142.6514	142.6514	142.6514	142.6514	142.6514	142.6514	142.6514	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	145.0542	160.5957	145.0542	149.8893	145.0542	149.8893	145.0542	145.0542	149.8893	145.0542	149.8893	145.0542	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	281.8953	284.8205	277.4491	261.7563	241.9469	223.3289	210.8909	207.9657	215.3371	231.0299	250.8393	269.4573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.2651	37.2651	37.2651	37.2651	37.2651	37.2651	37.2651	37.2651	37.2651	37.2651	37.2651	37.2651	(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)	-114.1211	-114.1211	-114.1211	-114.1211	-114.1211	-114.1211	-114.1211	-114.1211	-114.1211	-114.1211	-114.1211	-114.1211	(71)
Water heating gains (Table 5)	166.6883	164.0035	158.8317	147.4968	140.5539	133.2968	128.8396	132.5223	136.8401	144.8926	155.7584	165.2391	(72)
Total internal gains	662.4332	678.2150	650.1303	627.9378	596.3504	572.3104	550.5801	551.3377	567.8619	589.7721	625.2824	648.5460	(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	5.2900	10.6334	0.6300	0.7000	0.7700	17.1909	(74)
East	1.3300	19.6403	0.6300	0.7000	0.7700	7.9831	(76)
South	8.1000	46.7521	0.6300	0.7000	0.7700	115.7331	(78)
West	2.7800	19.6403	0.6300	0.7000	0.7700	16.6864	(80)
North	3.8000	10.6334	0.6300	0.7000	0.7700	12.3489	(74)

Solar gains	169.9424	294.2519	416.8429	542.8732	633.9736	641.2742	613.2747	543.1699	459.9815	328.8998	204.3844	144.9169	(83)
Total gains	832.3756	972.4669	1066.9733	1170.8110	1230.3240	1213.5846	1163.8548	1094.5075	1027.8434	918.6719	829.6668	793.4629	(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	41.2699	41.3680	41.4646	41.9243	42.0115	42.4220	42.4220	42.4989	42.2629	42.0115	41.8355	41.6532	
alpha	3.7513	3.7579	3.7643	3.7950	3.8008	3.8281	3.8281	3.8333	3.8175	3.8008	3.7890	3.7769	
util living area	0.9855	0.9734	0.9522	0.8991	0.7980	0.6362	0.4846	0.5304	0.7474	0.9198	0.9742	0.9878	(86)
MIT	19.2396	19.4953	19.8461	20.3032	20.6758	20.9031	20.9736	20.9627	20.8139	20.3321	19.7115	19.2001	(87)
Th 2	19.9481	19.9504	19.9525	19.9628	19.9647	19.9737	19.9737	19.9754	19.9703	19.9647	19.9608	19.9568	(88)
util rest of house	0.9822	0.9674	0.9410	0.8749	0.7496	0.5548	0.3797	0.4239	0.6748	0.8954	0.9672	0.9850	(89)
MIT 2	17.9069	18.2316	18.6736	19.2411	19.6721	19.9083	19.9624	19.9580	19.8291	19.2885	18.5157	17.8623	(90)
Living area fraction									fLA = Living area / (4) =			0.1409	(91)
MIT	18.0946	18.4096	18.8388	19.3907	19.8135	20.0484	20.1049	20.0995	19.9678	19.4355	18.6842	18.0508	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9446	18.2596	18.6888	19.2407	19.6635	19.8984	19.9549	19.9495	19.8178	19.2855	18.5342	17.9008	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9727	0.9538	0.9230	0.8541	0.7335	0.5484	0.3777	0.4211	0.6625	0.8747	0.9536	0.9766	(94)
Useful gains	809.6210	927.4993	984.8052	1000.0161	902.4063	665.5148	439.5650	460.8970	680.9942	803.5442	791.2002	774.8566	(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	1867.3975	1824.0606	1660.3250	1393.1330	1070.6412	705.4441	446.6747	471.7411	764.1498	1167.7131	1543.7204	1857.8285	(97)
Space heating kWh	786.9857	602.4892	502.5867	283.0442	125.1668	0.0000	0.0000	0.0000	0.0000	270.9417	541.8145	805.7311	(98a)
Space heating requirement - total per year (kWh/year)												3918.7598	
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	786.9857	602.4892	502.5867	283.0442	125.1668	0.0000	0.0000	0.0000	0.0000	270.9417	541.8145	805.7311	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3918.7598	
Space heating per m2											(98c) / (4) =	33.3568	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	88.6000	(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	786.9857	602.4892	502.5867	283.0442	125.1668	0.0000	0.0000	0.0000	0.0000	270.9417	541.8145	805.7311	(98)
Space heating efficiency (main heating system 1)	88.6000	88.6000	88.6000	88.6000	88.6000	0.0000	0.0000	0.0000	0.0000	88.6000	88.6000	88.6000	(210)
Space heating fuel (main heating system)	888.2457	680.0104	567.2536	319.4630	141.2718	0.0000	0.0000	0.0000	0.0000	305.8032	611.5288	909.4030	(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	291.0819	257.4864	273.5018	240.1345	232.6035	209.3855	206.3917	214.6322	217.0583	242.3118	258.0243	287.8391	(64)
Efficiency of water heater												79.6000	(216)
(217)m	85.9753	85.6988	85.2050	84.2289	82.5331	79.6000	79.6000	79.6000	79.6000	84.1103	85.4821	86.0395	(217)
Fuel for water heating, kWh/month	338.5644	300.4549	320.9928	285.0977	281.8307	263.0471	259.2860	269.6384	272.6863	288.0883	301.8460	334.5431	(219)
Space cooling fuel requirement	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)
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	29.5234	23.6847	21.3255	15.6240	12.0684	9.8600	11.0092	14.3102	18.5875	24.3878	27.5460	30.3439	(232)
Electricity generated by PVs (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233a)
(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)	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)
(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)	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)
(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)	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)
(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)	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)
(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)	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)
(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)	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)
(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)	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)
(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	4422.9795	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	79.6000	
Water heating fuel used	3516.0757	(219)
Space cooling fuel	0.0000	(221)

Electricity for pumps and fans:

central heating pump	41.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	86.0000	(231)
Electricity for lighting (calculated in Appendix L)	238.2704	(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	8263.3256	(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	4422.9795	0.2100	928.8257	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3516.0757	0.2100	738.3759	(264)
Space and water heating			1667.2016	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	238.2704	0.1443	34.3898	(268)
Total CO2, kg/year			1713.5206	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			14.5900	(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	4422.9795	1.1300	4997.9668	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3516.0757	1.1300	3973.1656	(278)
Space and water heating			8971.1324	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	238.2704	1.5338	365.4671	(282)
Total Primary energy kWh/year			9466.7002	(286)
Dwelling Primary energy Rate (DPER)			80.5800	(287)

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

1. Overall dwelling characteristics

		Area (m2)		Storey height (m)		Volume (m3)	
Main dwelling							
Ground floor		59.5500 (1b)	x	2.4000 (2b)	=	142.9200	(1b) - (3b)
First floor		57.9300 (1c)	x	2.6000 (2c)	=	150.6180	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	117.4800						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	293.5380	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1363	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3863	(18)
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2994	(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	0.3817	0.3742	0.3667	0.3293	0.3218	0.2844	0.2844	0.2769	0.2994	0.3218	0.3368	0.3517	(22b)
Effective ac	0.5728	0.5700	0.5672	0.5542	0.5518	0.5404	0.5404	0.5383	0.5448	0.5518	0.5567	0.5619	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Main dwelling								
TER Semi-glazed door			5.2700	1.0000	5.2700			(26a)
TER Opening Type			21.3000	1.1450	24.3893			(27)
Heatloss Floor 1			57.9300	0.1300	7.5309			(28a)
Cavity Wall	157.2000	26.5700	130.6300	0.1800	23.5134			(29a)
External Roof 1	57.9300		57.9300	0.1100	6.3723			(30)
External Roof 2	1.6200		1.6200	0.1100	0.1782			(30)
Total net area of external elements Aum(A, m2)			274.6800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.2541			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 173.0802 (35)

List of Thermal Bridges

	Length	Psi-value	Total	
K1 Element				
E2 Other lintels (including other steel lintels)	20.1600	0.0500	1.0080	
E3 Sill	14.9000	0.0500	0.7450	
E4 Jamb	39.2100	0.0500	1.9605	
E5 Ground floor (normal)	32.3800	0.1600	5.1808	
E6 Intermediate floor within a dwelling	30.5700	0.0000	0.0000	
E10 Eaves (insulation at ceiling level)	18.4700	0.0600	1.1082	
E12 Gable (insulation at ceiling level)	15.7000	0.0600	0.9420	
E16 Corner (normal)	24.8000	0.0900	2.2320	
E17 Corner (inverted - internal area greater than external area)	4.8000	-0.0900	-0.4320	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 12.7445 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 79.9986 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	55.4896	55.2157	54.9471	53.6857	53.4497	52.3510	52.3510	52.1475	52.7742	53.4497	53.9271	54.4262	(38)
Heat transfer coeff	135.4883	135.2143	134.9457	133.6843	133.4483	132.3496	132.3496	132.1461	132.7728	133.4483	133.9257	134.4249	(39)
Average = Sum(39)m / 12 =												133.6831	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1533	1.1510	1.1487	1.1379	1.1359	1.1266	1.1266	1.1248	1.1302	1.1359	1.1400	1.1442	(40)
HLP (average)												1.1379	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.8530 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	72.0557	70.9729	69.3949	66.3758	64.1478	61.6632	60.2509	61.8169	63.5335	66.2013	69.2852	71.7797	(42a)
Hot water usage for baths	31.1095	30.6475	29.9969	28.7973	27.8990	26.9030	26.3650	27.0110	27.7145	28.7803	30.0046	31.0044	(42b)
Hot water usage for other uses	43.8479	42.2534	40.6589	39.0645	37.4700	35.8755	35.8755	37.4700	39.0645	40.6589	42.2534	43.8479	(42c)
Average daily hot water use (litres/day)												135.1381	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	147.0131	143.8738	140.0508	134.2376	129.5168	124.4417	122.4914	126.2979	130.3124	135.6405	141.5432	146.6319	(44)
Energy conte	232.8329	204.8744	215.2528	183.7645	174.3545	153.0155	148.1427	156.3832	160.6883	184.0628	201.6543	229.5901	(45)
Energy content (annual)										Total = Sum(45)m =		2244.6160	
Distribution loss (46)m = 0.15 x (45)m	34.9249	30.7312	32.2879	27.5647	26.1532	22.9523	22.2214	23.4575	24.1032	27.6094	30.2481	34.4385	(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)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	283.7589	250.8721	266.1789	233.0478	225.2806	202.2988	199.0688	207.3092	209.9716	234.9889	250.9376	280.5162	(62)
WWHRS	-32.9409	-29.1332	-30.5066	-25.2607	-23.5420	-20.1451	-18.8828	-20.0800	-20.8429	-24.5714	-27.8365	-32.3309	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	250.8181	221.7389	235.6723	207.7872	201.7386	182.1538	180.1860	187.2293	189.1287	210.4175	223.1011	248.1853	(64)
									Total per year (kWh/year) = Sum(64)m =			2538.1566	(64)
12Total per year (kWh/year)												2538	(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	118.1578	104.9189	112.3124	100.5283	98.7137	90.3043	89.9983	92.7383	92.8555	101.9418	106.4767	117.0796	(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	142.6514	142.6514	142.6514	142.6514	142.6514	142.6514	142.6514	142.6514	142.6514	142.6514	142.6514	142.6514	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	145.0542	160.5957	145.0542	149.8893	145.0542	149.8893	145.0542	145.0542	149.8893	145.0542	149.8893	145.0542	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	281.8953	284.8205	277.4491	261.7563	241.9469	223.3289	210.8909	207.9657	215.3371	231.0299	250.8393	269.4573	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.2651	37.2651	37.2651	37.2651	37.2651	37.2651	37.2651	37.2651	37.2651	37.2651	37.2651	37.2651	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-114.1211	-114.1211	-114.1211	-114.1211	-114.1211	-114.1211	-114.1211	-114.1211	-114.1211	-114.1211	-114.1211	-114.1211	(71)
Water heating gains (Table 5)	158.8142	156.1293	150.9576	139.6227	132.6798	125.4226	120.9655	124.6482	128.9659	137.0185	147.8843	157.3650	(72)
Total internal gains	654.5591	670.3409	642.2562	620.0637	588.4763	564.4363	542.7060	543.4635	559.9878	581.8980	617.4083	640.6719	(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	9.0900	10.6334	0.6300	0.7000	0.7700	29.5398	(74)
East	1.3300	19.6403	0.6300	0.7000	0.7700	7.9831	(76)
South	8.1000	46.7521	0.6300	0.7000	0.7700	115.7331	(78)
West	2.7800	19.6403	0.6300	0.7000	0.7700	16.6864	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	169.9424	294.2519	416.8429	542.8732	633.9736	641.2742	613.2747	543.1699	459.9815	328.8998	204.3844	144.9169	(83)
Total gains	824.5015	964.5928	1059.0991	1162.9369	1222.4498	1205.7105	1155.9807	1086.6334	1019.9693	910.7978	821.7927	785.5888	(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	41.6876	41.7721	41.8552	42.2502	42.3249	42.6762	42.6762	42.7419	42.5402	42.3249	42.1740	42.0174	
alpha	3.7792	3.7848	3.7903	3.8167	3.8217	3.8451	3.8451	3.8495	3.8360	3.8217	3.8116	3.8012	
util living area	0.9859	0.9739	0.9527	0.8998	0.7986	0.6369	0.4852	0.5314	0.7486	0.9209	0.9748	0.9881	(86)
MIT	19.2533	19.5082	19.8570	20.3093	20.6795	20.9041	20.9740	20.9631	20.8152	20.3356	19.7182	19.2105	(87)
Th 2	19.9576	19.9594	19.9613	19.9700	19.9716	19.9792	19.9792	19.9806	19.9763	19.9716	19.9683	19.9649	(88)
util rest of house	0.9826	0.9680	0.9416	0.8757	0.7504	0.5559	0.3807	0.4252	0.6764	0.8967	0.9680	0.9854	(89)
MIT 2	17.9304	18.2540	18.6933	19.2539	19.6820	19.9143	19.9680	19.9634	19.8358	19.2980	18.5292	17.8809	(90)
Living area fraction									fLA = Living area / (4) =			0.1409	(91)
MIT	18.1168	18.4307	18.8573	19.4026	19.8225	20.0537	20.1097	20.1042	19.9738	19.4442	18.6967	18.0682	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.1168	18.4307	18.8573	19.4026	19.8225	20.0537	20.1097	20.1042	19.9738	19.4442	18.6967	18.0682	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9743	0.9560	0.9263	0.8597	0.7425	0.5622	0.3945	0.4387	0.6762	0.8811	0.9563	0.9780	(94)
Useful gains	803.2727	922.1680	981.0731	999.8153	907.6550	677.8552	456.0649	476.7380	689.6793	802.5341	785.9172	768.2951	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1872.0101	1829.5381	1667.5605	1404.0276	1083.9347	721.7995	464.5101	489.4939	779.8814	1180.2416	1553.0947	1864.2307	(97)
Space heating kWh	795.1407	609.7527	510.7466	291.0328	131.1521	0.0000	0.0000	0.0000	0.0000	281.0144	552.3679	815.3761	(98a)
Space heating requirement - total per year (kWh/year)												3986.5833	
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	795.1407	609.7527	510.7466	291.0328	131.1521	0.0000	0.0000	0.0000	0.0000	281.0144	552.3679	815.3761	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3986.5833	
Space heating per m2											(98c) / (4) =	33.9341	(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	795.1407	609.7527	510.7466	291.0328	131.1521	0.0000	0.0000	0.0000	0.0000	281.0144	552.3679	815.3761	(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)	861.4742	660.6205	553.3549	315.3118	142.0933	0.0000	0.0000	0.0000	0.0000	304.4576	598.4484	883.3977	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	250.8181	221.7389	235.6723	207.7872	201.7386	182.1538	180.1860	187.2293	189.1287	210.4175	223.1011	248.1853	(64)
Efficiency of water heater												79.8000	(216)
(217)m	86.4617	86.2072	85.7466	84.8154	83.1190	79.8000	79.8000	79.8000	79.8000	84.7094	86.0092	86.5229	(217)
Fuel for water heating, kWh/month	290.0917	257.2162	274.8474	244.9877	242.7106	228.2628	225.7969	234.6232	237.0034	248.3993	259.3920	286.8435	(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	30.1394	24.1789	21.7705	15.9500	12.3202	10.0657	11.2389	14.6088	18.9753	24.8967	28.1207	30.9771	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-53.3382	-74.0106	-104.7052	-115.7733	-123.1634	-114.2903	-112.7884	-107.2344	-97.2721	-83.6142	-58.1798	-46.2469	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-33.8547	-70.7581	-139.8304	-208.8951	-275.1871	-276.1988	-273.0294	-231.7112	-170.4995	-100.9120	-45.1011	-26.8138	(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	4319.1585	(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	3030.1747	(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)	243.2421	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-2943.4079	(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	4735.1673	(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	4319.1585	0.2100	907.0233	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3030.1747	0.2100	636.3367	(264)
Space and water heating			1543.3600	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	243.2421	0.1443	35.1074	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1090.6168	0.1349	-147.1756	
PV Unit electricity exported	-1852.7911	0.1260	-233.5401	
Total			-380.7157	(269)
Total CO2, kg/year			1209.6809	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			10.3000	(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	4319.1585	1.1300	4880.6491	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3030.1747	1.1300	3424.0974	(278)
Space and water heating			8304.7464	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	243.2421	1.5338	373.0929	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1090.6168	1.4988	-1634.5750	
PV Unit electricity exported	-1852.7911	0.4627	-857.2645	
Total			-2491.8394	(283)
Total Primary energy kWh/year			6316.1007	(286)
Target Primary Energy Rate (TPER)			53.7600	(287)

Building Regulations England Part L (BREL) Compliance Report

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

Date: Fri 14 Mar 2025 09:30:50

Project Information			
Assessed By	Richard Millard	Building Type	House, Detached
OCDEA Registration	EES/025661	Assessment Date	2025-03-14

Dwelling Details			
Assessment Type	As designed	Total Floor Area	130 m^2
Site Reference	D	Plot Reference	Proposed
Address	5		

Client Details	
Name	Ian White
Company	Cotswold Homes Ltd
Address	West House, Yate, Bristol, BS37 5NG

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

1a Target emission rate and dwelling emission rate		
Fuel for main heating system	Electricity	
Target carbon dioxide emission rate	*9.7 $kgCO_2/m^2$*	
Dwelling carbon dioxide emission rate	2.7 $kgCO_2/m^2$	OK
1b Target primary energy rate and dwelling primary energy		
Target primary energy	*50.71 kWh_{PE}/m^2*	
Dwelling primary energy	32.17 kWh_{PE}/m^2	OK
1c Target fabric energy efficiency and dwelling fabric energy efficiency		
Target fabric energy efficiency	*38.9 kWh/m^2*	
Dwelling fabric energy efficiency	37.6 kWh/m^2	OK

2a Fabric U-values				
Element	***Maximum permitted average U-Value [W/m^2K]***	**Dwelling average U-Value [W/m^2K]**	**Element with highest individual U-Value**	
External walls	*0.26*	0.18	Walls (1) (0.18)	OK
Party walls	*0.2*	N/A	N/A	**N/A**
Curtain walls	*1.6*	N/A	N/A	**N/A**
Floors	*0.18*	0.12	Heatloss Floor 1 (0.12)	OK
Roofs	*0.16*	0.11	Roof (1) (0.11)	OK
Windows, doors, and roof windows	*1.6*	1.2	WG01 (1.2)	OK
Rooflights	*2.2*	N/A	N/A	**N/A**

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))		
Name	**Net area [m^2]**	**U-Value [W/m^2K]**
Exposed wall: Walls (1)	141.19	0.18
Ground floor: Heatloss Floor 1, Heatloss Floor 1	65.04	0.12
Exposed roof: Roof (1)	65.04	0.11

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	**Area [m^2]**	**Orientation**	**Frame factor**	**U-Value [W/m^2K]**
WG01, Windows	2.1	North East	0.7	1.2
WG02, Windows	2.05	North East	0.7	1.2
WG03, Windows	1.64	South West	0.7	1.2
FG01, Windows	2.13	North East	0.7	1.2
FG02, Windows	0.67	North East	0.7	1.2
FG03, Windows	2.15	North East	0.7	1.2
FG04, Windows	1.44	South West	0.7	1.2
FG05, Windows	0.66	South West	0.7	1.2
FG06, Windows	1.45	South West	0.7	1.2
ED01, Doors	3.39	North East	N/A	1.2
ED02, Doors	2	South West	N/A	1.2
ED03, Glazed Doors	5.02	South West	0.7	1.2

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))				
Building part **1**: Thermal bridging calculated from linear thermal transmittances for each junction				
Main element	**Junction detail**	**Source**	**Psi value [W/mK]**	**Drawing / reference**
External wall	E1: Steel lintel with perforated steel base plate	Calculated by person with suitable expertise	0.241	EMPF125E101
External wall	E3: Sill	Calculated by person with suitable expertise	0.026 **(!)**	EMPF125E301
External wall	E4: Jamb	Calculated by person with suitable expertise	0.02 **(!)**	EMPF125E401
External wall	E5: Ground floor (normal)	Calculated by person with suitable expertise	0.045	EMPF125E504
External wall	E6: Intermediate floor within a dwelling	Calculated by person with suitable expertise	0.002 **(!)**	EMPF125E601
External wall	E10: Eaves (insulation at ceiling level)	Calculated by person with suitable expertise	0.05	EMPF125E1001
External wall	E12: Gable (insulation at ceiling level)	Calculated by person with suitable expertise	0.031 **(!)**	EMPF125E1201
External wall	E16: Corner (normal)	Calculated by person with suitable expertise	0.037 **(!)**	EMPF125E21601
External wall	E17: Corner (inverted - internal area greater than external area)	Calculated by person with suitable expertise	-0.09	EMPF125E21701

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

4 Space heating	
Main heating system 1: Heat pump with radiators or underfloor heating - Electricity	
Efficiency	241.5%
Emitter type	Radiators
Flow temperature	55°C
System type	Heat Pump
Manufacturer	Daikin Europe NV
Model	EDLA08EV3
Commissioning	
Secondary heating system: N/A	
Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water	
Cylinder/store - type: Cylinder	
Capacity	210 litres
Declared heat loss	1.7 kWh/day
Primary pipework insulated	Yes
Manufacturer	
Model	
Commissioning	
Waste water heat recovery system 1 - type: N/A	
Efficiency	
Manufacturer	
Model	

6 Controls	
Main heating 1 - type: Time and temperature zone control by arrangement of plumbing and electrical services	
Function	
Ecodesign class	
Manufacturer	
Model	
Water heating - type: Cylinder thermostat and HW separately timed	
Manufacturer	
Model	

7 Lighting		
Minimum permitted light source efficacy	*75 lm/W*	
Lowest light source efficacy	85 lm/W	**OK**
External lights control	N/A	

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

9 Local generation	
Technology type: **Photovoltaic system (1)**	
Peak power	2.01 kWp
Orientation	South East
Pitch	30°
Overshading	None or very little
Manufacturer	
MCS certificate	

10 Heat networks
N/A

11 Supporting documentary evidence
N/A

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

Full SAP Calculation Printout

Property Reference	D	**Issued on Date**	14/03/2025
Assessment Reference	Proposed	**Prop Type Ref**	Proposed 5
Property	5		

SAP Rating	86 B	**DER**	2.70	**TER**	9.70
Environmental	97 A	**% DER < TER**			72.16
CO_2 Emissions (t/year)	0.31	**DFEE**	37.61	**TFEE**	38.90
Compliance Check	See BREL	**% DFEE < TFEE**			3.32
% DPER < TPER	36.56	**DPER**	32.17	**TPER**	50.71

Assessor Details	Mr. Richard Millard	**Assessor ID**	U367-0001
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)	
Main dwelling						
Ground floor	65.0400 (1b)	x	2.4000 (2b)	=	156.0960	(1b) - (3b)
First floor	65.0400 (1c)	x	2.6000 (2c)	=	169.1040	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	130.0800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	325.2000	(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			5 * 10 =	50.0000	(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) =			50.0000 / (5) =	0.1538	(8)
Pressure test				Yes	
Pressure Test Method				Blower Door	
Measured/design AP50				5.0000	(17)
Infiltration rate				0.4038	(18)
Number of sides sheltered				3	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3129	(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	0.3990	0.3911	0.3833	0.3442	0.3364	0.2973	0.2973	0.2894	0.3129	0.3364	0.3520	0.3677	(22b)
Effective ac	0.5796	0.5765	0.5735	0.5592	0.5566	0.5442	0.5442	0.5419	0.5490	0.5566	0.5620	0.5676	(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	
Main dwelling								
Windows			14.2900	1.1450	16.3626			(27)
Glazed Doors			5.0200	1.1450	5.7481			(27)
Doors			5.3900	1.2000	6.4680			(26a)
Heatloss Floor 1			65.0400	0.1200	7.8048	75.0000	4878.0000	(28a)
Cavity Wall	165.8900	24.7000	141.1900	0.1800	25.4142	60.0000	8471.4000	(29a)
External Roof 1	65.0400		65.0400	0.1100	7.1544	9.0000	585.3600	(30)
Total net area of external elements Aum(A, m2)			295.9700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		68.9521			(33)
Main dwelling								
Internal Wall 1 - Block			51.6000			75.0000	3869.9999	(32c)
Internal Wall 2 - Stud			46.4700			9.0000	418.2300	(32c)
Internal Wall 3 - Up			206.0900			9.0000	1854.8100	(32c)
Internal Floor 1			65.0400			18.0000	1170.7200	(32d)
Internal Ceiling 1			65.0400			9.0000	585.3600	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		21833.8798	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							167.8496	(35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total

E1 Steel lintel with perforated steel base plate	17.4400	0.2410	4.2030	
E3 Sill	12.0000	0.0260	0.3120	
E4 Jamb	33.7000	0.0200	0.6740	
E5 Ground floor (normal)	33.1800	0.0450	1.4931	
E6 Intermediate floor within a dwelling	33.1800	0.0020	0.0664	
E10 Eaves (insulation at ceiling level)	16.2600	0.0500	0.8130	
E12 Gable (insulation at ceiling level)	16.9200	0.0310	0.5245	
E16 Corner (normal)	25.0000	0.0370	0.9250	
E17 Corner (inverted - internal area greater than external area)	5.0000	-0.0900	-0.4500	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 8.5610 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 77.5131 (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	62.1986	61.8669	61.5419	60.0150	59.7293	58.3995	58.3995	58.1532	58.9117	59.7293	60.3072	60.9114	(38)
Heat transfer coeff	139.7117	139.3800	139.0550	137.5281	137.2424	135.9126	135.9126	135.6663	136.4248	137.2424	137.8203	138.4245	(39)

Average = Sum(39)m / 12 = 137.5267

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0740	1.0715	1.0690	1.0573	1.0551	1.0448	1.0448	1.0429	1.0488	1.0551	1.0595	1.0641	(40)
HLP (average)												1.0572	
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 2.8952 (42)

Hot water usage for mixer showers

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
72.7628	71.6693	70.0759	67.0271	64.7773	62.2682	60.8421	62.4234	64.1569	66.8509	69.9651	72.4840	(42a)

Hot water usage for baths

31.4136	30.9471	30.2901	29.0787	28.1717	27.1659	26.6226	27.2750	27.9853	29.0616	30.2979	31.3074	(42b)

Hot water usage for other uses

44.2797	42.6695	41.0594	39.4492	37.8390	36.2289	36.2289	37.8390	39.4492	41.0594	42.6695	44.2797	(42c)

Average daily hot water use (litres/day) 136.4645 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	148.4561	145.2859	141.4253	135.5551	130.7880	125.6630	123.6936	127.5375	131.5915	136.9718	142.9325	148.0711	(44)
Energy conte	235.1181	206.8852	217.3654	185.5681	176.0658	154.5173	149.5967	157.9181	162.2654	185.8694	203.6335	231.8436	(45)
Energy content (annual)										Total = Sum(45)m =		2266.6465	
Distribution loss (46)m = 0.15 x (45)m	35.2677	31.0328	32.6048	27.8352	26.4099	23.1776	22.4395	23.6877	24.3398	27.8804	30.5450	34.7765	(46)

Water storage loss:

Store volume 210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.7000 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 0.9180 (55)

Total storage loss

28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(56)

If cylinder contains dedicated solar storage

28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(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

286.8385	253.6004	269.0858	235.6201	227.7862	204.5693	201.3171	209.6385	212.3174	237.5898	253.6855	283.5640	(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

286.8385	253.6004	269.0858	235.6201	227.7862	204.5693	201.3171	209.6385	212.3174	237.5898	253.6855	283.5640	(64)

Total per year (kWh/year) = Sum(64)m = 2875.6125 (64)

12Total per year (kWh/year) 2876 (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

119.5531	106.1615	113.6503	101.7430	99.9182	91.4186	91.1172	93.8841	93.9949	103.1779	107.7497	118.4643	(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	144.7599	144.7599	144.7599	144.7599	144.7599	144.7599	144.7599	144.7599	144.7599	144.7599	144.7599	144.7599	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	159.1391	176.1897	159.1391	164.4437	159.1391	164.4437	159.1391	159.1391	164.4437	159.1391	164.4437	159.1391	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	297.8169	300.9073	293.1196	276.5405	255.6123	235.9427	222.8022	219.7118	227.4996	244.0787	265.0069	284.6765	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.4760	37.4760	37.4760	37.4760	37.4760	37.4760	37.4760	37.4760	37.4760	37.4760	37.4760	37.4760	(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)	-115.8079	-115.8079	-115.8079	-115.8079	-115.8079	-115.8079	-115.8079	-115.8079	-115.8079	-115.8079	-115.8079	-115.8079	(71)
Water heating gains (Table 5)	160.6897	157.9784	152.7558	141.3097	134.2986	126.9703	122.4694	126.1883	130.5484	138.6800	149.6524	159.2262	(72)
Total internal gains	684.0736	701.5034	671.4425	648.7219	615.4779	593.7847	570.8386	571.4671	588.9196	608.3257	645.5310	669.4697	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	9.1000	11.2829	0.6300	0.7000	0.7700	31.3787	(75)
Southwest	5.1900	36.7938	0.6300	0.7000	0.7700	58.3599	(79)
Southwest	5.0200	36.7938	0.6300	0.7000	0.7700	56.4483	(79)

Solar gains	146.1869	259.4330	382.6523	520.5285	625.3906	639.4987	608.7918	527.7117	429.9507	294.1933	176.9962	123.8773	(83)

Total gains	830.2605	960.9364	1054.0948	1169.2504	1240.8685	1233.2834	1179.6304	1099.1788	1018.8703	902.5190	822.5272	793.3470	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	43.4106	43.5139	43.6156	44.0998	44.1916	44.6240	44.6240	44.7050	44.4565	44.1916	44.0063	43.8143	
alpha	3.8940	3.9009	3.9077	3.9400	3.9461	3.9749	3.9749	3.9803	3.9638	3.9461	3.9338	3.9210	
util living area													
	0.9884	0.9788	0.9605	0.9103	0.8089	0.6423	0.4896	0.5403	0.7658	0.9328	0.9792	0.9902	(86)
Living	19.2840	19.5203	19.8597	20.3167	20.6893	20.9112	20.9766	20.9655	20.8161	20.3326	19.7358	19.2486	
Non living	18.0159	18.3169	18.7465	19.3167	19.7511	19.9842	20.0355	20.0307	19.8983	19.3477	18.5997	17.9762	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	20.1222	19.5203	19.8597	20.3167	20.6893	20.9112	20.9766	20.9655	20.8161	20.3326	19.7358	19.4936	(87)
Th 2	20.0221	20.0242	20.0262	20.0359	20.0377	20.0461	20.0461	20.0477	20.0429	20.0377	20.0340	20.0302	(88)
util rest of house													
	0.9858	0.9740	0.9514	0.8891	0.7643	0.5659	0.3909	0.4397	0.6989	0.9125	0.9737	0.9880	(89)
MIT 2	19.2223	18.3169	18.7465	19.3167	19.7511	19.9842	20.0355	20.0307	19.8983	19.3477	18.5997	18.3464	(90)
Living area fraction										fLA = Living area / (4) =		0.1369	(91)
MIT	19.3455	18.4817	18.8989	19.4536	19.8796	20.1111	20.1643	20.1587	20.0239	19.4825	18.7553	18.5034	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.3455	18.4817	18.8989	19.4536	19.8796	20.1111	20.1643	20.1587	20.0239	19.4825	18.7553	18.5034	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9836	0.9637	0.9376	0.8736	0.7560	0.5715	0.4035	0.4520	0.6974	0.8976	0.9636	0.9832	(94)
Useful gains	816.6253	926.0808	988.3235	1021.4666	938.1422	704.8104	476.0350	496.7889	710.5419	810.0691	792.5826	780.0241	(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													
	2102.0328	1893.0147	1724.1264	1451.4219	1122.5859	749.0325	484.4388	509.9305	808.1721	1219.0598	1606.3355	1979.9470	(97)
Space heating kWh													
	956.3432	649.7796	547.4373	309.5678	137.2262	0.0000	0.0000	0.0000	0.0000	304.2891	585.9021	892.7426	(98a)
Space heating requirement - total per year (kWh/year)												4383.2880	
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													
	956.3432	649.7796	547.4373	309.5678	137.2262	0.0000	0.0000	0.0000	0.0000	304.2891	585.9021	892.7426	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4383.2880	
Space heating per m2											(98c) / (4) =	33.6969	(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 %)												241.4793	(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													
	956.3432	649.7796	547.4373	309.5678	137.2262	0.0000	0.0000	0.0000	0.0000	304.2891	585.9021	892.7426	(98)
Space heating efficiency (main heating system 1)													
	241.4793	241.4793	241.4793	241.4793	241.4793	0.0000	0.0000	0.0000	0.0000	241.4793	241.4793	241.4793	(210)
Space heating fuel (main heating system)													
	396.0353	269.0830	226.7016	128.1964	56.8273	0.0000	0.0000	0.0000	0.0000	126.0105	242.6304	369.6974	(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													
	286.8385	253.6004	269.0858	235.6201	227.7862	204.5693	201.3171	209.6385	212.3174	237.5898	253.6855	283.5640	(64)
Efficiency of water heater												166.2650	(216)
(217)m	166.2650	166.2650	166.2650	166.2650	166.2650	166.2650	166.2650	166.2650	166.2650	166.2650	166.2650	166.2650	(217)
Fuel for water heating, kWh/month													
	172.5189	152.5279	161.8416	141.7136	137.0019	123.0381	121.0821	126.0870	127.6982	142.8983	152.5791	170.5494	(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	32.3901	25.9845	23.3962	17.1411	13.2402	10.8174	12.0782	15.6997	20.3924	26.7559	30.2207	33.2903	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-35.7515	-55.4099	-87.5837	-105.2462	-116.4537	-106.1835	-104.5621	-95.9572	-80.7889	-65.1053	-40.4685	-30.1259	(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	-8.5503	-20.5369	-46.2531	-79.2141	-114.8006	-122.2950	-120.4436	-98.5882	-68.1734	-33.2886	-12.4990	-6.6529	(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												1815.1818	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												166.2650	
Water heating fuel used												1729.5361	(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)	261.4067	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-1654.9322	(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	2151.1924	(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	1815.1818	0.1554	282.1610	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1729.5361	0.1410	243.8149	(264)
Space and water heating			525.9758	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	261.4067	0.1443	37.7291	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-923.6365	0.1335	-123.3430	
PV Unit electricity exported	-731.2957	0.1222	-89.3298	
Total			-212.6728	(269)
Total CO2, kg/year			351.0321	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			2.7000	(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	1815.1818	1.5755	2859.7410	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1729.5361	1.5213	2631.0814	(278)
Space and water heating			5490.8224	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	261.4067	1.5338	400.9543	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-923.6365	1.4935	-1379.4506	
PV Unit electricity exported	-731.2957	0.4482	-327.7457	
Total			-1707.1963	(283)
Total Primary energy kWh/year			4184.5805	(286)
Dwelling Primary energy Rate (DPER)			32.1700	(287)

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Main dwelling						
Ground floor	65.0400	(1b) x	2.4000	(2b) =	156.0960	(1b) - (3b)
First floor	65.0400	(1c) x	2.6000	(2c) =	169.1040	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	130.0800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		325.2000	(5)

2. Ventilation rate

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	4 * 10 =	40.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1230	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3730	(18)
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2891	(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												
	0.3686	0.3613	0.3541	0.3180	0.3108	0.2746	0.2746	0.2674	0.2891	0.3108	0.3252	0.3397 (22b)
Effective ac	0.5679	0.5653	0.5627	0.5506	0.5483	0.5377	0.5377	0.5358	0.5418	0.5483	0.5529	0.5577 (25)

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3. Heat losses and heat loss parameter

Element	Gross	Openings	NetArea	U-value	A x U	K-value	A x K	
	m2	m2	m2	W/m2K	W/K	kJ/m2K	kJ/K	
Main dwelling								
TER Semi-glazed door			5.3900	1.0000	5.3900			(26a)
TER Opening Type			19.3100	1.1450	22.1107			(27)
Heatloss Floor 1			65.0400	0.1300	8.4552			(28a)
Cavity Wall	165.8900	24.7000	141.1900	0.1800	25.4142			(29a)
External Roof 1	65.0400		65.0400	0.1100	7.1544			(30)
Total net area of external elements Aum(A, m2)			295.9700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		68.5245			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 167.8496 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	17.4400	0.0500	0.8720
E3 Sill	12.0000	0.0500	0.6000
E4 Jamb	33.7000	0.0500	1.6850
E5 Ground floor (normal)	33.1800	0.1600	5.3088
E6 Intermediate floor within a dwelling	33.1800	0.0000	0.0000
E10 Eaves (insulation at ceiling level)	16.2600	0.0600	0.9756
E12 Gable (insulation at ceiling level)	16.9200	0.0600	1.0152
E16 Corner (normal)	25.0000	0.0900	2.2500
E17 Corner (inverted - internal area greater than external area)	5.0000	-0.0900	-0.4500

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 12.2566 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 80.7811 (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	60.9472	60.6641	60.3867	59.0836	58.8397	57.7047	57.7047	57.4946	58.1419	58.8397	59.3330	59.8486	(38)
Heat transfer coeff	141.7283	141.4452	141.1678	139.8646	139.6208	138.4858	138.4858	138.2756	138.9230	139.6208	140.1141	140.6297	(39)

Average = Sum(39)m / 12 = 139.8635

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0895	1.0874	1.0852	1.0752	1.0733	1.0646	1.0646	1.0630	1.0680	1.0733	1.0771	1.0811	(40)
HLP (average)												1.0752	
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 2.8952 (42)

Hot water usage for mixer showers

72.7628	71.6693	70.0759	67.0271	64.7773	62.2682	60.8421	62.4234	64.1569	66.8509	69.9651	72.4840	(42a)

Hot water usage for baths

31.4136	30.9471	30.2901	29.0787	28.1717	27.1659	26.6226	27.2750	27.9853	29.0616	30.2979	31.3074	(42b)

Hot water usage for other uses

44.2797	42.6695	41.0594	39.4492	37.8390	36.2289	36.2289	37.8390	39.4492	41.0594	42.6695	44.2797	(42c)

Average daily hot water use (litres/day) 136.4645 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	148.4561	145.2859	141.4253	135.5551	130.7880	125.6630	123.6936	127.5375	131.5915	136.9718	142.9325	148.0711	(44)
Energy conte	235.1181	206.8852	217.3654	185.5681	176.0658	154.5173	149.5967	157.9181	162.2654	185.8694	203.6335	231.8436	(45)
Energy content (annual)										Total = Sum(45)m =		2266.6465	
Distribution loss (46)m = 0.15 x (45)m	35.2677	31.0328	32.6048	27.8352	26.4099	23.1776	22.4395	23.6877	24.3398	27.8804	30.5450	34.7765	(46)

Water storage loss:

Store volume 210.0000 (47)

a) If manufacturer declared loss factor is known (kWh/day): 1.7016 (48)

Temperature factor from Table 2b 0.5400 (49)

Enter (49) or (54) in (55) 0.9188 (55)

Total storage loss

28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(56)

If cylinder contains dedicated solar storage

28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(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

286.8647	253.6240	269.1120	235.6455	227.8123	204.5946	201.3433	209.6646	212.3428	237.6160	253.7108	283.5901	(62)
WWHRS -33.2641	-29.4190	-30.8059	-25.5085	-23.7730	-20.3427	-19.0681	-20.2770	-21.0474	-24.8126	-28.1096	-32.6481	(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

253.6006	224.2050	238.3061	210.1369	204.0393	184.2519	182.2752	189.3877	191.2954	212.8035	225.6012	250.9420	(64)
								Total per year (kWh/year) = Sum(64)m =			2566.8448	(64)

12Total per year (kWh/year) 2567 (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

119.5741	106.1804	113.6713	101.7633	99.9391	91.4389	91.1382	93.9050	94.0151	103.1989	107.7700	118.4853	(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	144.7599	144.7599	144.7599	144.7599	144.7599	144.7599	144.7599	144.7599	144.7599	144.7599	144.7599	144.7599	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	159.1391	176.1897	159.1391	164.4437	159.1391	164.4437	159.1391	159.1391	164.4437	159.1391	164.4437	159.1391	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	297.8169	300.9073	293.1196	276.5405	255.6123	235.9427	222.8022	219.7118	227.4996	244.0787	265.0069	284.6765	(68)

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

	37.4760	37.4760	37.4760	37.4760	37.4760	37.4760	37.4760	37.4760	37.4760	37.4760	37.4760	37.4760	(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)													
	-115.8079	-115.8079	-115.8079	-115.8079	-115.8079	-115.8079	-115.8079	-115.8079	-115.8079	-115.8079	-115.8079	-115.8079	(71)
Water heating gains (Table 5)													
	160.7178	158.0066	152.7840	141.3379	134.3268	126.9984	122.4975	126.2164	130.5766	138.7081	149.6806	159.2544	(72)
Total internal gains													
	687.1018	704.5316	674.4706	651.7500	618.5061	593.8128	570.8668	571.4953	588.9478	611.3539	648.5592	672.4979	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	9.1000	11.2829	0.6300	0.7000	0.7700	31.3787	(75)
Southwest	10.2100	36.7938	0.6300	0.7000	0.7700	114.8081	(79)

Solar gains	146.1869	259.4330	382.6523	520.5285	625.3906	639.4987	608.7918	527.7117	429.9507	294.1933	176.9962	123.8773	(83)
Total gains	833.2887	963.9646	1057.1230	1172.2786	1243.8967	1233.3115	1179.6586	1099.2070	1018.8985	905.5472	825.5554	796.3752	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	42.7929	42.8786	42.9628	43.3631	43.4388	43.7949	43.7949	43.8614	43.6570	43.4388	43.2859	43.1272	
alpha	3.8529	3.8586	3.8642	3.8909	3.8959	3.9197	3.9197	3.9241	3.9105	3.8959	3.8857	3.8751	
util living area													
	0.9883	0.9788	0.9608	0.9117	0.8125	0.6497	0.4970	0.5481	0.7714	0.9336	0.9792	0.9901	(86)
MIT	19.2559	19.4919	19.8333	20.2927	20.6734	20.9033	20.9738	20.9618	20.8039	20.3117	19.7086	19.2174	(87)
Th 2	20.0094	20.0112	20.0129	20.0211	20.0227	20.0298	20.0298	20.0312	20.0271	20.0227	20.0195	20.0163	(88)
util rest of house													
	0.9857	0.9740	0.9517	0.8906	0.7678	0.5722	0.3958	0.4451	0.7042	0.9133	0.9737	0.9879	(89)
MIT 2	17.9718	18.2723	18.7042	19.2768	19.7214	19.9623	20.0180	20.0124	19.8727	19.3114	18.5556	17.9274	(90)
Living area fraction									fLA = Living area / (4) =			0.1369	(91)
MIT	18.1476	18.4393	18.8588	19.4159	19.8517	20.0912	20.1489	20.1424	20.0002	19.4483	18.7135	18.1040	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.1476	18.4393	18.8588	19.4159	19.8517	20.0912	20.1489	20.1424	20.0002	19.4483	18.7135	18.1040	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9785	0.9636	0.9377	0.8747	0.7590	0.5774	0.4087	0.4575	0.7021	0.8981	0.9634	0.9815	(94)
Useful gains	815.3321	928.8471	991.2589	1025.4372	944.0923	712.1628	482.0730	502.8759	715.4023	813.2967	795.3391	781.6605	(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													
	1962.6001	1915.0658	1744.6626	1470.8063	1138.1469	760.4486	491.4668	517.4768	819.6725	1235.4102	1627.2143	1955.3142	(97)
Space heating kWh													
	853.5674	662.7390	560.5324	320.6657	144.3766	0.0000	0.0000	0.0000	0.0000	314.0525	598.9501	873.1984	(98a)
Space heating requirement - total per year (kWh/year)												4328.0820	
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													
	853.5674	662.7390	560.5324	320.6657	144.3766	0.0000	0.0000	0.0000	0.0000	314.0525	598.9501	873.1984	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4328.0820	
Space heating per m2											(98c) / (4) =	33.2725	(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													
	853.5674	662.7390	560.5324	320.6657	144.3766	0.0000	0.0000	0.0000	0.0000	314.0525	598.9501	873.1984	(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)													
	924.7751	718.0270	607.2941	347.4168	156.4211	0.0000	0.0000	0.0000	0.0000	340.2519	648.9167	946.0437	(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													
	253.6006	224.2050	238.3061	210.1369	204.0393	184.2519	182.2752	189.3877	191.2954	212.8035	225.6012	250.9420	(64)
Efficiency of water heater												79.8000	(216)
(217)m	86.5638	86.3385	85.9096	85.0047	83.2984	79.8000	79.8000	79.8000	79.8000	84.9311	86.1419	86.6192	(217)
Fuel for water heating, kWh/month													
	292.9639	259.6812	277.3917	247.2064	244.9500	230.8921	228.4150	237.3279	239.7185	250.5603	261.8950	289.7070	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	33.0660	26.5267	23.8844	17.4987	13.5165	11.0431	12.3302	16.0273	20.8179	27.3142	30.8513	33.9850	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-57.7621	-79.8906	-112.6457	-124.1021	-131.6269	-121.9834	-120.3754	-114.6506	-104.3099	-90.0531	-62.9124	-50.1132	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)

Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-37.4693	-78.2246	-154.4340	-230.4980	-303.4481	-304.5055	-301.0115	-255.5428	-188.1479	-111.4849	-49.8902	-29.6831	(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	4689.1463	(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	3060.7090	(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)	266.8612	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-3214.7650	(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	4887.9515	(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	4689.1463	0.2100	984.7207	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3060.7090	0.2100	642.7489	(264)
Space and water heating			1627.4696	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	266.8612	0.1443	38.5163	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1170.4253	0.1350	-158.0356	
PV Unit electricity exported	-2044.3397	0.1261	-257.7399	
Total			-415.7755	(269)
Total CO2, kg/year			1262.1397	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			9.7000	(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	4689.1463	1.1300	5298.7353	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3060.7090	1.1300	3458.6011	(278)
Space and water heating			8757.3365	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	266.8612	1.5338	409.3207	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1170.4253	1.4991	-1754.5270	
PV Unit electricity exported	-2044.3397	0.4628	-946.0980	
Total			-2700.6250	(283)
Total Primary energy kWh/year			6596.1329	(286)
Target Primary Energy Rate (TPER)			50.7100	(287)

Building Regulations England Part L (BREL) Compliance Report

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

Date: Fri 14 Mar 2025 09:30:53

Project Information			
Assessed By	Richard Millard	Building Type	House, Detached
OCDEA Registration	EES/025661	Assessment Date	2025-03-14

Dwelling Details			
Assessment Type	As designed	Total Floor Area	130 m^2
Site Reference	D	Plot Reference	Regulated (Baseline)
Address	5		

Client Details	
Name	Ian White
Company	Cotswold Homes Ltd
Address	West House, Yate, Bristol, BS37 5NG

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

1a Target emission rate and dwelling emission rate		
Fuel for main heating system	Mains gas	
Target carbon dioxide emission rate	*9.69 $kgCO_2/m^2$*	
Dwelling carbon dioxide emission rate	13.86 $kgCO_2/m^2$	**FAIL**
1b Target primary energy rate and dwelling primary energy		
Target primary energy	*50.63 kWh_{PE}/m^2*	
Dwelling primary energy	76.62 kWh_{PE}/m^2	**FAIL**
1c Target fabric energy efficiency and dwelling fabric energy efficiency		
Target fabric energy efficiency	*38.9 kWh/m^2*	
Dwelling fabric energy efficiency	39.0 kWh/m^2	**FAIL**

2a Fabric U-values				
Element	***Maximum permitted average U-Value [W/m^2K]***	**Dwelling average U-Value [W/m^2K]**	**Element with highest individual U-Value**	
External walls	*0.26*	0.18	Walls (1) (0.18)	**OK**
Party walls	*0.2*	N/A	N/A	**N/A**
Curtain walls	*1.6*	N/A	N/A	**N/A**
Floors	*0.18*	0.13	Heatloss Floor 1 (0.13)	**OK**
Roofs	*0.16*	0.11	Roof (1) (0.11)	**OK**
Windows, doors, and roof windows	*1.6*	1.2	WG01 (1.2)	**OK**
Rooflights	*2.2*	N/A	N/A	**N/A**

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))		
Name	**Net area [m^2]**	**U-Value [W/m^2K]**
Exposed wall: Walls (1)	141.19	0.18
Ground floor: Heatloss Floor 1, Heatloss Floor 1	65.04	0.13
Exposed roof: Roof (1)	65.04	0.11

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	**Area [m^2]**	**Orientation**	**Frame factor**	**U-Value [W/m^2K]**
WG01, Windows	2.1	North East	0.7	1.2
WG02, Windows	2.05	North East	0.7	1.2
WG03, Windows	1.64	South West	0.7	1.2
FG01, Windows	2.13	North East	0.7	1.2
FG02, Windows	0.67	North East	0.7	1.2
FG03, Windows	2.15	North East	0.7	1.2
FG04, Windows	1.44	South West	0.7	1.2
FG05, Windows	0.66	South West	0.7	1.2
FG06, Windows	1.45	South West	0.7	1.2
ED01, Doors	3.39	North East	N/A	1.2
ED02, Doors	2	South West	N/A	1.2
ED03, Glazed Doors	5.02	South West	0.7	1.2

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))				
Building part **1**: Thermal bridging calculated from linear thermal transmittances for each junction				
Main element	**Junction detail**	**Source**	**Psi value [W/mK]**	**Drawing / reference**
External wall	E2: Other lintels (including other steel lintels)	Calculated by person with suitable expertise	0.05	mpf125e2-04
External wall	E3: Sill	Calculated by person with suitable expertise	0.05	mpf125e3-01
External wall	E4: Jamb	Calculated by person with suitable expertise	0.022 **(!)**	mpf125e4-01
External wall	E5: Ground floor (normal)	Calculated by person with suitable expertise	0.16	mpf125e5-04
External wall	E6: Intermediate floor within a dwelling	Calculated by person with suitable expertise	0.003 **(!)**	mpf125e6-01
External wall	E10: Eaves (insulation at ceiling level)	Calculated by person with suitable expertise	0.06	mpf125e10-01
External wall	E12: Gable (insulation at ceiling level)	Calculated by person with suitable expertise	0.06	mpf125e12-01
External wall	E16: Corner (normal)	Calculated by person with suitable expertise	0.09	mpf125e16-01
External wall	E17: Corner (inverted - internal area greater than external area)	Calculated by person with suitable expertise	-0.085	mpf125e17-01

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

4 Space heating	
Main heating system 1: Boiler with radiators or underfloor heating - Mains gas	
Efficiency	88.6%
Emitter type	Radiators
Flow temperature	45°C
System type	Regular boiler
Manufacturer	Bosch Thermotechnology
Model	Greenstar 8000 Life
Commissioning	
Secondary heating system: N/A	
Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water	
Cylinder/store - type: Cylinder	
Capacity	200 litres
Declared heat loss	2.09 kWh/day
Primary pipework insulated	Yes
Manufacturer	
Model	
Commissioning	
Waste water heat recovery system 1 - type: N/A	
Efficiency	
Manufacturer	
Model	

6 Controls	
Main heating 1 - type: Time and temperature zone control by arrangement of plumbing and electrical services	
Function	
Ecodesign class	
Manufacturer	
Model	
Water heating - type: Cylinder thermostat and HW separately timed	
Manufacturer	
Model	

7 Lighting		
Minimum permitted light source efficacy	*75 lm/W*	
Lowest light source efficacy	85 lm/W	**OK**
External lights control	N/A	

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

9 Local generation
N/A

10 Heat networks
N/A

11 Supporting documentary evidence
N/A

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

Full SAP Calculation Printout

Property Reference	D	**Issued on Date**	14/03/2025
Assessment Reference	Regulated (Baseline)	**Prop Type Ref**	Proposed 5
Property	5		

SAP Rating	85 B	**DER**	13.86	**TER**	9.69
Environmental	87 B	**% DER < TER**			-43.03
CO_2 Emissions (t/year)	1.69	**DFEE**	39.00	**TFEE**	38.90
Compliance Check	See BREL	**% DFEE < TFEE**			-0.26
% DPER < TPER	-51.33	**DPER**	76.62	**TPER**	50.63

Assessor Details	Mr. Richard Millard	**Assessor ID**	U367-0001
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)	
Main dwelling						
Ground floor	65.0400 (1b)	x	2.4000 (2b)	=	156.0960	(1b) - (3b)
First floor	65.0400 (1c)	x	2.6000 (2c)	=	169.1040	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	130.0800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	325.2000	(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	5 * 10 =	50.0000	(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) =	50.0000 / (5) =	0.1538	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.4038	(18)
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3129	(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	0.3990	0.3911	0.3833	0.3442	0.3364	0.2973	0.2973	0.2894	0.3129	0.3364	0.3520	0.3677	(22b)
Effective ac	0.5796	0.5765	0.5735	0.5592	0.5566	0.5442	0.5442	0.5419	0.5490	0.5566	0.5620	0.5676	(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	
Main dwelling								
Windows			14.2900	1.1450	16.3626			(27)
Glazed Doors			5.0200	1.1450	5.7481			(27)
Doors			5.3900	1.2000	6.4680			(26a)
Heatloss Floor 1			65.0400	0.1300	8.4552	75.0000	4878.0000	(28a)
Cavity Wall	165.8900	24.7000	141.1900	0.1800	25.4142	60.0000	8471.4000	(29a)
External Roof 1	65.0400		65.0400	0.1100	7.1544	9.0000	585.3600	(30)
Total net area of external elements Aum(A, m2)			295.9700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		69.6025			(33)
Main dwelling								
Internal Wall 1 - Block			51.6000			75.0000	3870.0000	(32c)
Internal Wall 2 - Stud			46.4700			9.0000	418.2300	(32c)
Internal Wall 3 - Up			206.0900			9.0000	1854.8100	(32c)
Internal Floor 1			65.0400			18.0000	1170.7200	(32d)
Internal Ceiling 1			65.0400			9.0000	585.3600	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		21833.8800	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							167.8496	(35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total

E2 Other lintels (including other steel lintels)	17.4400	0.0500	0.8720	
E3 Sill	12.0000	0.0500	0.6000	
E4 Jamb	33.7000	0.0220	0.7414	
E5 Ground floor (normal)	33.1800	0.1600	5.3088	
E6 Intermediate floor within a dwelling	33.1800	0.0030	0.0995	
E10 Eaves (insulation at ceiling level)	16.2600	0.0600	0.9756	
E12 Gable (insulation at ceiling level)	16.9200	0.0600	1.0152	
E16 Corner (normal)	25.0000	0.0900	2.2500	
E17 Corner (inverted - internal area greater than external area)	5.0000	-0.0850	-0.4250	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 11.4375 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 81.0400 (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	62.1986	61.8669	61.5419	60.0150	59.7293	58.3995	58.3995	58.1532	58.9117	59.7293	60.3072	60.9114	(38)
Heat transfer coeff	143.2386	142.9070	142.5819	141.0550	140.7693	139.4395	139.4395	139.1932	139.9517	140.7693	141.3473	141.9514	(39)

Average = Sum(39)m / 12 = 141.0537

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1012	1.0986	1.0961	1.0844	1.0822	1.0720	1.0720	1.0701	1.0759	1.0822	1.0866	1.0913	(40)
HLP (average)												1.0844	
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 2.8952 (42)

Hot water usage for mixer showers

72.7628	71.6693	70.0759	67.0271	64.7773	62.2682	60.8421	62.4234	64.1569	66.8509	69.9651	72.4840	(42a)

Hot water usage for baths

31.4136	30.9471	30.2901	29.0787	28.1717	27.1659	26.6226	27.2750	27.9853	29.0616	30.2979	31.3074	(42b)

Hot water usage for other uses

44.2797	42.6695	41.0594	39.4492	37.8390	36.2289	36.2289	37.8390	39.4492	41.0594	42.6695	44.2797	(42c)

Average daily hot water use (litres/day) 136.4645 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	148.4561	145.2859	141.4253	135.5551	130.7880	125.6630	123.6936	127.5375	131.5915	136.9718	142.9325	148.0711	(44)
Energy conte	235.1181	206.8852	217.3654	185.5681	176.0658	154.5173	149.5967	157.9181	162.2654	185.8694	203.6335	231.8435	(45)
Energy content (annual)										Total = Sum(45)m =		2266.6465	
Distribution loss (46)m = 0.15 x (45)m	35.2677	31.0328	32.6048	27.8352	26.4099	23.1776	22.4395	23.6877	24.3398	27.8804	30.5450	34.7765	(46)

Water storage loss:

Store volume 200.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 2.0900 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 1.1286 (55)

Total storage loss

34.9866	31.6008	34.9866	33.8580	34.9866	33.8580	34.9866	34.9866	33.8580	34.9866	33.8580	34.9866	(56)

If cylinder contains dedicated solar storage

34.9866	31.6008	34.9866	33.8580	34.9866	33.8580	34.9866	34.9866	33.8580	34.9866	33.8580	34.9866	(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

293.3671	259.4972	275.6144	241.9381	234.3148	210.8873	207.8457	216.1671	218.6354	244.1184	260.0035	290.0925	(62)
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
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

293.3671	259.4972	275.6144	241.9381	234.3148	210.8873	207.8457	216.1671	218.6354	244.1184	260.0035	290.0925	(64)

Total per year (kWh/year) = Sum(64)m = 2952.4815 (64)

12Total per year (kWh/year) 2952 (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

124.7760	110.8789	118.8732	106.7974	105.1411	96.4730	96.3401	99.1070	99.0493	108.4008	112.8041	123.6872	(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	144.7599	144.7599	144.7599	144.7599	144.7599	144.7599	144.7599	144.7599	144.7599	144.7599	144.7599	144.7599	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	159.1391	176.1897	159.1391	164.4437	159.1391	164.4437	159.1391	159.1391	164.4437	159.1391	164.4437	159.1391	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	297.8169	300.9073	293.1196	276.5405	255.6123	235.9427	222.8022	219.7118	227.4996	244.0787	265.0069	284.6765	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.4760	37.4760	37.4760	37.4760	37.4760	37.4760	37.4760	37.4760	37.4760	37.4760	37.4760	37.4760	(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)	-115.8079	-115.8079	-115.8079	-115.8079	-115.8079	-115.8079	-115.8079	-115.8079	-115.8079	-115.8079	-115.8079	-115.8079	(71)
Water heating gains (Table 5)	167.7097	164.9984	159.7758	148.3297	141.3186	133.9903	129.4894	133.2083	137.5684	145.7000	156.6724	166.2462	(72)
Total internal gains	694.0936	711.5234	681.4625	658.7419	625.4979	600.8047	577.8586	578.4871	595.9396	618.3457	655.5510	679.4897	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	9.1000	11.2829	0.6300	0.7000	0.7700	31.3787	(75)
Southwest	5.1900	36.7938	0.6300	0.7000	0.7700	58.3599	(79)
Southwest	5.0200	36.7938	0.6300	0.7000	0.7700	56.4483	(79)

Solar gains	146.1869	259.4330	382.6523	520.5285	625.3906	639.4987	608.7918	527.7117	429.9507	294.1933	176.9962	123.8773	(83)

Total gains	840.2805	970.9564	1064.1148	1179.2704	1250.8885	1240.3034	1186.6504	1106.1988	1025.8903	912.5390	832.5472	803.3670	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	42.3417	42.4400	42.5367	42.9972	43.0844	43.4953	43.4953	43.5723	43.3361	43.0844	42.9083	42.7256	
alpha	3.8228	3.8293	3.8358	3.8665	3.8723	3.8997	3.8997	3.9048	3.8891	3.8723	3.8606	3.8484	
util living area													
	0.9880	0.9784	0.9604	0.9113	0.8124	0.6497	0.4972	0.5479	0.7707	0.9329	0.9787	0.9899	(86)
MIT	19.2401	19.4769	19.8205	20.2848	20.6684	20.9017	20.9733	20.9611	20.8016	20.3063	19.6996	19.2044	(87)
Th 2	19.9999	20.0020	20.0040	20.0136	20.0154	20.0238	20.0238	20.0254	20.0206	20.0154	20.0118	20.0080	(88)
util rest of house													
	0.9853	0.9736	0.9512	0.8901	0.7676	0.5718	0.3953	0.4444	0.7032	0.9124	0.9731	0.9876	(89)
MIT 2	17.9454	18.2472	18.6819	19.2615	19.7098	19.9553	20.0117	20.0063	19.8647	19.2994	18.5390	17.9054	(90)
Living area fraction										fLA = Living area / (4) =		0.1369	(91)
MIT	18.1227	18.4155	18.8378	19.4016	19.8410	20.0849	20.1434	20.1370	19.9929	19.4373	18.6979	18.0832	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9727	18.2655	18.6878	19.2516	19.6910	19.9349	19.9934	19.9870	19.8429	19.2873	18.5479	17.9332	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9771	0.9617	0.9348	0.8697	0.7506	0.5642	0.3920	0.4400	0.6892	0.8925	0.9611	0.9803	(94)
Useful gains	821.0677	933.7586	994.7802	1025.6442	938.9054	699.7306	465.1966	486.7735	707.0392	814.4338	800.1922	787.5711	(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													
	1958.4532	1910.0293	1737.7589	1460.1469	1124.8893	743.8908	473.1718	499.2896	803.7333	1222.9041	1618.1316	1949.4523	(97)
Space heating kWh													
	846.2148	656.0540	552.7761	312.8419	138.3720	0.0000	0.0000	0.0000	0.0000	303.9019	588.9163	864.4396	(98a)
Space heating requirement - total per year (kWh/year)												4263.5166	
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													
	846.2148	656.0540	552.7761	312.8419	138.3720	0.0000	0.0000	0.0000	0.0000	303.9019	588.9163	864.4396	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4263.5166	
Space heating per m2											(98c) / (4) =	32.7761	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												88.6000	(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													
	846.2148	656.0540	552.7761	312.8419	138.3720	0.0000	0.0000	0.0000	0.0000	303.9019	588.9163	864.4396	(98)
Space heating efficiency (main heating system 1)													
	88.6000	88.6000	88.6000	88.6000	88.6000	0.0000	0.0000	0.0000	0.0000	88.6000	88.6000	88.6000	(210)
Space heating fuel (main heating system)													
	955.0957	740.4672	623.9008	353.0947	156.1761	0.0000	0.0000	0.0000	0.0000	343.0044	664.6911	975.6654	(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													
	293.3671	259.4972	275.6144	241.9381	234.3148	210.8873	207.8457	216.1671	218.6354	244.1184	260.0035	290.0925	(64)
Efficiency of water heater												79.6000	(216)
(217)m	86.0941	85.8489	85.3879	84.4366	82.7198	79.6000	79.6000	79.6000	79.6000	84.3516	85.6345	86.1525	(217)
Fuel for water heating, kWh/month													
	340.7518	302.2721	322.7794	286.5321	283.2633	264.9338	261.1126	271.5667	274.6676	289.4058	303.6199	336.7199	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	32.3901	25.9845	23.3962	17.1411	13.2402	10.8174	12.0782	15.6997	20.3924	26.7559	30.2207	33.2903	(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												4812.0955	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												79.6000	
Water heating fuel used												3537.6252	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
central heating pump												41.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												86.0000	(231)

Electricity for lighting (calculated in Appendix L)	261.4067	(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	8697.1273	(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	4812.0955	0.2100	1010.5400	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3537.6252	0.2100	742.9013	(264)
Space and water heating			1753.4413	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	261.4067	0.1443	37.7291	(268)
Total CO2, kg/year			1803.0997	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			13.8600	(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	4812.0955	1.1300	5437.6679	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3537.6252	1.1300	3997.5164	(278)
Space and water heating			9435.1843	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	261.4067	1.5338	400.9543	(282)
Total Primary energy kWh/year			9966.2395	(286)
Dwelling Primary energy Rate (DPER)			76.6200	(287)

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Main dwelling						
Ground floor	65.0400	(1b) x	2.4000	(2b) =	156.0960	(1b) - (3b)
First floor	65.0400	(1c) x	2.6000	(2c) =	169.1040	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 130.0800						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		325.2000	(5)

2. Ventilation rate

	m3 per hour		
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	4 * 10 =	40.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1230	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3730	(18)
Number of sides sheltered		3	(19)
Shelter factor (20) = 1 - [0.075 x (19)] =		0.7750	(20)
Infiltration rate adjusted to include shelter factor (21) = (18) x (20) =		0.2891	(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	0.3686	0.3613	0.3541	0.3180	0.3108	0.2746	0.2746	0.2674	0.2891	0.3108	0.3252	0.3397	(22b)
Effective ac	0.5679	0.5653	0.5627	0.5506	0.5483	0.5377	0.5377	0.5358	0.5418	0.5483	0.5529	0.5577	(25)

3. Heat losses and heat loss parameter

Element	Gross	Openings	NetArea	U-value	A x U	K-value	A x K

Main dwelling	m2	m2	m2	W/m2K	W/K	kJ/m2K	kJ/K	
TER Semi-glazed door			5.3900	1.0000	5.3900			(26a)
TER Opening Type			19.3100	1.1450	22.1107			(27)
Heatloss Floor 1			65.0400	0.1300	8.4552			(28a)
Cavity Wall	165.8900	24.7000	141.1900	0.1800	25.4142			(29a)
External Roof 1	65.0400		65.0400	0.1100	7.1544			(30)
Total net area of external elements Aum(A, m2)			295.9700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		68.5245			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 167.8496 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	17.4400	0.0500	0.8720
E3 Sill	12.0000	0.0500	0.6000
E4 Jamb	33.7000	0.0500	1.6850
E5 Ground floor (normal)	33.1800	0.1600	5.3088
E6 Intermediate floor within a dwelling	33.1800	0.0000	0.0000
E10 Eaves (insulation at ceiling level)	16.2600	0.0600	0.9756
E12 Gable (insulation at ceiling level)	16.9200	0.0600	1.0152
E16 Corner (normal)	25.0000	0.0900	2.2500
E17 Corner (inverted - internal area greater than external area)	5.0000	-0.0900	-0.4500

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 12.2566 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 80.7811 (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	60.9472	60.6641	60.3867	59.0836	58.8397	57.7047	57.7047	57.4946	58.1419	58.8397	59.3330	59.8486	(38)
Heat transfer coeff	141.7283	141.4452	141.1678	139.8646	139.6208	138.4858	138.4858	138.2756	138.9230	139.6208	140.1141	140.6297	(39)
Average = Sum(39)m / 12 =												139.8635	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0895	1.0874	1.0852	1.0752	1.0733	1.0646	1.0646	1.0630	1.0680	1.0733	1.0771	1.0811	(40)
HLP (average)												1.0752	
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 2.8952 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	72.7628	71.6693	70.0759	67.0271	64.7773	62.2682	60.8421	62.4234	64.1569	66.8509	69.9651	72.4840	(42a)
Hot water usage for baths	31.4136	30.9471	30.2901	29.0787	28.1717	27.1659	26.6226	27.2750	27.9853	29.0616	30.2979	31.3074	(42b)
Hot water usage for other uses	44.2797	42.6695	41.0594	39.4492	37.8390	36.2289	36.2289	37.8390	39.4492	41.0594	42.6695	44.2797	(42c)
Average daily hot water use (litres/day)												136.4645	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	148.4561	145.2859	141.4253	135.5551	130.7880	125.6630	123.6936	127.5375	131.5915	136.9718	142.9325	148.0711	(44)
Energy conte	235.1181	206.8852	217.3654	185.5681	176.0658	154.5173	149.5967	157.9181	162.2654	185.8694	203.6335	231.8435	(45)
Energy content (annual)										Total = Sum(45)m =		2266.6465	
Distribution loss (46)m = 0.15 x (45)m	35.2677	31.0328	32.6048	27.8352	26.4099	23.1776	22.4395	23.6877	24.3398	27.8804	30.5450	34.7765	(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)
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	286.0442	252.8829	268.2915	234.8514	226.9918	203.8006	200.5227	208.8441	211.5487	236.7955	252.9168	282.7696	(62)
WWHRS	-33.2641	-29.4190	-30.8059	-25.5085	-23.7730	-20.3427	-19.0681	-20.2770	-21.0474	-24.8126	-28.1096	-32.6481	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	252.7801	223.4639	237.4856	209.3429	203.2188	183.4579	181.4547	188.5671	190.5013	211.9829	224.8072	250.1215	(64)
										Total per year (kWh/year) = Sum(64)m =		2557.1839	(64)
12Total per year (kWh/year)												2557	(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	118.9176	105.5875	113.0149	101.1280	99.2827	90.8036	90.4817	93.2486	93.3799	102.5424	107.1348	117.8288	(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	144.7599	144.7599	144.7599	144.7599	144.7599	144.7599	144.7599	144.7599	144.7599	144.7599	144.7599	144.7599	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	159.1391	176.1897	159.1391	164.4437	159.1391	164.4437	159.1391	159.1391	164.4437	159.1391	164.4437	159.1391	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	297.8169	300.9073	293.1196	276.5405	255.6123	235.9427	222.8022	219.7118	227.4996	244.0787	265.0069	284.6765	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.4760	37.4760	37.4760	37.4760	37.4760	37.4760	37.4760	37.4760	37.4760	37.4760	37.4760	37.4760	(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)	-115.8079	-115.8079	-115.8079	-115.8079	-115.8079	-115.8079	-115.8079	-115.8079	-115.8079	-115.8079	-115.8079	-115.8079	(71)
Water heating gains (Table 5)	159.8355	157.1243	151.9017	140.4556	133.4445	126.1162	121.6153	125.3342	129.6943	137.8259	148.7983	158.3721	(72)
Total internal gains	686.2195	703.6493	673.5884	650.8677	617.6238	592.9305	569.9845	570.6130	588.0655	610.4716	647.6769	671.6156	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	9.1000	11.2829	0.6300	0.7000	0.7700	31.3787	(75)
Southwest	10.2100	36.7938	0.6300	0.7000	0.7700	114.8081	(79)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	146.1869	259.4330	382.6523	520.5285	625.3906	639.4987	608.7918	527.7117	429.9507	294.1933	176.9962	123.8773	(83)
Total gains	832.4064	963.0823	1056.2407	1171.3963	1243.0144	1232.4293	1178.7763	1098.3247	1018.0162	904.6649	824.6731	795.4929	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	42.7929	42.8786	42.9628	43.3631	43.4388	43.7949	43.7949	43.8614	43.6570	43.4388	43.2859	43.1272	
alpha	3.8529	3.8586	3.8642	3.8909	3.8959	3.9197	3.9197	3.9241	3.9105	3.8959	3.8857	3.8751	
util living area	0.9884	0.9788	0.9609	0.9119	0.8127	0.6500	0.4974	0.5485	0.7717	0.9338	0.9792	0.9902	(86)
MIT	19.2550	19.4910	19.8325	20.2921	20.6730	20.9031	20.9738	20.9617	20.8035	20.3109	19.7076	19.2165	(87)
Th 2	20.0094	20.0112	20.0129	20.0211	20.0227	20.0298	20.0298	20.0312	20.0271	20.0227	20.0195	20.0163	(88)
util rest of house	0.9857	0.9741	0.9518	0.8908	0.7681	0.5725	0.3960	0.4454	0.7046	0.9136	0.9738	0.9880	(89)
MIT 2	17.9706	18.2712	18.7032	19.2760	19.7209	19.9622	20.0180	20.0123	19.8724	19.3105	18.5545	17.9261	(90)
Living area fraction									fLA = Living area / (4) =			0.1369	(91)
MIT	18.1465	18.4382	18.8578	19.4151	19.8513	20.0910	20.1488	20.1423	19.9999	19.4475	18.7124	18.1028	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.1465	18.4382	18.8578	19.4151	19.8513	20.0910	20.1488	20.1423	19.9999	19.4475	18.7124	18.1028	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9785	0.9637	0.9378	0.8749	0.7593	0.5778	0.4089	0.4578	0.7025	0.8984	0.9635	0.9816	(94)
Useful gains	814.5245	928.0853	990.5698	1024.9013	943.7717	712.0506	482.0457	502.8323	715.1629	812.7078	794.5783	780.8433	(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	1962.4348	1914.9087	1744.5198	1470.6970	1138.0850	760.4289	491.4621	517.4694	819.6280	1235.2896	1627.0585	1955.1483	(97)
Space heating kWh	854.0452	663.1453	560.9388	320.9729	144.5692	0.0000	0.0000	0.0000	0.0000	314.4009	599.3857	873.6829	(98a)
Space heating requirement - total per year (kWh/year)												4331.1408	
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	854.0452	663.1453	560.9388	320.9729	144.5692	0.0000	0.0000	0.0000	0.0000	314.4009	599.3857	873.6829	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4331.1408	
Space heating per m2											(98c) / (4) =	33.2960	(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	854.0452	663.1453	560.9388	320.9729	144.5692	0.0000	0.0000	0.0000	0.0000	314.4009	599.3857	873.6829	(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)	925.2928	718.4673	607.7343	347.7496	156.6296	0.0000	0.0000	0.0000	0.0000	340.6293	649.3886	946.5687	(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	252.7801	223.4639	237.4856	209.3429	203.2188	183.4579	181.4547	188.5671	190.5013	211.9829	224.8072	250.1215	(64)
Efficiency of water heater												79.8000	(216)
(217)m	86.5702	86.3455	85.9178	85.0151	83.3098	79.8000	79.8000	79.8000	79.8000	84.9420	86.1498	86.6256	(217)
Fuel for water heating, kWh/month	291.9945	258.8018	276.4103	246.2421	243.9313	229.8971	227.3868	236.2997	238.7235	249.5619	260.9491	288.7387	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	33.0660	26.5267	23.8844	17.4987	13.5165	11.0431	12.3302	16.0273	20.8179	27.3142	30.8513	33.9850	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-57.7621	-79.8906	-112.6457	-124.1021	-131.6269	-121.9834	-120.3754	-114.6506	-104.3099	-90.0531	-62.9124	-50.1132	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-37.4693	-78.2246	-154.4340	-230.4980	-303.4481	-304.5055	-301.0115	-255.5428	-188.1479	-111.4849	-49.8902	-29.6831	(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	4692.4602	(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	3048.9368	(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)	266.8612	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-3214.7650	(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	4879.4933	(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	4692.4602	0.2100	985.4167	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3048.9368	0.2100	640.2767	(264)
Space and water heating			1625.6934	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	266.8612	0.1443	38.5163	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1170.4253	0.1350	-158.0356	
PV Unit electricity exported	-2044.3397	0.1261	-257.7399	
Total			-415.7755	(269)
Total CO2, kg/year			1260.3634	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			9.6900	(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	4692.4602	1.1300	5302.4801	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3048.9368	1.1300	3445.2985	(278)
Space and water heating			8747.7786	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	266.8612	1.5338	409.3207	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1170.4253	1.4991	-1754.5270	
PV Unit electricity exported	-2044.3397	0.4628	-946.0980	
Total			-2700.6250	(283)
Total Primary energy kWh/year			6586.5751	(286)
Target Primary Energy Rate (TPER)			50.6300	(287)

Building Regulations England Part L (BREL) Compliance Report

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

Date: Fri 14 Mar 2025 09:30:52

Project Information			
Assessed By	Richard Millard	Building Type	House, Detached
OCDEA Registration	EES/025661	Assessment Date	2025-03-14

Dwelling Details			
Assessment Type	As designed	Total Floor Area	132 m^2
Site Reference	D+	Plot Reference	Proposed
Address	25		

Client Details	
Name	Ian White
Company	Cotswold Homes Ltd
Address	West House, Yate, Bristol, BS37 5NG

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

1a Target emission rate and dwelling emission rate		
Fuel for main heating system	Electricity	
Target carbon dioxide emission rate	*10.01 $kgCO_2/m^2$*	
Dwelling carbon dioxide emission rate	2.81 $kgCO_2/m^2$	**OK**
1b Target primary energy rate and dwelling primary energy		
Target primary energy	*52.36 kWh_{PE}/m^2*	
Dwelling primary energy	33.2 kWh_{PE}/m^2	**OK**
1c Target fabric energy efficiency and dwelling fabric energy efficiency		
Target fabric energy efficiency	*41.2 kWh/m^2*	
Dwelling fabric energy efficiency	39.8 kWh/m^2	**OK**

2a Fabric U-values				
Element	***Maximum permitted average U-Value [W/m^2K]***	**Dwelling average U-Value [W/m^2K]**	**Element with highest individual U-Value**	
External walls	*0.26*	0.18	Walls (1) (0.18)	**OK**
Party walls	*0.2*	N/A	N/A	**N/A**
Curtain walls	*1.6*	N/A	N/A	**N/A**
Floors	*0.18*	0.12	Heatloss Floor 1 (0.12)	**OK**
Roofs	*0.16*	0.11	Roof (2) (0.13)	**OK**
Windows, doors, and roof windows	*1.6*	1.2	WG01 (1.2)	**OK**
Rooflights	*2.2*	N/A	N/A	**N/A**

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))		
Name	**Net area [m^2]**	**U-Value [W/m^2K]**
Exposed wall: Walls (1)	140.15	0.18
Ground floor: Heatloss Floor 1, Heatloss Floor 1	66.66	0.12
Exposed roof: Roof (1)	65.04	0.11
Exposed roof: Roof (2)	1.62	0.13

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	**Area [m^2]**	**Orientation**	**Frame factor**	**U-Value [W/m^2K]**
WG01, Windows	2.1	South East	0.7	1.2
WG02, Windows	2.05	South East	0.7	1.2
WG03, Windows	1.64	North West	0.7	1.2
FG01, Windows	2.13	South East	0.7	1.2
FG02, Windows	0.67	South East	0.7	1.2
FG03, Windows	2.15	South East	0.7	1.2
FG04, Windows	1.44	North West	0.7	1.2
FG05, Windows	0.66	North West	0.7	1.2
FG06, Windows	1.45	North West	0.7	1.2
ED01, Doors	3.39	South East	N/A	1.2
ED02, Doors	2	North West	N/A	1.2
ED03, Glazed Doors	5.02	North West	0.7	1.2
WG04, Windows	1.33	South East	0.7	1.2

Name	Area [m^2]	Orientation	Frame factor	U-Value [W/m^2K]
WG05, Windows	2.62	North East	0.7	1.2
WG06, Windows	1.33	North West	0.7	1.2

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))

Building part **1**: Thermal bridging calculated from linear thermal transmittances for each junction

Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E1: Steel lintel with perforated steel base plate	Calculated by person with suitable expertise	0.241	EMPF125E101
External wall	E3: Sill	Calculated by person with suitable expertise	0.026 **(!)**	EMPF125E301
External wall	E4: Jamb	Calculated by person with suitable expertise	0.02 **(!)**	EMPF125E401
External wall	E5: Ground floor (normal)	Calculated by person with suitable expertise	0.045	EMPF125E504
External wall	E6: Intermediate floor within a dwelling	Calculated by person with suitable expertise	0.002 **(!)**	EMPF125E601
External wall	E10: Eaves (insulation at ceiling level)	Calculated by person with suitable expertise	0.05	EMPF125E1001
External wall	E12: Gable (insulation at ceiling level)	Calculated by person with suitable expertise	0.031 **(!)**	EMPF125E1201
External wall	E16: Corner (normal)	Calculated by person with suitable expertise	0.037 **(!)**	EMPF125E21601
External wall	E17: Corner (inverted - internal area greater than external area)	Calculated by person with suitable expertise	-0.09	EMPF125E21701

3 Air permeability (better than typically expected values are flagged with a subsequent (!))

Maximum permitted air permeability at 50Pa	*8 m^3/hm^2*	
Dwelling air permeability at 50Pa	5 m^3/hm^2, Design value	OK
Air permeability test certificate reference		

4 Space heating

Main heating system 1: Heat pump with radiators or underfloor heating - Electricity	
Efficiency	242.8%
Emitter type	Radiators
Flow temperature	55°C
System type	Heat Pump
Manufacturer	Daikin Europe NV
Model	EDLA08EV3
Commissioning	
Secondary heating system: N/A	
Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water

Cylinder/store - type: Cylinder	
Capacity	210 litres
Declared heat loss	1.7 kWh/day
Primary pipework insulated	Yes
Manufacturer	
Model	
Commissioning	
Waste water heat recovery system 1 - type: N/A	
Efficiency	
Manufacturer	
Model	

6 Controls

Main heating 1 - type: Time and temperature zone control by arrangement of plumbing and electrical services	
Function	
Ecodesign class	
Manufacturer	
Model	

Water heating - type: Cylinder thermostat and HW separately timed	
Manufacturer	
Model	

7 Lighting		
Minimum permitted light source efficacy	*75 lm/W*	
Lowest light source efficacy	85 lm/W	**OK**
External lights control	N/A	

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

9 Local generation	
Technology type: **Photovoltaic system (1)**	
Peak power	2.01 kWp
Orientation	South East
Pitch	30°
Overshading	None or very little
Manufacturer	
MCS certificate	

10 Heat networks
N/A

11 Supporting documentary evidence
N/A

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

Full SAP Calculation Printout

Property Reference	D+	**Issued on Date**	14/03/2025
Assessment Reference	Proposed	**Prop Type Ref**	Proposed 25
Property	25		

SAP Rating	85 B	**DER**	2.81	**TER**	10.01
Environmental	97 A	**% DER < TER**			71.93
CO_2 Emissions (t/year)	0.32	**DFEE**	39.83	**TFEE**	41.16
Compliance Check	See BREL	**% DFEE < TFEE**			3.23
% DPER < TPER	36.59	**DPER**	33.20	**TPER**	52.36

Assessor Details	Mr. Richard Millard	**Assessor ID**	U367-0001
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)	
Main dwelling						
Ground floor	66.6600 (1b)	x	2.4000 (2b)	=	159.9840	(1b) - (3b)
First floor	65.0400 (1c)	x	2.6000 (2c)	=	169.1040	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	131.7000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	329.0880	(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		5 * 10 =	50.0000	(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) =		50.0000 / (5) =	0.1519	(8)
Pressure test			Yes	
Pressure Test Method			Blower Door	
Measured/design AP50			5.0000	(17)
Infiltration rate			0.4019	(18)
Number of sides sheltered			2	(19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor		(21) = (18) x (20) =	0.3416	(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	0.4356	0.4271	0.4185	0.3758	0.3673	0.3246	0.3246	0.3160	0.3416	0.3673	0.3844	0.4014	(22b)
Effective ac	0.5949	0.5912	0.5876	0.5706	0.5674	0.5527	0.5527	0.5499	0.5584	0.5674	0.5739	0.5806	(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	
Main dwelling								
Windows			19.5700	1.1450	22.4084			(27)
Glazed Doors			5.0200	1.1450	5.7481			(27)
Doors			5.3900	1.2000	6.4680			(26a)
Heatloss Floor 1			66.6600	0.1200	7.9992	75.0000	4999.5000	(28a)
Cavity Wall	170.1300	29.9800	140.1500	0.1800	25.2270	60.0000	8409.0003	(29a)
External Roof 1	65.0400		65.0400	0.1100	7.1544	9.0000	585.3600	(30)
External Roof 2	1.6200		1.6200	0.1300	0.2106	9.0000	14.5800	(30)
Total net area of external elements Aum(A, m2)			303.4500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		75.2157			(33)
Main dwelling								
Internal Wall 1 - Block			51.6000			75.0000	3869.9999	(32c)
Internal Wall 2 - Stud			46.4700			9.0000	418.2300	(32c)
Internal Wall 3 - Up			206.0900			9.0000	1854.8100	(32c)
Internal Floor 1			65.0400			18.0000	1170.7200	(32d)
Internal Ceiling 1			66.6600			9.0000	599.9400	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		21922.1402	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							166.4551	(35)
List of Thermal Bridges								

	Length	Psi-value	Total	
K1 Element				
E1 Steel lintel with perforated steel base plate	19.8300	0.2410	4.7790	
E3 Sill	14.3900	0.0260	0.3741	
E4 Jamb	37.0200	0.0200	0.7404	
E5 Ground floor (normal)	34.9900	0.0450	1.5746	
E6 Intermediate floor within a dwelling	33.1800	0.0020	0.0664	
E10 Eaves (insulation at ceiling level)	18.0400	0.0500	0.9020	
E12 Gable (insulation at ceiling level)	18.8300	0.0310	0.5837	
E16 Corner (normal)	29.8000	0.0370	1.1026	
E17 Corner (inverted - internal area greater than external area)	9.8000	-0.0900	-0.8820	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			9.2408	(36)
Point Thermal bridges		(36a) =	0.0000	
Total fabric heat loss		(33) + (36) + (36a) =	84.4565	(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	64.6026	64.2025	63.8103	61.9684	61.6238	60.0195	60.0195	59.7224	60.6374	61.6238	62.3209	63.0498	(38)
Heat transfer coeff	149.0591	148.6590	148.2668	146.4249	146.0803	144.4760	144.4760	144.1789	145.0939	146.0803	146.7774	147.5063	(39)
Average = Sum(39)m / 12 =												146.4232	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1318	1.1288	1.1258	1.1118	1.1092	1.0970	1.0970	1.0948	1.1017	1.1092	1.1145	1.1200	(40)
HLP (average)												1.1118	
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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Assumed occupancy												2.8993	(42)
Hot water usage for mixer showers	72.8310	71.7365	70.1416	67.0900	64.8380	62.3266	60.8991	62.4820	64.2171	66.9135	70.0307	72.5519	(42a)
Hot water usage for baths	31.4429	30.9760	30.3184	29.1059	28.1980	27.1913	26.6475	27.3005	28.0115	29.0887	30.3262	31.3366	(42b)
Hot water usage for other uses	44.3214	42.7097	41.0980	39.4863	37.8746	36.2629	36.2629	37.8746	39.4863	41.0980	42.7097	44.3214	(42c)
Average daily hot water use (litres/day)												136.5924	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	148.5953	145.4221	141.5579	135.6822	130.9106	125.7808	123.8096	127.6571	131.7149	137.1002	143.0665	148.2099	(44)
Energy conte	235.3386	207.0792	217.5693	185.7421	176.2308	154.6622	149.7369	158.0661	162.4176	186.0437	203.8245	232.0610	(45)
Energy content (annual)										Total = Sum(45)m =		2268.7720	
Distribution loss (46)m = 0.15 x (45)m	35.3008	31.0619	32.6354	27.8613	26.4346	23.1993	22.4605	23.7099	24.3626	27.9066	30.5737	34.8091	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9180	(55)
Total storage loss	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(56)
If cylinder contains dedicated solar storage	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	287.0590	253.7944	269.2897	235.7941	227.9512	204.7142	201.4573	209.7865	212.4696	237.7641	253.8765	283.7814	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	287.0590	253.7944	269.2897	235.7941	227.9512	204.7142	201.4573	209.7865	212.4696	237.7641	253.8765	283.7814	(64)
										Total per year (kWh/year) = Sum(64)m =		2877.7380	(64)
12Total per year (kWh/year)												2878	(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	119.6264	106.2260	113.7181	101.8009	99.9731	91.4668	91.1639	93.9333	94.0454	103.2359	107.8132	118.5366	(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	144.9633	144.9633	144.9633	144.9633	144.9633	144.9633	144.9633	144.9633	144.9633	144.9633	144.9633	144.9633	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	153.5678	170.0215	153.5678	158.6868	153.5678	158.6868	153.5678	153.5678	158.6868	153.5678	158.6868	153.5678	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	299.7580	302.8685	295.0301	278.3428	257.2782	237.4805	224.2544	221.1438	228.9823	245.6695	266.7341	286.5319	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.4963	37.4963	37.4963	37.4963	37.4963	37.4963	37.4963	37.4963	37.4963	37.4963	37.4963	37.4963	(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)	-115.9706	-115.9706	-115.9706	-115.9706	-115.9706	-115.9706	-115.9706	-115.9706	-115.9706	-115.9706	-115.9706	-115.9706	(71)
Water heating gains (Table 5)	160.7882	158.0744	152.8469	141.3901	134.3724	127.0372	122.5321	126.2545	130.6187	138.7579	149.7406	159.3234	(72)
Total internal gains	680.6030	697.4534	667.9338	644.9087	611.7075	589.6934	566.8433	567.4551	584.7767	604.4842	641.6505	665.9121	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	2.6200	11.2829	0.6300	0.7000	0.7700	9.0343	(75)
Southeast	10.4300	36.7938	0.6300	0.7000	0.7700	117.2819	(77)
Northwest	6.5200	11.2829	0.6300	0.7000	0.7700	22.4824	(81)
Northwest	5.0200	11.2829	0.6300	0.7000	0.7700	17.3100	(81)

Solar gains	166.1086	299.1627	452.4061	632.7594	774.6498	798.0381	757.3295	647.0408	514.1642	342.2536	201.9134	140.2432	(83)
Total gains	846.7116	996.6162	1120.3399	1277.6681	1386.3573	1387.7315	1324.1728	1214.4959	1098.9410	946.7379	843.5638	806.1553	(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	40.8528	40.9628	41.0711	41.5878	41.6859	42.1488	42.1488	42.2356	41.9693	41.6859	41.4879	41.2829	
alpha	3.7235	3.7309	3.7381	3.7725	3.7791	3.8099	3.8099	3.8157	3.7980	3.7791	3.7659	3.7522	
util living area	0.9880	0.9774	0.9561	0.8972	0.7827	0.6111	0.4644	0.5200	0.7532	0.9296	0.9786	0.9900	(86)
Living	19.1635	19.4217	19.7996	20.3015	20.6944	20.9142	20.9767	20.9645	20.8058	20.2857	19.6444	19.1277	
Non living	17.8330	18.1619	18.6393	19.2631	19.7162	19.9447	19.9930	19.9880	19.8487	19.2586	18.4552	17.7936	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	20.0605	19.4217	19.7996	20.3015	20.6944	20.9142	20.9767	20.9645	20.8058	20.2857	19.6444	19.3896	(87)
Th 2	19.9749	19.9774	19.9798	19.9912	19.9933	20.0033	20.0033	20.0051	19.9994	19.9933	19.9890	19.9845	(88)
util rest of house	0.9853	0.9724	0.9460	0.8734	0.7345	0.5332	0.3659	0.4182	0.6835	0.9081	0.9730	0.9877	(89)
MIT 2	19.1210	18.1619	18.6393	19.2631	19.7162	19.9447	19.9930	19.9880	19.8487	19.2586	18.4552	18.1884	(90)
Living area fraction									fLA = Living area / (4) =			0.1475	(91)
MIT	19.2596	18.3478	18.8105	19.4163	19.8605	20.0878	20.1381	20.1321	19.9899	19.4101	18.6307	18.3656	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.2596	18.3478	18.8105	19.4163	19.8605	20.0878	20.1381	20.1321	19.9899	19.4101	18.6307	18.3656	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9830	0.9612	0.9309	0.8572	0.7274	0.5402	0.3797	0.4318	0.6827	0.8923	0.9622	0.9826	(94)
Useful gains	832.2929	957.9507	1042.8799	1095.2226	1008.3888	749.6457	502.7341	524.4024	750.2622	844.7968	811.6715	792.1129	(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	2229.8690	1999.1370	1825.2376	1539.8529	1192.0889	792.8489	511.1726	538.0911	854.5958	1286.9857	1692.4424	2089.5147	(97)
Space heating kWh	1039.7966	699.6772	582.0742	320.1338	136.6728	0.0000	0.0000	0.0000	0.0000	328.9886	634.1551	965.2669	(98a)
Space heating requirement - total per year (kWh/year)												4706.7652	
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	1039.7966	699.6772	582.0742	320.1338	136.6728	0.0000	0.0000	0.0000	0.0000	328.9886	634.1551	965.2669	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4706.7652	
Space heating per m2											(98c) / (4) =	35.7385	(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 %)												242.7753	(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	1039.7966	699.6772	582.0742	320.1338	136.6728	0.0000	0.0000	0.0000	0.0000	328.9886	634.1551	965.2669	(98)
Space heating efficiency (main heating system 1)	242.7753	242.7753	242.7753	242.7753	242.7753	0.0000	0.0000	0.0000	0.0000	242.7753	242.7753	242.7753	(210)
Space heating fuel (main heating system)	428.2958	288.1994	239.7584	131.8642	56.2960	0.0000	0.0000	0.0000	0.0000	135.5115	261.2107	397.5968	(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	287.0590	253.7944	269.2897	235.7941	227.9512	204.7142	201.4573	209.7865	212.4696	237.7641	253.8765	283.7814	(64)
Efficiency of water heater												165.8261	(216)
(217)m	165.8261	165.8261	165.8261	165.8261	165.8261	165.8261	165.8261	165.8261	165.8261	165.8261	165.8261	165.8261	(217)
Fuel for water heating, kWh/month	173.1084	153.0485	162.3928	142.1936	137.4640	123.4511	121.4871	126.5099	128.1279	143.3816	153.0980	171.1319	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(231)
Lighting	31.2562	25.0749	22.5771	16.5410	12.7767	10.4387	11.6554	15.1501	19.6784	25.8192	29.1627	32.1249	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-35.8878	-55.6468	-87.9535	-105.5200	-116.5599	-106.3571	-104.7263	-96.0832	-80.8698	-65.3563	-40.6179	-30.2231	(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	-8.4140	-20.3000	-45.8833	-78.9403	-114.6944	-122.1215	-120.2794	-98.4622	-68.0925	-33.0376	-12.3497	-6.5557	(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												1938.7328	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												165.8261	

Water heating fuel used	1735.3947	(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)	252.2552	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-1654.9322	(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	2271.4505	(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	1938.7328	0.1556	301.5755	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1735.3947	0.1410	244.6416	(264)
Space and water heating			546.2170	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	252.2552	0.1443	36.4082	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-925.8017	0.1336	-123.6484	
PV Unit electricity exported	-729.1305	0.1221	-89.0047	
Total			-212.6530	(269)
Total CO2, kg/year			369.9722	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			2.8100	(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	1938.7328	1.5759	3055.1579	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1735.3947	1.5213	2639.9967	(278)
Space and water heating			5695.1546	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	252.2552	1.5338	386.9175	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-925.8017	1.4936	-1382.7459	
PV Unit electricity exported	-729.1305	0.4479	-326.5502	
Total			-1709.2962	(283)
Total Primary energy kWh/year			4372.7759	(286)
Dwelling Primary energy Rate (DPER)			33.2000	(287)

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Main dwelling						
Ground floor	66.6600 (1b)	x	2.4000 (2b)	=	159.9840	(1b) - (3b)
First floor	65.0400 (1c)	x	2.6000 (2c)	=	169.1040	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 131.7000						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	329.0880	(5)

2. Ventilation rate

	m3 per hour		
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	4 * 10 =	40.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1215	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3715	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3158	(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													
	0.4027	0.3948	0.3869	0.3474	0.3395	0.3000	0.3000	0.2921	0.3158	0.3395	0.3553	0.3711	(22b)
Effective ac	0.5811	0.5779	0.5748	0.5603	0.5576	0.5450	0.5450	0.5427	0.5499	0.5576	0.5631	0.5689	(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	
Main dwelling								
TER Semi-glazed door			5.3900	1.0000	5.3900			(26a)
TER Opening Type			24.5900	1.1450	28.1565			(27)
Heatloss Floor 1			66.6600	0.1300	8.6658			(28a)
Cavity Wall	170.1300	29.9800	140.1500	0.1800	25.2270			(29a)
External Roof 1	65.0400		65.0400	0.1100	7.1544			(30)
External Roof 2	1.6200		1.6200	0.1100	0.1782			(30)
Total net area of external elements Aum(A, m2)			303.4500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		74.7719			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 166.4551 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	19.8300	0.0500	0.9915
E3 Sill	14.3900	0.0500	0.7195
E4 Jamb	37.0200	0.0500	1.8510
E5 Ground floor (normal)	34.9900	0.1600	5.5984
E6 Intermediate floor within a dwelling	33.1800	0.0000	0.0000
E10 Eaves (insulation at ceiling level)	18.0400	0.0600	1.0824
E12 Gable (insulation at ceiling level)	18.8300	0.0600	1.1298
E16 Corner (normal)	29.8000	0.0900	2.6820
E17 Corner (inverted - internal area greater than external area)	9.8000	-0.0900	-0.8820

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 13.1726 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 87.9445 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	63.1036	62.7617	62.4266	60.8527	60.5582	59.1873	59.1873	58.9334	59.7153	60.5582	61.1539	61.7767	(38)
Heat transfer coeff													
	151.0481	150.7062	150.3711	148.7971	148.5027	147.1318	147.1318	146.8779	147.6598	148.5027	149.0984	149.7212	(39)
Average = Sum(39)m / 12 =												148.7957	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1469	1.1443	1.1418	1.1298	1.1276	1.1172	1.1172	1.1152	1.1212	1.1276	1.1321	1.1368	(40)
HLP (average)												1.1298	
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 2.8993 (42)

Hot water usage for mixer showers

72.8310	71.7365	70.1416	67.0900	64.8380	62.3266	60.8991	62.4820	64.2171	66.9135	70.0307	72.5519	(42a)

Hot water usage for baths

31.4429	30.9760	30.3184	29.1059	28.1980	27.1913	26.6475	27.3005	28.0115	29.0887	30.3262	31.3366	(42b)

Hot water usage for other uses

44.3214	42.7097	41.0980	39.4863	37.8746	36.2629	36.2629	37.8746	39.4863	41.0980	42.7097	44.3214	(42c)

Average daily hot water use (litres/day) 136.5924 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	148.5953	145.4221	141.5579	135.6822	130.9106	125.7808	123.8096	127.6571	131.7149	137.1002	143.0665	148.2099	(44)
Energy conte	235.3386	207.0792	217.5693	185.7421	176.2308	154.6622	149.7369	158.0661	162.4176	186.0437	203.8245	232.0610	(45)
Energy content (annual)										Total = Sum(45)m =		2268.7720	
Distribution loss (46)m = 0.15 x (45)m													
	35.3008	31.0619	32.6354	27.8613	26.4346	23.1993	22.4605	23.7099	24.3626	27.9066	30.5737	34.8091	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7016	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9188	(55)
Total storage loss													
	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(56)
If cylinder contains dedicated solar storage													
	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month													
	287.0852	253.8180	269.3159	235.8195	227.9774	204.7395	201.4835	209.8127	212.4949	237.7903	253.9018	283.8075	(62)
WWHRS	-33.2953	-29.4466	-30.8348	-25.5324	-23.7953	-20.3618	-19.0860	-20.2960	-21.0671	-24.8358	-28.1360	-32.6787	(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													
	253.7899	224.3714	238.4811	210.2870	204.1821	184.3777	182.3976	189.5167	191.4278	212.9545	225.7658	251.1288	(64)
										Total per year (kWh/year) = Sum(64)m =		2568.6805	(64)
12Total per year (kWh/year)												2569	(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													
	119.6474	106.2449	113.7391	101.8211	99.9940	91.4871	91.1848	93.9543	94.0657	103.2568	107.8335	118.5575	(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	144.9633	144.9633	144.9633	144.9633	144.9633	144.9633	144.9633	144.9633	144.9633	144.9633	144.9633	144.9633	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	153.5678	170.0215	153.5678	158.6868	153.5678	158.6868	153.5678	153.5678	158.6868	153.5678	158.6868	153.5678	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	299.7580	302.8685	295.0301	278.3428	257.2782	237.4805	224.2544	221.1438	228.9823	245.6695	266.7341	286.5319	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.4963	37.4963	37.4963	37.4963	37.4963	37.4963	37.4963	37.4963	37.4963	37.4963	37.4963	37.4963	(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)													
	-115.9706	-115.9706	-115.9706	-115.9706	-115.9706	-115.9706	-115.9706	-115.9706	-115.9706	-115.9706	-115.9706	-115.9706	(71)
Water heating gains (Table 5)													
	160.8163	158.1025	152.8751	141.4182	134.4006	127.0654	122.5602	126.2826	130.6468	138.7860	149.7688	159.3515	(72)
Total internal gains													
	683.6312	700.4816	670.9619	647.9368	614.7356	589.7216	566.8714	567.4833	584.8049	607.5124	644.6786	668.9402	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	2.6200	11.2829	0.6300	0.7000	0.7700	9.0343	(75)
Southeast	10.4300	36.7938	0.6300	0.7000	0.7700	117.2819	(77)
Northwest	11.5400	11.2829	0.6300	0.7000	0.7700	39.7924	(81)

Solar gains	166.1086	299.1627	452.4061	632.7594	774.6498	798.0381	757.3295	647.0408	514.1642	342.2536	201.9134	140.2432	(83)
Total gains	849.7398	999.6443	1123.3681	1280.6962	1389.3855	1387.7597	1324.2009	1214.5241	1098.9691	949.7660	846.5920	809.1835	(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	40.3149	40.4063	40.4964	40.9247	41.0059	41.3880	41.3880	41.4595	41.2399	41.0059	40.8420	40.6721	
alpha	3.6877	3.6938	3.6998	3.7283	3.7337	3.7592	3.7592	3.7640	3.7493	3.7337	3.7228	3.7115	
util living area													
	0.9879	0.9774	0.9564	0.8987	0.7864	0.6183	0.4713	0.5274	0.7586	0.9303	0.9786	0.9899	(86)
MIT	19.1368	19.3946	19.7741	20.2779	20.6791	20.9067	20.9741	20.9608	20.7937	20.2649	19.6178	19.0974	(87)
Th 2	19.9627	19.9648	19.9669	19.9766	19.9784	19.9868	19.9868	19.9884	19.9836	19.9784	19.9747	19.9709	(88)
util rest of house													
	0.9852	0.9724	0.9463	0.8750	0.7380	0.5391	0.3703	0.4232	0.6885	0.9090	0.9729	0.9876	(89)
MIT 2	17.7912	18.1193	18.5986	19.2240	19.6873	19.9232	19.9754	19.9696	19.8233	19.2227	18.4121	17.7463	(90)
Living area fraction										fLA = Living area / (4) =		0.1475	(91)
MIT	17.9897	18.3074	18.7720	19.3795	19.8336	20.0683	20.1228	20.1158	19.9665	19.3765	18.5900	17.9456	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.9897	18.3074	18.7720	19.3795	19.8336	20.0683	20.1228	20.1158	19.9665	19.3765	18.5900	17.9456	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9775	0.9610	0.9309	0.8584	0.7304	0.5458	0.3843	0.4369	0.6872	0.8928	0.9620	0.9808	(94)
Useful gains	830.5992	960.6763	1045.7814	1099.3499	1014.7842	757.4866	508.9235	530.6382	755.2179	847.9605	814.3888	793.6295	(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													
	2067.8076	2020.5850	1845.3583	1559.3233	1207.8632	804.5578	518.3118	545.7744	866.2430	1303.3298	1713.1431	2058.0140	(97)
Space heating kWh													
	920.4831	712.2587	594.8852	331.1809	143.6508	0.0000	0.0000	0.0000	0.0000	338.7948	647.1031	940.7021	(98a)
Space heating requirement - total per year (kWh/year)												4629.0586	
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													
	920.4831	712.2587	594.8852	331.1809	143.6508	0.0000	0.0000	0.0000	0.0000	338.7948	647.1031	940.7021	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4629.0586	
Space heating per m2											(98c) / (4) =	35.1485	(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													
	920.4831	712.2587	594.8852	331.1809	143.6508	0.0000	0.0000	0.0000	0.0000	338.7948	647.1031	940.7021	(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)													
	997.2731	771.6779	644.5127	358.8092	155.6346	0.0000	0.0000	0.0000	0.0000	367.0583	701.0868	1019.1788	(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													
	253.7899	224.3714	238.4811	210.2870	204.1821	184.3777	182.3976	189.5167	191.4278	212.9545	225.7658	251.1288	(64)
Efficiency of water heater												79.8000	(216)
(217)m	86.6870	86.4640	86.0236	85.0737	83.2861	79.8000	79.8000	79.8000	79.8000	85.0958	86.2831	86.7387	(217)
Fuel for water heating, kWh/month													
	292.7658	259.4969	277.2273	247.1821	245.1575	231.0498	228.5684	237.4896	239.8845	250.2526	261.6572	289.5233	(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	31.9084	25.5981	23.0482	16.8861	13.0433	10.6565	11.8986	15.4662	20.0891	26.3579	29.7712	32.7952	(232)

Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	-58.8668	-81.2616	-114.3731	-125.7821	-133.2322	-123.4078	-121.7610	-116.0314	-105.6919	-91.4564	-64.0493	-51.0887 (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	-38.7366	-80.7919	-159.3589	-237.6503	-312.6795	-313.7040	-310.1217	-263.3828	-194.0504	-115.1014	-51.5629	-30.6951 (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	5015.2314	(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	3060.2551	(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)	257.5188	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-3294.8377	(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	5124.1676	(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	5015.2314	0.2100	1053.1986	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3060.2551	0.2100	642.6536	(264)
Space and water heating			1695.8522	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	257.5188	0.1443	37.1679	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1187.0023	0.1351	-160.3210	
PV Unit electricity exported	-2107.8354	0.1261	-265.7958	
Total			-426.1168	(269)
Total CO2, kg/year			1318.8325	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			10.0100	(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	5015.2314	1.1300	5667.2115	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3060.2551	1.1300	3458.0883	(278)
Space and water heating			9125.2998	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	257.5188	1.5338	394.9909	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1187.0023	1.4992	-1779.5533	
PV Unit electricity exported	-2107.8354	0.4629	-975.6714	
Total			-2755.2247	(283)
Total Primary energy kWh/year			6895.1667	(286)
Target Primary Energy Rate (TPER)			52.3600	(287)

Building Regulations England Part L (BREL) Compliance Report

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

Date: Fri 14 Mar 2025 09:30:58

Project Information			
Assessed By	Richard Millard	Building Type	House, Detached
OCDEA Registration	EES/025661	Assessment Date	2025-03-14

Dwelling Details			
Assessment Type	As designed	Total Floor Area	147 m^2
Site Reference	P+	Plot Reference	Regulated (Baseline)
Address	30		

Client Details	
Name	Ian White
Company	Cotswold Homes Ltd
Address	West House, Yate, Bristol, BS37 5NG

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

1a Target emission rate and dwelling emission rate		
Fuel for main heating system	Mains gas	
Target carbon dioxide emission rate	*8.9 $kgCO_2/m^2$*	
Dwelling carbon dioxide emission rate	12.9 $kgCO_2/m^2$	**FAIL**
1b Target primary energy rate and dwelling primary energy		
Target primary energy	*46.5 kWh_{PE}/m^2*	
Dwelling primary energy	71.27 kWh_{PE}/m^2	**FAIL**
1c Target fabric energy efficiency and dwelling fabric energy efficiency		
Target fabric energy efficiency	*37.9 kWh/m^2*	
Dwelling fabric energy efficiency	37.7 kWh/m^2	**OK**

2a Fabric U-values				
Element	***Maximum permitted average U-Value [W/m^2K]***	**Dwelling average U-Value [W/m^2K]**	**Element with highest individual U-Value**	
External walls	*0.26*	0.18	Walls (1) (0.18)	**OK**
Party walls	*0.2*	N/A	N/A	**N/A**
Curtain walls	*1.6*	N/A	N/A	**N/A**
Floors	*0.18*	0.13	Heatloss Floor 1 (0.13)	**OK**
Roofs	*0.16*	0.11	Roof (1) (0.11)	**OK**
Windows, doors, and roof windows	*1.6*	1.2	WG02 (1.2)	**OK**
Rooflights	*2.2*	N/A	N/A	**N/A**

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))		
Name	**Net area [m^2]**	**U-Value [W/m^2K]**
Exposed wall: Walls (1)	125.95	0.18
Ground floor: Heatloss Floor 1, Heatloss Floor 1	75.03	0.13
Exposed roof: Roof (1)	73.41	0.11
Exposed roof: Roof (2)	1.62	0.11

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	**Area [m^2]**	**Orientation**	**Frame factor**	**U-Value [W/m^2K]**
WG02, Windows	1.65	North West	0.7	1.2
WG03, Windows	1.43	North East	0.7	1.2
FG01, Windows	2.13	North West	0.7	1.2
FG02, Windows	1.08	North West	0.7	1.2
FG03, Windows	1.48	North West	0.7	1.2
FG04, Windows	0.67	South West	0.7	1.2
FG05, Windows	1.43	South East	0.7	1.2
FG06, Windows	1.43	South East	0.7	1.2
ED01, Doors	2	North West	N/A	1.2
ED02, Doors	2	South West	N/A	1.2
ED03, Glazed Doors	3.78	South East	0.7	1.2
WG04, Windows	2.06	South East	0.7	1.2
WG05, Windows	1.33	South East	0.7	1.2

Name	Area [m^2]	Orientation	Frame factor	U-Value [W/m^2K]
FG07, Windows	1.43	South East	0.7	1.2
FG08, Windows	0.67	North East	0.7	1.2
WG01, Windows	2.4	North West	0.7	1.2
WG06, Windows	2.62	North East	0.7	1.2
WG07, Windows	1.33	South East	0.7	1.2

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))				
Building part **1**: Thermal bridging calculated from linear thermal transmittances for each junction				
Main element	**Junction detail**	**Source**	**Psi value [W/mK]**	**Drawing / reference**
External wall	E2: Other lintels (including other steel lintels)	Calculated by person with suitable expertise	0.05	mpf125e2-04
External wall	E3: Sill	Calculated by person with suitable expertise	0.05	mpf125e3-01
External wall	E4: Jamb	Calculated by person with suitable expertise	0.022 **(!)**	mpf125e4-01
External wall	E5: Ground floor (normal)	Calculated by person with suitable expertise	0.16	mpf125e5-04
External wall	E6: Intermediate floor within a dwelling	Calculated by person with suitable expertise	0.003 **(!)**	mpf125e6-01
External wall	E10: Eaves (insulation at ceiling level)	Calculated by person with suitable expertise	0.06	mpf125e10-01
External wall	E12: Gable (insulation at ceiling level)	Calculated by person with suitable expertise	0.06	mpf125e12-01
External wall	E16: Corner (normal)	Calculated by person with suitable expertise	0.09	mpf125e16-01
External wall	E17: Corner (inverted - internal area greater than external area)	Calculated by person with suitable expertise	-0.085	mpf125e17-01

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

4 Space heating	
Main heating system 1: Boiler with radiators or underfloor heating - Mains gas	
Efficiency	88.6%
Emitter type	Radiators
Flow temperature	45°C
System type	Regular boiler
Manufacturer	Bosch Thermotechnology
Model	Greenstar 8000 Life
Commissioning	
Secondary heating system: N/A	
Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water	
Cylinder/store - type: Cylinder	
Capacity	210 litres
Declared heat loss	1.7 kWh/day
Primary pipework insulated	Yes
Manufacturer	
Model	
Commissioning	
Waste water heat recovery system 1 - type: N/A	
Efficiency	
Manufacturer	
Model	

6 Controls		
Main heating 1 - type: Time and temperature zone control by arrangement of plumbing and electrical services		
Function		
Ecodesign class		
Manufacturer		
Model		
Water heating - type: Cylinder thermostat and HW separately timed		
Manufacturer		
Model		

7 Lighting		
Minimum permitted light source efficacy	*75 lm/W*	
Lowest light source efficacy	85 lm/W	**OK**
External lights control	N/A	

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

9 Local generation
N/A

10 Heat networks
N/A

11 Supporting documentary evidence
N/A

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

Full SAP Calculation Printout

Property Reference	P+	**Issued on Date**	14/03/2025
Assessment Reference	Regulated (Baseline)	**Prop Type Ref**	Proposed 30
Property	30		

SAP Rating	86 B	**DER**	12.90	**TER**	8.90
Environmental	87 B	**% DER < TER**			-44.94
CO_2 Emissions (t/year)	1.77	**DFEE**	37.73	**TFEE**	37.86
Compliance Check	See BREL	**% DFEE < TFEE**			0.33
% DPER < TPER	-53.26	**DPER**	71.27	**TPER**	46.50

Assessor Details	Mr. Richard Millard	**Assessor ID**	U367-0001
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)	
Main dwelling						
Ground floor	73.3400 (1b)	x	2.4000 (2b)	=	176.0160	(1b) - (3b)
First floor	73.3400 (1c)	x	2.6000 (2c)	=	190.6840	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	146.6800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	366.7000	(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		6 * 10 =	60.0000	(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) =		60.0000 / (5) =	0.1636	(8)
Pressure test			Yes	
Pressure Test Method			Blower Door	
Measured/design AP50			5.0000	(17)
Infiltration rate			0.4136	(18)
Number of sides sheltered			3	(19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor		(21) = (18) x (20) =	0.3206	(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	0.4087	0.4007	0.3927	0.3526	0.3446	0.3045	0.3045	0.2965	0.3206	0.3446	0.3606	0.3767	(22b)
Effective ac	0.5835	0.5803	0.5771	0.5622	0.5594	0.5464	0.5464	0.5440	0.5514	0.5594	0.5650	0.5709	(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	
Main dwelling								
Windows			23.1400	1.1450	26.4962			(27)
Glazed Doors			3.7800	1.1450	4.3282			(27)
Doors			4.0000	1.2000	4.8000			(26)
Heatloss Floor 1			75.0300	0.1300	9.7539	75.0000	5627.2500	(28a)
Cavity Wall	156.8700	30.9200	125.9500	0.1800	22.6710	60.0000	7557.0000	(29a)
External Roof 1	73.4100		73.4100	0.1100	8.0751	9.0000	660.6900	(30)
External Roof 2	1.6200		1.6200	0.1100	0.1782	9.0000	14.5800	(30)
Total net area of external elements Aum(A, m2)			306.9300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		76.3026			(33)
Main dwelling								
Internal Wall 1 - Block			73.8800			75.0000	5541.0000	(32c)
Internal Wall 2 - Stud			31.4100			9.0000	282.6900	(32c)
Internal Wall 3 - Up			190.3800			9.0000	1713.4200	(32c)
Internal Floor 1			73.4100			18.0000	1321.3800	(32d)
Internal Ceiling 1			75.0300			9.0000	675.2700	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		23393.2800	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							159.4851	(35)
List of Thermal Bridges								

	Length	Psi-value	Total	
K1 Element				
E2 Other lintels (including other steel lintels)	20.0500	0.0500	1.0025	
E3 Sill	18.3400	0.0500	0.9170	
E4 Jamb	47.1800	0.0220	1.0380	
E5 Ground floor (normal)	36.0200	0.1600	5.7632	
E6 Intermediate floor within a dwelling	36.0200	0.0030	0.1081	
E10 Eaves (insulation at ceiling level)	18.7600	0.0600	1.1256	
E12 Gable (insulation at ceiling level)	20.8500	0.0600	1.2510	
E16 Corner (normal)	20.2000	0.0900	1.8180	
E17 Corner (inverted - internal area greater than external area)	9.8000	-0.0850	-0.8330	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			12.1903	(36)
Point Thermal bridges		(36a) =	0.0000	
Total fabric heat loss		(33) + (36) + (36a) =	88.4929	(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	70.6126	70.2201	69.8354	68.0285	67.6904	66.1166	66.1166	65.8252	66.7228	67.6904	68.3743	69.0893	(38)
Heat transfer coeff	159.1055	158.7130	158.3283	156.5214	156.1834	154.6096	154.6096	154.3182	155.2158	156.1834	156.8673	157.5823	(39)
Average = Sum(39)m / 12 =												156.5198	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0847	1.0820	1.0794	1.0671	1.0648	1.0541	1.0541	1.0521	1.0582	1.0648	1.0695	1.0743	(40)
HLP (average)												1.0671	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.9289 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	73.3274	72.2254	70.6196	67.5472	65.2799	62.7514	61.3142	62.9078	64.6547	67.3696	70.5080	73.0464	(42a)
Hot water usage for baths	31.6564	31.1862	30.5242	29.3035	28.3894	27.3759	26.8284	27.4858	28.2016	29.2862	30.5320	31.5494	(42b)
Hot water usage for other uses	44.6246	43.0019	41.3791	39.7564	38.1337	36.5110	36.5110	38.1337	39.7564	41.3791	43.0019	44.6246	(42c)
Average daily hot water use (litres/day)												137.5236	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	149.6083	146.4135	142.5229	136.6071	131.8030	126.6383	124.6536	128.5274	132.6128	138.0349	144.0418	149.2204	(44)
Energy conte	236.9430	208.4909	219.0525	187.0084	177.4322	155.7165	150.7577	159.1437	163.5249	187.3121	205.2140	233.6430	(45)
Energy content (annual)											Total = Sum(45)m =	2284.2389	
Distribution loss (46)m = 0.15 x (45)m	35.5415	31.2736	32.8579	28.0513	26.6148	23.3575	22.6137	23.8716	24.5287	28.0968	30.7821	35.0465	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9180	(55)
Total storage loss	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(56)
If cylinder contains dedicated solar storage	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(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	288.6634	255.2061	270.7729	237.0604	229.1526	205.7685	202.4781	210.8641	213.5769	239.0325	255.2660	285.3634	(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	288.6634	255.2061	270.7729	237.0604	229.1526	205.7685	202.4781	210.8641	213.5769	239.0325	255.2660	285.3634	(64)
										Total per year (kWh/year) = Sum(64)m =		2893.2049	(64)
12Total per year (kWh/year)												2893	(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	120.1599	106.6954	114.2113	102.2219	100.3725	91.8173	91.5033	94.2916	94.4136	103.6576	108.2753	119.0626	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	146.4435	146.4435	146.4435	146.4435	146.4435	146.4435	146.4435	146.4435	146.4435	146.4435	146.4435	146.4435	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	162.7548	180.1928	162.7548	168.1799	162.7548	168.1799	162.7548	162.7548	168.1799	162.7548	168.1799	162.7548	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	316.8875	320.1759	311.8894	294.2486	271.9803	251.0512	237.0693	233.7810	242.0674	259.7082	281.9765	302.9056	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.6444	37.6444	37.6444	37.6444	37.6444	37.6444	37.6444	37.6444	37.6444	37.6444	37.6444	37.6444	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-117.1548	-117.1548	-117.1548	-117.1548	-117.1548	-117.1548	-117.1548	-117.1548	-117.1548	-117.1548	-117.1548	-117.1548	(71)
Water heating gains (Table 5)	161.5052	158.7729	153.5098	141.9748	134.9093	127.5241	122.9883	126.7360	131.1300	139.3247	150.3823	160.0304	(72)
Total internal gains	711.0806	729.0746	698.0870	674.3365	639.5775	613.6883	589.7454	590.2049	608.3104	631.7207	670.4718	695.6239	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	4.7200	11.2829	0.6300	0.7000	0.7700	16.2756	(75)
Southeast	9.0100	36.7938	0.6300	0.7000	0.7700	101.3145	(77)
Southwest	0.6700	36.7938	0.6300	0.7000	0.7700	7.5339	(79)
Northwest	8.7400	11.2829	0.6300	0.7000	0.7700	30.1374	(81)
Southeast	3.7800	36.7938	0.6300	0.7000	0.7700	42.5049	(77)

Solar gains	197.7663	352.2856	522.9615	716.6115	865.3131	886.6126	843.3212	728.1701	589.3594	400.3915	239.6859	167.4300	(83)
Total gains	908.8468	1081.3602	1221.0486	1390.9480	1504.8905	1500.3009	1433.0666	1318.3750	1197.6698	1032.1123	910.1577	863.0539	(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	40.8417	40.9427	41.0421	41.5159	41.6058	42.0293	42.0293	42.1087	41.8652	41.6058	41.4244	41.2365	
alpha	3.7228	3.7295	3.7361	3.7677	3.7737	3.8020	3.8020	3.8072	3.7910	3.7737	3.7616	3.7491	
util living area	0.9878	0.9762	0.9534	0.8923	0.7763	0.6062	0.4596	0.5136	0.7449	0.9256	0.9779	0.9899	(86)
MIT	19.1682	19.4375	19.8201	20.3171	20.7025	20.9160	20.9773	20.9657	20.8125	20.2998	19.6510	19.1280	(87)
Th 2	20.0133	20.0155	20.0177	20.0278	20.0297	20.0385	20.0385	20.0402	20.0351	20.0297	20.0259	20.0219	(88)
util rest of house	0.9852	0.9712	0.9433	0.8688	0.7295	0.5314	0.3655	0.4164	0.6774	0.9042	0.9723	0.9877	(89)
MIT 2	17.8693	18.2122	18.6952	19.3120	19.7569	19.9798	20.0281	20.0230	19.8873	19.3052	18.4931	17.8236	(90)
Living area fraction									fLA = Living area / (4) =			0.1546	(91)
MIT	18.0700	18.4015	18.8690	19.4673	19.9030	20.1245	20.1748	20.1687	20.0303	19.4589	18.6720	18.0252	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9200	18.2515	18.7190	19.3173	19.7530	19.9745	20.0248	20.0187	19.8803	19.3089	18.5220	17.8752	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9768	0.9584	0.9255	0.8480	0.7145	0.5261	0.3642	0.4141	0.6652	0.8838	0.9599	0.9803	(94)
Useful gains	887.7254	1036.4186	1130.0618	1179.5535	1075.3093	789.2926	521.8585	546.0027	796.7194	912.1358	873.6651	846.0874	(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	2167.0234	2119.0631	1934.6215	1630.5354	1257.7504	830.9481	529.5014	558.4303	897.1932	1360.1831	1791.7415	2154.9728	(97)
Space heating kWh	951.7977	727.5371	598.5924	324.7069	135.7362	0.0000	0.0000	0.0000	0.0000	333.3471	661.0150	973.8107	(98a)
Space heating requirement - total per year (kWh/year)												4706.5432	
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	951.7977	727.5371	598.5924	324.7069	135.7362	0.0000	0.0000	0.0000	0.0000	333.3471	661.0150	973.8107	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4706.5432	
Space heating per m2											(98c) / (4) =	32.0872	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												88.6000	(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	951.7977	727.5371	598.5924	324.7069	135.7362	0.0000	0.0000	0.0000	0.0000	333.3471	661.0150	973.8107	(98)
Space heating efficiency (main heating system 1)	88.6000	88.6000	88.6000	88.6000	88.6000	0.0000	0.0000	0.0000	0.0000	88.6000	88.6000	88.6000	(210)
Space heating fuel (main heating system)	1074.2638	821.1479	675.6122	366.4864	153.2011	0.0000	0.0000	0.0000	0.0000	376.2383	746.0666	1099.1092	(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	288.6634	255.2061	270.7729	237.0604	229.1526	205.7685	202.4781	210.8641	213.5769	239.0325	255.2660	285.3634	(64)
Efficiency of water heater												79.6000	(216)
(217)m	86.3286	86.0728	85.5861	84.5652	82.7260	79.6000	79.6000	79.6000	79.6000	84.6052	85.8944	86.3865	(217)
Fuel for water heating, kWh/month	334.3775	296.5004	316.3750	280.3285	277.0020	258.5032	254.3695	264.9047	268.3126	282.5270	297.1858	330.3335	(219)
Space cooling fuel requirement	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)
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	33.1260	26.5749	23.9278	17.5305	13.5411	11.0632	12.3526	16.0564	20.8557	27.3638	30.9073	34.0467	(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	5312.1255	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	79.6000	
Water heating fuel used	3460.7197	(219)
Space cooling fuel	0.0000	(221)

Electricity for pumps and fans:

central heating pump	41.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	86.0000	(231)
Electricity for lighting (calculated in Appendix L)	267.3459	(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	9126.1912	(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	5312.1255	0.2100	1115.5464	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3460.7197	0.2100	726.7511	(264)
Space and water heating			1842.2975	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	267.3459	0.1443	38.5863	(268)
Total CO2, kg/year			1892.8130	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			12.9000	(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	5312.1255	1.1300	6002.7018	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3460.7197	1.1300	3910.6133	(278)
Space and water heating			9913.3151	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	267.3459	1.5338	410.0641	(282)
Total Primary energy kWh/year			10453.4800	(286)
Dwelling Primary energy Rate (DPER)			71.2700	(287)

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

1. Overall dwelling characteristics

		Area (m2)		Storey height (m)		Volume (m3)	
Main dwelling							
Ground floor		73.3400 (1b)	x	2.4000 (2b)	=	176.0160	(1b) - (3b)
First floor		73.3400 (1c)	x	2.6000 (2c)	=	190.6840	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	146.6800						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	366.7000	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1091	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3591	(18)
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2783	(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	0.3548	0.3479	0.3409	0.3061	0.2992	0.2644	0.2644	0.2574	0.2783	0.2992	0.3131	0.3270	(22b)
Effective ac	0.5629	0.5605	0.5581	0.5469	0.5447	0.5349	0.5349	0.5331	0.5387	0.5447	0.5490	0.5535	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Main dwelling								
TER Opaque door			4.0000	1.0000	4.0000			(26)
TER Opening Type			26.9200	1.1450	30.8244			(27)
Heatloss Floor 1			75.0300	0.1300	9.7539			(28a)
Cavity Wall	156.8700	30.9200	125.9500	0.1800	22.6710			(29a)
External Roof 1	73.4100		73.4100	0.1100	8.0751			(30)
External Roof 2	1.6200		1.6200	0.1100	0.1782			(30)
Total net area of external elements Aum(A, m2)			306.9300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	75.5026			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 159.4851 (35)

List of Thermal Bridges

	K1 Element	Length	Psi-value	Total	
E2	Other lintels (including other steel lintels)	20.0500	0.0500	1.0025	
E3	Sill	18.3400	0.0500	0.9170	
E4	Jamb	47.1800	0.0500	2.3590	
E5	Ground floor (normal)	36.0200	0.1600	5.7632	
E6	Intermediate floor within a dwelling	36.0200	0.0000	0.0000	
E10	Eaves (insulation at ceiling level)	18.7600	0.0600	1.1256	
E12	Gable (insulation at ceiling level)	20.8500	0.0600	1.2510	
E16	Corner (normal)	20.2000	0.0900	1.8180	
E17	Corner (inverted - internal area greater than external area)	9.8000	-0.0900	-0.8820	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 13.3543 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 88.8569 (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	68.1228	67.8271	67.5371	66.1753	65.9205	64.7344	64.7344	64.5148	65.1913	65.9205	66.4360	66.9748	(38)
Heat transfer coeff	156.9798	156.6840	156.3940	155.0322	154.7774	153.5914	153.5914	153.3717	154.0482	154.7774	155.2929	155.8318	(39)
Average = Sum(39)m / 12 =												155.0310	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0702	1.0682	1.0662	1.0569	1.0552	1.0471	1.0471	1.0456	1.0502	1.0552	1.0587	1.0624	(40)
HLP (average)												1.0569	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.9289 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	73.3274	72.2254	70.6196	67.5472	65.2799	62.7514	61.3142	62.9078	64.6547	67.3696	70.5080	73.0464	(42a)
Hot water usage for baths	31.6564	31.1862	30.5242	29.3035	28.3894	27.3759	26.8284	27.4858	28.2016	29.2862	30.5320	31.5494	(42b)
Hot water usage for other uses	44.6246	43.0019	41.3791	39.7564	38.1337	36.5110	36.5110	38.1337	39.7564	41.3791	43.0019	44.6246	(42c)
Average daily hot water use (litres/day)												137.5236	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	149.6083	146.4135	142.5229	136.6071	131.8030	126.6383	124.6536	128.5274	132.6128	138.0349	144.0418	149.2204	(44)
Energy conte	236.9430	208.4909	219.0525	187.0084	177.4322	155.7165	150.7577	159.1437	163.5249	187.3121	205.2140	233.6430	(45)
Energy content (annual)										Total = Sum(45)m =		2284.2389	
Distribution loss (46)m = 0.15 x (45)m	35.5415	31.2736	32.8579	28.0513	26.6148	23.3575	22.6137	23.8716	24.5287	28.0968	30.7821	35.0465	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7016	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9188	(55)
Total storage loss	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(56)
If cylinder contains dedicated solar storage	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(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	288.6896	255.2297	270.7991	237.0857	229.1788	205.7939	202.5043	210.8903	213.6022	239.0587	255.2914	285.3896	(62)
WWHRS	-33.5222	-29.6473	-31.0450	-25.7065	-23.9575	-20.5006	-19.2160	-20.4343	-21.2107	-25.0051	-28.3277	-32.9014	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	255.1674	225.5824	239.7541	211.3792	205.2213	185.2933	183.2883	190.4560	192.3915	214.0536	226.9636	252.4882	(64)
										Total per year (kWh/year) = Sum(64)m =		2582.0389	(64)
12Total per year (kWh/year)												2582	(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	120.1808	106.7143	114.2322	102.2422	100.3935	91.8376	91.5242	94.3126	94.4339	103.6785	108.2955	119.0836	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	146.4435	146.4435	146.4435	146.4435	146.4435	146.4435	146.4435	146.4435	146.4435	146.4435	146.4435	146.4435	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	162.7548	180.1928	162.7548	168.1799	162.7548	168.1799	162.7548	162.7548	168.1799	162.7548	168.1799	162.7548	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	316.8875	320.1759	311.8894	294.2486	271.9803	251.0512	237.0693	233.7810	242.0674	259.7082	281.9765	302.9056	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.6444	37.6444	37.6444	37.6444	37.6444	37.6444	37.6444	37.6444	37.6444	37.6444	37.6444	37.6444	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-117.1548	-117.1548	-117.1548	-117.1548	-117.1548	-117.1548	-117.1548	-117.1548	-117.1548	-117.1548	-117.1548	-117.1548	(71)
Water heating gains (Table 5)	161.5334	158.8010	153.5379	142.0030	134.9375	127.5523	123.0164	126.7642	131.1582	139.3529	150.4105	160.0586	(72)
Total internal gains	711.1087	729.1027	698.1152	674.3646	639.6056	613.7165	589.7735	590.2330	608.3386	631.7489	670.5000	695.6520	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	4.7200	11.2829	0.6300	0.7000	0.7700	16.2756	(75)
Southeast	12.7900	36.7938	0.6300	0.7000	0.7700	143.8194	(77)
Southwest	0.6700	36.7938	0.6300	0.7000	0.7700	7.5339	(79)
Northwest	8.7400	11.2829	0.6300	0.7000	0.7700	30.1374	(81)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	197.7663	352.2856	522.9615	716.6115	865.3131	886.6126	843.3212	728.1701	589.3594	400.3915	239.6859	167.4300	(83)
Total gains	908.8750	1081.3883	1221.0767	1390.9761	1504.9187	1500.3290	1433.0947	1318.4032	1197.6980	1032.1404	910.1859	863.0821	(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	41.3947	41.4729	41.5497	41.9147	41.9837	42.3079	42.3079	42.3685	42.1825	41.9837	41.8444	41.6997	
alpha	3.7596	3.7649	3.7700	3.7943	3.7989	3.8205	3.8205	3.8246	3.8122	3.7989	3.7896	3.7800	
util living area	0.9877	0.9760	0.9528	0.8909	0.7737	0.6035	0.4571	0.5112	0.7425	0.9248	0.9777	0.9898	(86)
MIT	19.1983	19.4658	19.8447	20.3322	20.7113	20.9185	20.9782	20.9668	20.8176	20.3125	19.6701	19.1529	(87)
Th 2	20.0252	20.0269	20.0285	20.0362	20.0376	20.0443	20.0443	20.0455	20.0417	20.0376	20.0347	20.0317	(88)
util rest of house	0.9851	0.9710	0.9426	0.8673	0.7269	0.5292	0.3639	0.4148	0.6752	0.9033	0.9721	0.9876	(89)
MIT 2	17.9154	18.2555	18.7332	19.3363	19.7730	19.9873	20.0342	20.0289	19.8979	19.3262	18.5229	17.8618	(90)
Living area fraction									fLA = Living area / (4) =			0.1546	(91)
MIT	18.1136	18.4425	18.9050	19.4902	19.9180	20.1313	20.1801	20.1738	20.0400	19.4786	18.7002	18.0613	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.1136	18.4425	18.9050	19.4902	19.9180	20.1313	20.1801	20.1738	20.0400	19.4786	18.7002	18.0613	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9775	0.9596	0.9273	0.8515	0.7205	0.5364	0.3775	0.4282	0.6750	0.8876	0.9613	0.9810	(94)
Useful gains	888.4700	1037.7141	1132.3306	1184.3865	1084.2964	804.7073	541.0581	564.5976	808.4779	916.1761	874.9681	846.7144	(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	2168.4634	2121.8978	1940.0703	1641.8222	1271.9623	849.5531	549.8679	578.8007	915.0487	1374.2091	1801.4342	2160.0354	(97)
Space heating kWh	952.3151	728.5715	600.9583	329.3537	139.6234	0.0000	0.0000	0.0000	0.0000	340.7765	667.0556	977.1108	(98a)
Space heating requirement - total per year (kWh/year)												4735.7648	
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	952.3151	728.5715	600.9583	329.3537	139.6234	0.0000	0.0000	0.0000	0.0000	340.7765	667.0556	977.1108	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4735.7648	
Space heating per m2											(98c) / (4) =	32.2864	(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	952.3151	728.5715	600.9583	329.3537	139.6234	0.0000	0.0000	0.0000	0.0000	340.7765	667.0556	977.1108	(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)	1031.7606	789.3515	651.0924	356.8295	151.2713	0.0000	0.0000	0.0000	0.0000	369.2053	722.7038	1058.6249	(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	255.1674	225.5824	239.7541	211.3792	205.2213	185.2933	183.2883	190.4560	192.3915	214.0536	226.9636	252.4882	(64)
Efficiency of water heater												79.8000	(216)
(217)m	86.7329	86.4937	86.0329	85.0503	83.2148	79.8000	79.8000	79.8000	79.8000	85.0973	86.3283	86.7900	(217)
Fuel for water heating, kWh/month	294.1992	260.8078	278.6772	248.5344	246.6164	232.1971	229.6846	238.6666	241.0921	251.5398	262.9077	290.9184	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	33.8172	27.1294	24.4270	17.8963	13.8236	11.2940	12.6104	16.3914	21.2909	27.9347	31.5522	34.7571	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-64.0400	-88.0389	-123.4000	-135.1180	-142.6166	-131.9007	-130.1190	-124.2307	-113.5472	-98.7812	-69.5385	-55.6204	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-43.3442	-90.2539	-177.7627	-264.7339	-347.9800	-349.0140	-345.0427	-293.2045	-216.2323	-128.4758	-57.6592	-34.3590	(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	5130.8395	(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	3075.8411	(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)	272.9244	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-3625.0132	(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	4940.5917	(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	5130.8395	0.2100	1077.4763	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3075.8411	0.2100	645.9266	(264)
Space and water heating			1723.4029	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	272.9244	0.1443	39.3914	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1276.9512	0.1352	-172.5908	
PV Unit electricity exported	-2348.0620	0.1261	-296.1816	
Total			-468.7724	(269)
Total CO2, kg/year			1305.9512	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			8.9000	(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	5130.8395	1.1300	5797.8486	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3075.8411	1.1300	3475.7005	(278)
Space and water heating			9273.5491	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	272.9244	1.5338	418.6205	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1276.9512	1.4996	-1914.8583	
PV Unit electricity exported	-2348.0620	0.4630	-1087.2144	
Total			-3002.0727	(283)
Total Primary energy kWh/year			6820.1977	(286)
Target Primary Energy Rate (TPER)			46.5000	(287)

Building Regulations England Part L (BREL) Compliance Report

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

Date: Fri 14 Mar 2025 09:30:50

Project Information			
Assessed By	Richard Millard	Building Type	House, Detached
OCDEA Registration	EES/025661	Assessment Date	2025-03-14

Dwelling Details			
Assessment Type	As designed	Total Floor Area	133 m^2
Site Reference	DV1	Plot Reference	Proposed
Address	53		

Client Details	
Name	Ian White
Company	Cotswold Homes Ltd
Address	West House, Yate, Bristol, BS37 5NG

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

1a Target emission rate and dwelling emission rate		
Fuel for main heating system	Electricity	
Target carbon dioxide emission rate	*9.83 $kgCO_2/m^2$*	
Dwelling carbon dioxide emission rate	2.76 $kgCO_2/m^2$	OK
1b Target primary energy rate and dwelling primary energy		
Target primary energy	*51.37 kWh_{PE}/m^2*	
Dwelling primary energy	32.63 kWh_{PE}/m^2	OK
1c Target fabric energy efficiency and dwelling fabric energy efficiency		
Target fabric energy efficiency	*40.1 kWh/m^2*	
Dwelling fabric energy efficiency	38.6 kWh/m^2	OK

2a Fabric U-values				
Element	***Maximum permitted average U-Value [W/m^2K]***	**Dwelling average U-Value [W/m^2K]**	**Element with highest individual U-Value**	
External walls	*0.26*	0.18	Walls (1) (0.18)	OK
Party walls	*0.2*	N/A	N/A	**N/A**
Curtain walls	*1.6*	N/A	N/A	**N/A**
Floors	*0.18*	0.12	Heatloss Floor 1 (0.12)	OK
Roofs	*0.16*	0.11	Roof (1) (0.11)	OK
Windows, doors, and roof windows	*1.6*	1.2	WG01 (1.2)	OK
Rooflights	*2.2*	N/A	N/A	**N/A**

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))		
Name	**Net area [m^2]**	**U-Value [W/m^2K]**
Exposed wall: Walls (1)	143.44	0.18
Ground floor: Heatloss Floor 1, Heatloss Floor 1	66.39	0.12
Exposed roof: Roof (1)	66.39	0.11

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	**Area [m^2]**	**Orientation**	**Frame factor**	**U-Value [W/m^2K]**
WG01, Windows	2.12	North West	0.7	1.2
WG02, Windows	2.12	North West	0.7	1.2
WG03, Windows	1.64	South East	0.7	1.2
WG04, Windows	0.67	North East	0.7	1.2
WG05, Windows	1.56	North East	0.7	1.2
FG01, Windows	2.16	North West	0.7	1.2
FG02, Windows	0.67	North West	0.7	1.2
FG03, Windows	2.12	North West	0.7	1.2
FG04, Windows	1.45	South East	0.7	1.2
FG05, Windows	0.66	South East	0.7	1.2
FG06, Windows	1.44	South East	0.7	1.2
ED01, Doors	3.08	North West	N/A	1.2
ED02, Doors	2	South East	N/A	1.2
ED03, Glazed Doors	5.05	South East	0.7	1.2

Name	Area [m^2]	Orientation	Frame factor	U-Value [W/m^2K]

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))				
Building part **1**: Thermal bridging calculated from linear thermal transmittances for each junction				
Main element	**Junction detail**	**Source**	**Psi value [W/mK]**	**Drawing / reference**
External wall	E1: Steel lintel with perforated steel base plate	Calculated by person with suitable expertise	0.241	EMPF125E101
External wall	E3: Sill	Calculated by person with suitable expertise	0.026 **(!)**	EMPF125E301
External wall	E4: Jamb	Calculated by person with suitable expertise	0.02 **(!)**	EMPF125E401
External wall	E5: Ground floor (normal)	Calculated by person with suitable expertise	0.045	EMPF125E504
External wall	E6: Intermediate floor within a dwelling	Calculated by person with suitable expertise	0.002 **(!)**	EMPF125E601
External wall	E10: Eaves (insulation at ceiling level)	Calculated by person with suitable expertise	0.05	EMPF125E1001
External wall	E12: Gable (insulation at ceiling level)	Calculated by person with suitable expertise	0.031 **(!)**	EMPF125E1201
External wall	E16: Corner (normal)	Calculated by person with suitable expertise	0.037 **(!)**	EMPF125E21601
External wall	E17: Corner (inverted - internal area greater than external area)	Calculated by person with suitable expertise	-0.09	EMPF125E21701

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

4 Space heating	
Main heating system 1: Heat pump with radiators or underfloor heating - Electricity	
Efficiency	242.0%
Emitter type	Radiators
Flow temperature	55°C
System type	Heat Pump
Manufacturer	Daikin Europe NV
Model	EDLA08EV3
Commissioning	
Secondary heating system: N/A	
Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water	
Cylinder/store - type: Cylinder	
Capacity	210 litres
Declared heat loss	1.7 kWh/day
Primary pipework insulated	Yes
Manufacturer	
Model	
Commissioning	
Waste water heat recovery system 1 - type: N/A	
Efficiency	
Manufacturer	
Model	

6 Controls	
Main heating 1 - type: Time and temperature zone control by arrangement of plumbing and electrical services	
Function	
Ecodesign class	
Manufacturer	
Model	
Water heating - type: Cylinder thermostat and HW separately timed	
Manufacturer	
Model	

7 Lighting		
Minimum permitted light source efficacy	*75 lm/W*	
Lowest light source efficacy	85 lm/W	**OK**
External lights control	N/A	

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

9 Local generation	
Technology type: **Photovoltaic system (1)**	
Peak power	2.01 kWp
Orientation	South East
Pitch	30°
Overshading	None or very little
Manufacturer	
MCS certificate	

10 Heat networks
N/A

11 Supporting documentary evidence
N/A

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

Full SAP Calculation Printout

Property Reference	DV1	**Issued on Date**	14/03/2025
Assessment Reference	Proposed	**Prop Type Ref**	Proposed 53
Property	53		

SAP Rating	86 B	**DER**	2.76	**TER**	9.83
Environmental	97 A	**% DER < TER**			71.92
CO_2 Emissions (t/year)	0.32	**DFEE**	38.63	**TFEE**	40.06
Compliance Check	See BREL	**% DFEE < TFEE**			3.57
% DPER < TPER	36.49	**DPER**	32.63	**TPER**	51.37

Assessor Details	Mr. Richard Millard	**Assessor ID**	U367-0001
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)	
Main dwelling						
Ground floor	66.3900 (1b)	x	2.4000 (2b)	=	159.3360	(1b) - (3b)
First floor	66.3900 (1c)	x	2.6000 (2c)	=	172.6140	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	132.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	331.9500	(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		5 * 10 =	50.0000	(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) =		50.0000 / (5) =	0.1506	(8)
Pressure test			Yes	
Pressure Test Method			Blower Door	
Measured/design AP50			5.0000	(17)
Infiltration rate			0.4006	(18)
Number of sides sheltered			2	(19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor		(21) = (18) x (20) =	0.3405	(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	0.4342	0.4257	0.4172	0.3746	0.3661	0.3235	0.3235	0.3150	0.3405	0.3661	0.3831	0.4001	(22b)
Effective ac	0.5943	0.5906	0.5870	0.5702	0.5670	0.5523	0.5523	0.5496	0.5580	0.5670	0.5734	0.5800	(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	
Main dwelling								
Windows			16.6100	1.1450	19.0191			(27)
Glazed Doors			5.0500	1.1450	5.7824			(27)
Doors			5.0800	1.2000	6.0960			(26a)
Heatloss Floor 1			66.3900	0.1200	7.9668	75.0000	4979.2500	(28a)
Cavity Wall	170.1800	26.7400	143.4400	0.1800	25.8192	60.0000	8606.3996	(29a)
External Roof 1	66.3900		66.3900	0.1100	7.3029	9.0000	597.5100	(30)
Total net area of external elements Aum(A, m2)			302.9600					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.9864			(33)
Main dwelling								
Internal Wall 1 - Block			51.6900			75.0000	3876.7499	(32c)
Internal Wall 2 - Stud			34.7000			9.0000	312.3000	(32c)
Internal Wall 3 - Up			206.8600			9.0000	1861.7400	(32c)
Internal Floor 1			66.3900			18.0000	1195.0200	(32d)
Internal Ceiling 1			66.3900			9.0000	597.5100	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		22026.4795	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							165.8870	(35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total

E1 Steel lintel with perforated steel base plate	18.6400	0.2410	4.4922	
E3 Sill	13.7900	0.0260	0.3585	
E4 Jamb	38.5800	0.0200	0.7716	
E5 Ground floor (normal)	34.0600	0.0450	1.5327	
E6 Intermediate floor within a dwelling	34.0600	0.0020	0.0681	
E10 Eaves (insulation at ceiling level)	13.8200	0.0500	0.6910	
E12 Gable (insulation at ceiling level)	20.2200	0.0310	0.6268	
E16 Corner (normal)	30.0000	0.0370	1.1100	
E17 Corner (inverted - internal area greater than external area)	10.0000	-0.0900	-0.9000	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 8.7510 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 80.7374 (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	65.0968	64.6958	64.3028	62.4570	62.1116	60.5039	60.5039	60.2062	61.1232	62.1116	62.8103	63.5407	(38)
Heat transfer coeff	145.8342	145.4333	145.0403	143.1944	142.8491	141.2414	141.2414	140.9436	141.8606	142.8491	143.5477	144.2781	(39)

Average = Sum(39)m / 12 = 143.1928

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0983	1.0953	1.0923	1.0784	1.0758	1.0637	1.0637	1.0615	1.0684	1.0758	1.0811	1.0866	(40)
HLP (average)												1.0784	
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 2.9019 (42)

Hot water usage for mixer showers

72.8744	71.7792	70.1834	67.1300	64.8766	62.3637	60.9354	62.5192	64.2553	66.9534	70.0724	72.5952	(42a)

Hot water usage for baths

31.4616	30.9943	30.3364	29.1232	28.2147	27.2074	26.6633	27.3167	28.0281	29.1060	30.3441	31.3552	(42b)

Hot water usage for other uses

44.3479	42.7352	41.1226	39.5099	37.8973	36.2846	36.2846	37.8973	39.5099	41.1226	42.7352	44.3479	(42c)

Average daily hot water use (litres/day) 136.6738 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	148.6839	145.5088	141.6423	135.7630	130.9886	125.8558	123.8834	127.7332	131.7934	137.1819	143.1518	148.2983	(44)
Energy conte	235.4789	207.2026	217.6989	185.8528	176.3359	154.7544	149.8262	158.1603	162.5144	186.1546	203.9459	232.1993	(45)

Energy content (annual) Total = Sum(45)m = 2270.1242

Distribution loss (46)m = 0.15 x (45)m												
35.3218	31.0804	32.6548	27.8779	26.4504	23.2132	22.4739	23.7241	24.3772	27.9232	30.5919	34.8299	(46)

Water storage loss:

Store volume 210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.7000 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 0.9180 (55)

Total storage loss												
28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(56)
If cylinder contains dedicated solar storage												
28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(57)
Primary loss 23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month												
287.1993	253.9178	269.4193	235.9048	228.0563	204.8064	201.5466	209.8807	212.5664	237.8750	253.9979	283.9197	(62)
WWHRS 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter -0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h												
287.1993	253.9178	269.4193	235.9048	228.0563	204.8064	201.5466	209.8807	212.5664	237.8750	253.9979	283.9197	(64)

Total per year (kWh/year) = Sum(64)m = 2879.0902 (64)
12Total per year (kWh/year) 2879 (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												
119.6730	106.2670	113.7612	101.8377	100.0080	91.4974	91.1935	93.9646	94.0776	103.2727	107.8536	118.5826	(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	145.0927	145.0927	145.0927	145.0927	145.0927	145.0927	145.0927	145.0927	145.0927	145.0927	145.0927	145.0927	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	157.8155	174.7243	157.8155	163.0760	157.8155	163.0760	157.8155	157.8155	163.0760	157.8155	163.0760	157.8155	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	301.0409	304.1647	296.2927	279.5341	258.3793	238.4968	225.2141	222.0902	229.9623	246.7209	267.8757	287.7581	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.5093	37.5093	37.5093	37.5093	37.5093	37.5093	37.5093	37.5093	37.5093	37.5093	37.5093	37.5093	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-116.0741	-116.0741	-116.0741	-116.0741	-116.0741	-116.0741	-116.0741	-116.0741	-116.0741	-116.0741	-116.0741	-116.0741	(71)
Water heating gains (Table 5)	160.8509	158.1354	152.9049	141.4412	134.4194	127.0798	122.5719	126.2966	130.6634	138.8074	149.7967	159.3852	(72)
Total internal gains	686.2350	703.5522	673.5408	650.5791	617.1419	595.1804	572.1293	572.7301	590.2295	609.8716	647.2761	671.4866	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	2.2300	11.2829	0.6300	0.7000	0.7700	7.6895	(75)
Southeast	5.1900	36.7938	0.6300	0.7000	0.7700	58.3599	(77)
Northwest	9.1900	11.2829	0.6300	0.7000	0.7700	31.6891	(81)
Southeast	5.0500	36.7938	0.6300	0.7000	0.7700	56.7856	(77)

Solar gains	154.5241	276.2916	412.7770	569.6849	691.2480	709.6297	674.4289	580.1629	466.5514	314.7286	187.4662	130.6991	(83)
Total gains	840.7591	979.8438	1086.3178	1220.2640	1308.3900	1304.8101	1246.5582	1152.8930	1056.7808	924.6002	834.7423	802.1857	(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	41.9549	42.0706	42.1846	42.7284	42.8317	43.3192	43.3192	43.4107	43.1301	42.8317	42.6232	42.4074	
alpha	3.7970	3.8047	3.8123	3.8486	3.8554	3.8879	3.8879	3.8940	3.8753	3.8554	3.8415	3.8272	
util living area	0.9884	0.9785	0.9593	0.9061	0.8001	0.6315	0.4813	0.5345	0.7634	0.9326	0.9792	0.9902	(86)
Living	19.2124	19.4583	19.8162	20.2980	20.6843	20.9101	20.9758	20.9639	20.8068	20.3015	19.6819	19.1791	
Non living	17.9133	18.2269	18.6797	19.2812	19.7307	19.9681	20.0196	20.0147	19.8749	19.2984	18.5212	17.8772	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	20.0855	19.4583	19.8162	20.2980	20.6843	20.9101	20.9758	20.9639	20.8068	20.3015	19.6819	19.4338	(87)
Th 2	20.0022	20.0047	20.0071	20.0185	20.0206	20.0306	20.0306	20.0324	20.0267	20.0206	20.0163	20.0118	(88)
util rest of house	0.9858	0.9738	0.9500	0.8842	0.7543	0.5547	0.3826	0.4334	0.6958	0.9122	0.9738	0.9880	(89)
MIT 2	19.1694	18.2269	18.6797	19.2812	19.7307	19.9681	20.0196	20.0147	19.8749	19.2984	18.5212	18.2618	(90)
Living area fraction										fLA = Living area / (4) =		0.1321	(91)
MIT	19.2905	18.3895	18.8299	19.4155	19.8566	20.0926	20.1459	20.1401	19.9980	19.4309	18.6746	18.4166	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.2905	18.3895	18.8299	19.4155	19.8566	20.0926	20.1459	20.1401	19.9980	19.4309	18.6746	18.4166	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9835	0.9630	0.9354	0.8679	0.7457	0.5599	0.3948	0.4452	0.6936	0.8965	0.9633	0.9831	(94)
Useful gains	826.8745	943.6024	1016.1921	1059.0849	975.6605	730.5554	492.0837	513.2512	732.9808	828.8937	804.1373	788.5992	(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	2186.1207	1961.8279	1788.3260	1505.7601	1165.1674	775.7783	500.8318	527.1387	836.6904	1261.4850	1661.5009	2051.1493	(97)
Space heating kWh	1011.2791	684.2475	574.4676	321.6062	140.9931	0.0000	0.0000	0.0000	0.0000	321.8480	617.3018	939.3373	(98a)
Space heating requirement - total per year (kWh/year)												4611.0806	
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	1011.2791	684.2475	574.4676	321.6062	140.9931	0.0000	0.0000	0.0000	0.0000	321.8480	617.3018	939.3373	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4611.0806	
Space heating per m2											(98c) / (4) =	34.7272	(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 %) 241.9849 (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	1011.2791	684.2475	574.4676	321.6062	140.9931	0.0000	0.0000	0.0000	0.0000	321.8480	617.3018	939.3373	(98)
Space heating efficiency (main heating system 1)	241.9849	241.9849	241.9849	241.9849	241.9849	0.0000	0.0000	0.0000	0.0000	241.9849	241.9849	241.9849	(210)
Space heating fuel (main heating system)	417.9100	282.7646	237.3981	132.9034	58.2652	0.0000	0.0000	0.0000	0.0000	133.0033	255.0993	388.1801	(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	287.1993	253.9178	269.4193	235.9048	228.0563	204.8064	201.5466	209.8807	212.5664	237.8750	253.9979	283.9197	(64)
Efficiency of water heater												165.7423	(216)
(217)m	165.7423	165.7423	165.7423	165.7423	165.7423	165.7423	165.7423	165.7423	165.7423	165.7423	165.7423	165.7423	(217)
Fuel for water heating, kWh/month	173.2806	153.2003	162.5531	142.3323	137.5969	123.5691	121.6024	126.6307	128.2511	143.5210	153.2487	171.3018	(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	32.1207	25.7684	23.2016	16.9985	13.1301	10.7274	11.9777	15.5691	20.2227	26.5333	29.9693	33.0134	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-35.8566	-55.6098	-87.9494	-105.6644	-116.8529	-106.5104	-104.8801	-96.2192	-80.9754	-65.3453	-40.5889	-30.2004	(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	-8.4453	-20.3370	-45.8874	-78.7959	-114.4013	-121.9682	-120.1256	-98.3262	-67.9869	-33.0486	-12.3786	-6.5785	(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												1905.5242	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												165.7423	
Water heating fuel used												1737.0880	(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)	259.2325	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-1654.9322	(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	2246.9125	(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	1905.5242	0.1555	296.2616	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1737.0880	0.1410	244.8808	(264)
Space and water heating			541.1424	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	259.2325	0.1443	37.4153	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-926.6527	0.1335	-123.7501	
PV Unit electricity exported	-728.2795	0.1221	-88.9149	
Total			-212.6650	(269)
Total CO2, kg/year			365.8927	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			2.7600	(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	1905.5242	1.5756	3002.2815	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1737.0880	1.5213	2642.5745	(278)
Space and water heating			5644.8561	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	259.2325	1.5338	397.6195	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-926.6527	1.4935	-1383.9718	
PV Unit electricity exported	-728.2795	0.4479	-326.2203	
Total			-1710.1921	(283)
Total Primary energy kWh/year			4332.2834	(286)
Dwelling Primary energy Rate (DPER)			32.6300	(287)

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Main dwelling						
Ground floor	66.3900	(1b) x	2.4000	(2b) =	159.3360	(1b) - (3b)
First floor	66.3900	(1c) x	2.6000	(2c) =	172.6140	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	132.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		331.9500	(5)

2. Ventilation rate

	m3 per hour		
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	4 * 10 =	40.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1205	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3705	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3149	(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	0.4015	0.3937	0.3858	0.3464	0.3385	0.2992	0.2992	0.2913	0.3149	0.3385	0.3543	0.3700	(22b)
Effective ac	0.5806	0.5775	0.5744	0.5600	0.5573	0.5448	0.5448	0.5424	0.5496	0.5573	0.5628	0.5685	(25)

3. Heat losses and heat loss parameter

Element	Gross	Openings	NetArea	U-value	A x U	K-value	A x K	
	m2	m2	m2	W/m2K	W/K	kJ/m2K	kJ/K	
Main dwelling								
TER Semi-glazed door			5.0800	1.0000	5.0800			(26a)
TER Opening Type			21.6600	1.1450	24.8015			(27)
Heatloss Floor 1			66.3900	0.1300	8.6307			(28a)
Cavity Wall	170.1800	26.7400	143.4400	0.1800	25.8192			(29a)
External Roof 1	66.3900		66.3900	0.1100	7.3029			(30)
Total net area of external elements Aum(A, m2)			302.9600					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	71.6343			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 165.8870 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	18.6400	0.0500	0.9320
E3 Sill	13.7900	0.0500	0.6895
E4 Jamb	38.5800	0.0500	1.9290
E5 Ground floor (normal)	34.0600	0.1600	5.4496
E6 Intermediate floor within a dwelling	34.0600	0.0000	0.0000
E10 Eaves (insulation at ceiling level)	13.8200	0.0600	0.8292
E12 Gable (insulation at ceiling level)	20.2200	0.0600	1.2132
E16 Corner (normal)	30.0000	0.0900	2.7000
E17 Corner (inverted - internal area greater than external area)	10.0000	-0.0900	-0.9000

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 12.8425 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 84.4768 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	63.6024	63.2595	62.9234	61.3446	61.0493	59.6743	59.6743	59.4196	60.2039	61.0493	61.6468	62.2715	(38)
Heat transfer coeff	148.0792	147.7363	147.4002	145.8215	145.5261	144.1511	144.1511	143.8965	144.6807	145.5261	146.1236	146.7483	(39)
Average = Sum(39)m / 12 =												145.8201	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1152	1.1126	1.1101	1.0982	1.0960	1.0856	1.0856	1.0837	1.0896	1.0960	1.1005	1.1052	(40)
HLP (average)												1.0982	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.9019 (42)

Hot water usage for mixer showers

72.8744	71.7792	70.1834	67.1300	64.8766	62.3637	60.9354	62.5192	64.2553	66.9534	70.0724	72.5952	(42a)

Hot water usage for baths

31.4616	30.9943	30.3364	29.1232	28.2147	27.2074	26.6633	27.3167	28.0281	29.1060	30.3441	31.3552	(42b)

Hot water usage for other uses

44.3479	42.7352	41.1226	39.5099	37.8973	36.2846	36.2846	37.8973	39.5099	41.1226	42.7352	44.3479	(42c)

Average daily hot water use (litres/day) 136.6738 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	148.6839	145.5088	141.6423	135.7630	130.9886	125.8558	123.8834	127.7332	131.7934	137.1819	143.1518	148.2983	(44)
Energy conte	235.4789	207.2026	217.6989	185.8528	176.3359	154.7544	149.8262	158.1603	162.5144	186.1546	203.9459	232.1993	(45)
Energy content (annual)										Total = Sum(45)m =		2270.1242	
Distribution loss (46)m = 0.15 x (45)m	35.3218	31.0804	32.6548	27.8779	26.4504	23.2132	22.4739	23.7241	24.3772	27.9232	30.5919	34.8299	(46)

Water storage loss:

Store volume	210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):	1.7016	(48)
Temperature factor from Table 2b	0.5400	(49)
Enter (49) or (54) in (55)	0.9188	(55)

Total storage loss

28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(56)

If cylinder contains dedicated solar storage

28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(57)

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

Total heat required for water heating calculated for each month

287.2255	253.9414	269.4455	235.9302	228.0825	204.8317	201.5728	209.9069	212.5917	237.9012	254.0233	283.9459	(62)

WWHRS	-33.3151	-29.4642	-30.8532	-25.5477	-23.8095	-20.3740	-19.0973	-20.3081	-21.0797	-24.8506	-28.1527	-32.6982	(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

253.9103	224.4773	238.5923	210.3825	204.2730	184.4578	182.4754	189.5988	191.5121	213.0506	225.8705	251.2477	(64)
								Total per year (kWh/year) = Sum(64)m =			2569.8483	(64)
12Total per year (kWh/year)											2570	(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

119.6940	106.2859	113.7822	101.8579	100.0289	91.5177	91.2145	93.9856	94.0979	103.2937	107.8739	118.6035	(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	145.0927	145.0927	145.0927	145.0927	145.0927	145.0927	145.0927	145.0927	145.0927	145.0927	145.0927	145.0927	(66)

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

157.8155	174.7243	157.8155	163.0760	157.8155	163.0760	157.8155	157.8155	163.0760	157.8155	163.0760	157.8155	(67)

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

301.0409	304.1647	296.2927	279.5341	258.3793	238.4968	225.2141	222.0902	229.9623	246.7209	267.8757	287.7581	(68)

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

	37.5093	37.5093	37.5093	37.5093	37.5093	37.5093	37.5093	37.5093	37.5093	37.5093	37.5093	37.5093	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-116.0741	-116.0741	-116.0741	-116.0741	-116.0741	-116.0741	-116.0741	-116.0741	-116.0741	-116.0741	-116.0741	-116.0741	(71)
Water heating gains (Table 5)													
	160.8790	158.1636	152.9330	141.4694	134.4475	127.1079	122.6001	126.3247	130.6915	138.8356	149.8249	159.4133	(72)
Total internal gains													
	689.2632	706.5804	676.5690	653.6072	620.1701	595.2085	572.1575	572.7582	590.2576	612.8998	650.3043	674.5148	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	2.2300	11.2829	0.6300	0.7000	0.7700	7.6895	(75)
Southeast	10.2400	36.7938	0.6300	0.7000	0.7700	115.1455	(77)
Northwest	9.1900	11.2829	0.6300	0.7000	0.7700	31.6891	(81)

Solar gains	154.5241	276.2916	412.7770	569.6849	691.2480	709.6297	674.4289	580.1629	466.5514	314.7286	187.4662	130.6991	(83)
Total gains	843.7872	982.8720	1089.3460	1223.2921	1311.4181	1304.8383	1246.5864	1152.9211	1056.8090	927.6284	837.7705	805.2138	(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	41.3189	41.4148	41.5092	41.9586	42.0438	42.4448	42.4448	42.5199	42.2894	42.0438	41.8718	41.6936	
alpha	3.7546	3.7610	3.7673	3.7972	3.8029	3.8297	3.8297	3.8347	3.8193	3.8029	3.7915	3.7796	
util living area													
	0.9883	0.9785	0.9597	0.9078	0.8041	0.6395	0.4893	0.5429	0.7694	0.9335	0.9792	0.9901	(86)
MIT	19.1816	19.4272	19.7871	20.2713	20.6668	20.9014	20.9728	20.9597	20.7932	20.2781	19.6518	19.1447	(87)
Th 2	19.9884	19.9905	19.9926	20.0023	20.0041	20.0126	20.0126	20.0142	20.0093	20.0041	20.0004	19.9966	(88)
util rest of house													
	0.9857	0.9738	0.9504	0.8859	0.7583	0.5614	0.3878	0.4391	0.7015	0.9132	0.9738	0.9879	(89)
MIT 2	17.8652	18.1781	18.6334	19.2371	19.6979	19.9441	20.0003	19.9944	19.8466	19.2581	18.4726	17.8235	(90)
Living area fraction									fLA = Living area / (4) =			0.1321	(91)
MIT	18.0391	18.3431	18.7858	19.3737	19.8259	20.0705	20.1288	20.1219	19.9716	19.3929	18.6284	17.9980	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.0391	18.3431	18.7858	19.3737	19.8259	20.0705	20.1288	20.1219	19.9716	19.3929	18.6284	17.9980	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9782	0.9628	0.9356	0.8692	0.7490	0.5663	0.4001	0.4511	0.6986	0.8971	0.9631	0.9813	(94)
Useful gains	825.3724	946.3571	1019.1524	1063.3029	982.2603	738.8678	498.8203	520.0279	738.3110	832.1849	806.8827	790.1674	(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													
	2034.4728	1986.0274	1810.9233	1527.2966	1182.5264	788.5854	508.6756	535.5682	849.5111	1279.5934	1684.5671	2024.8357	(97)
Space heating kWh													
	899.5707	698.6585	589.0776	334.0754	148.9980	0.0000	0.0000	0.0000	0.0000	332.8720	631.9327	918.5932	(98a)
Space heating requirement - total per year (kWh/year)												4553.7781	
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													
	899.5707	698.6585	589.0776	334.0754	148.9980	0.0000	0.0000	0.0000	0.0000	332.8720	631.9327	918.5932	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4553.7781	
Space heating per m2											(98c) / (4) =	34.2957	(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													
	899.5707	698.6585	589.0776	334.0754	148.9980	0.0000	0.0000	0.0000	0.0000	332.8720	631.9327	918.5932	(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)													
	974.6162	756.9431	638.2205	361.9452	161.4279	0.0000	0.0000	0.0000	0.0000	360.6413	684.6509	995.2256	(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													
	253.9103	224.4773	238.5923	210.3825	204.2730	184.4578	182.4754	189.5988	191.5121	213.0506	225.8705	251.2477	(64)
Efficiency of water heater												79.8000	(216)
(217)m	86.6488	86.4297	86.0039	85.0917	83.3635	79.8000	79.8000	79.8000	79.8000	85.0563	86.2390	86.6999	(217)
Fuel for water heating, kWh/month													
	293.0337	259.7225	277.4205	247.2420	245.0388	231.1501	228.6660	237.5925	239.9900	250.4818	261.9124	289.7899	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	32.7909	26.3061	23.6857	17.3532	13.4041	10.9513	12.2277	15.8940	20.6447	27.0870	30.5947	33.7023	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-58.7791	-81.2106	-114.3910	-125.8966	-133.4255	-123.6101	-121.9689	-116.2067	-105.8014	-91.4610	-63.9834	-51.0049	(233a)

Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233b)m	-38.4289	-80.1865	-158.2322	-236.0637	-310.6801	-311.7312	-308.1645	-261.6706	-192.7268	-114.2602	-51.1605	-30.4477 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235b)m	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	(235d)

Annual totals kWh/year		
Space heating fuel - main system 1	4933.6707	(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	3062.0403	(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)	264.6417	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-3281.4921	(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	5064.8606	(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	4933.6707	0.2100	1036.0708	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3062.0403	0.2100	643.0285	(264)
Space and water heating			1679.0993	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	264.6417	0.1443	38.1960	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1187.7392	0.1350	-160.4006	
PV Unit electricity exported	-2093.7529	0.1261	-263.9958	
Total			-424.3964	(269)
Total CO2, kg/year			1304.8282	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			9.8300	(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	4933.6707	1.1300	5575.0479	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3062.0403	1.1300	3460.1055	(278)
Space and water heating			9035.1534	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	264.6417	1.5338	405.9162	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1187.7392	1.4991	-1780.5831	
PV Unit electricity exported	-2093.7529	0.4628	-969.0630	
Total			-2749.6461	(283)
Total Primary energy kWh/year			6821.5243	(286)
Target Primary Energy Rate (TPER)			51.3700	(287)

Building Regulations England Part L (BREL) Compliance Report

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

Date: Fri 14 Mar 2025 09:30:54

Project Information			
Assessed By	Richard Millard	Building Type	House, Detached
OCDEA Registration	EES/025661	Assessment Date	2025-03-14

Dwelling Details			
Assessment Type	As designed	Total Floor Area	133 m^2
Site Reference	DV1	Plot Reference	Regulated (Baseline)
Address	53		

Client Details	
Name	Ian White
Company	Cotswold Homes Ltd
Address	West House, Yate, Bristol, BS37 5NG

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

1a Target emission rate and dwelling emission rate		
Fuel for main heating system	Mains gas	
Target carbon dioxide emission rate	*9.83 $kgCO_2/m^2$*	
Dwelling carbon dioxide emission rate	13.87 $kgCO_2/m^2$	**FAIL**
1b Target primary energy rate and dwelling primary energy		
Target primary energy	*51.37 kWh_{PE}/m^2*	
Dwelling primary energy	76.61 kWh_{PE}/m^2	**FAIL**
1c Target fabric energy efficiency and dwelling fabric energy efficiency		
Target fabric energy efficiency	*40.1 kWh/m^2*	
Dwelling fabric energy efficiency	40.1 kWh/m^2	**OK**

2a Fabric U-values				
Element	***Maximum permitted average U-Value [W/m^2K]***	**Dwelling average U-Value [W/m^2K]**	**Element with highest individual U-Value**	
External walls	*0.26*	0.18	Walls (1) (0.18)	**OK**
Party walls	*0.2*	N/A	N/A	**N/A**
Curtain walls	*1.6*	N/A	N/A	**N/A**
Floors	*0.18*	0.13	Heatloss Floor 1 (0.13)	**OK**
Roofs	*0.16*	0.11	Roof (1) (0.11)	**OK**
Windows, doors, and roof windows	*1.6*	1.2	WG01 (1.2)	**OK**
Rooflights	*2.2*	N/A	N/A	**N/A**

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))		
Name	**Net area [m^2]**	**U-Value [W/m^2K]**
Exposed wall: Walls (1)	143.44	0.18
Ground floor: Heatloss Floor 1, Heatloss Floor 1	66.39	0.13
Exposed roof: Roof (1)	66.39	0.11

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	**Area [m^2]**	**Orientation**	**Frame factor**	**U-Value [W/m^2K]**
WG01, Windows	2.12	North West	0.7	1.2
WG02, Windows	2.12	North West	0.7	1.2
WG03, Windows	1.64	South East	0.7	1.2
WG04, Windows	0.67	North East	0.7	1.2
WG05, Windows	1.56	North East	0.7	1.2
FG01, Windows	2.16	North West	0.7	1.2
FG02, Windows	0.67	North West	0.7	1.2
FG03, Windows	2.12	North West	0.7	1.2
FG04, Windows	1.45	South East	0.7	1.2
FG05, Windows	0.66	South East	0.7	1.2
FG06, Windows	1.44	South East	0.7	1.2
ED01, Doors	3.08	North West	N/A	1.2
ED02, Doors	2	South East	N/A	1.2
ED03, Glazed Doors	5.05	South East	0.7	1.2

Name	Area [m^2]	Orientation	Frame factor	U-Value [W/m^2K]

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))				
Building part **1**: Thermal bridging calculated from linear thermal transmittances for each junction				
Main element	**Junction detail**	**Source**	**Psi value [W/mK]**	**Drawing / reference**
External wall	E2: Other lintels (including other steel lintels)	Calculated by person with suitable expertise	0.05	mpf125e2-04
External wall	E3: Sill	Calculated by person with suitable expertise	0.05	mpf125e3-01
External wall	E4: Jamb	Calculated by person with suitable expertise	0.022 **(!)**	mpf125e4-01
External wall	E5: Ground floor (normal)	Calculated by person with suitable expertise	0.16	mpf125e5-04
External wall	E6: Intermediate floor within a dwelling	Calculated by person with suitable expertise	0.003 **(!)**	mpf125e6-01
External wall	E10: Eaves (insulation at ceiling level)	Calculated by person with suitable expertise	0.06	mpf125e10-01
External wall	E12: Gable (insulation at ceiling level)	Calculated by person with suitable expertise	0.06	mpf125e12-01
External wall	E16: Corner (normal)	Calculated by person with suitable expertise	0.09	mpf125e16-01
External wall	E17: Corner (inverted - internal area greater than external area)	Calculated by person with suitable expertise	-0.085	mpf125e17-01

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

4 Space heating	
Main heating system 1: Boiler with radiators or underfloor heating - Mains gas	
Efficiency	88.6%
Emitter type	Radiators
Flow temperature	45°C
System type	Regular boiler
Manufacturer	Bosch Thermotechnology
Model	Greenstar 8000 Life
Commissioning	
Secondary heating system: N/A	
Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water	
Cylinder/store - type: Cylinder	
Capacity	210 litres
Declared heat loss	1.7 kWh/day
Primary pipework insulated	Yes
Manufacturer	
Model	
Commissioning	
Waste water heat recovery system 1 - type: N/A	
Efficiency	
Manufacturer	
Model	

6 Controls	
Main heating 1 - type: Time and temperature zone control by arrangement of plumbing and electrical services	
Function	
Ecodesign class	
Manufacturer	
Model	
Water heating - type: Cylinder thermostat and HW separately timed	
Manufacturer	
Model	

7 Lighting		
Minimum permitted light source efficacy	*75 lm/W*	
Lowest light source efficacy	85 lm/W	OK
External lights control	N/A	

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

9 Local generation
N/A

10 Heat networks
N/A

11 Supporting documentary evidence
N/A

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

Full SAP Calculation Printout

Property Reference	DV1	**Issued on Date**	14/03/2025
Assessment Reference	Regulated (Baseline)	**Prop Type Ref**	Proposed 53
Property	53		

SAP Rating	85 B	**DER**	13.87	**TER**	9.83
Environmental	86 B	**% DER < TER**			-41.10
CO_2 Emissions (t/year)	1.72	**DFEE**	40.09	**TFEE**	40.06
Compliance Check	See BREL	**% DFEE < TFEE**			-0.08
% DPER < TPER	-49.13	**DPER**	76.61	**TPER**	51.37

Assessor Details	Mr. Richard Millard	**Assessor ID**	U367-0001
Client			

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Main dwelling						
Ground floor	66.3900 (1b)	x	2.4000 (2b)	=	159.3360	(1b) - (3b)
First floor	66.3900 (1c)	x	2.6000 (2c)	=	172.6140	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	132.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	331.9500	(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		5 * 10 =	50.0000	(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) =		50.0000 / (5) =	0.1506	(8)
Pressure test			Yes	
Pressure Test Method			Blower Door	
Measured/design AP50			5.0000	(17)
Infiltration rate			0.4006	(18)
Number of sides sheltered			2	(19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor		(21) = (18) x (20) =	0.3405	(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	0.4342	0.4257	0.4172	0.3746	0.3661	0.3235	0.3235	0.3150	0.3405	0.3661	0.3831	0.4001	(22b)
Effective ac	0.5943	0.5906	0.5870	0.5702	0.5670	0.5523	0.5523	0.5496	0.5580	0.5670	0.5734	0.5800	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Main dwelling								
Windows			16.6100	1.1450	19.0191			(27)
Glazed Doors			5.0500	1.1450	5.7824			(27)
Doors			5.0800	1.2000	6.0960			(26a)
Heatloss Floor 1			66.3900	0.1300	8.6307	75.0000	4979.2500	(28a)
Cavity Wall	170.1800	26.7400	143.4400	0.1800	25.8192	60.0000	8606.4000	(29a)
External Roof 1	66.3900		66.3900	0.1100	7.3029	9.0000	597.5100	(30)
Total net area of external elements Aum(A, m2)			302.9600					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		72.6503			(33)
Main dwelling								
Internal Wall 1 - Block			51.6900			75.0000	3876.7500	(32c)
Internal Wall 2 - Stud			34.7000			9.0000	312.3000	(32c)
Internal Wall 3 - Up			206.8600			9.0000	1861.7400	(32c)
Internal Floor 1			66.3900			18.0000	1195.0200	(32d)
Internal Ceiling 1			66.3900			9.0000	597.5100	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		22026.4800	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							165.8870	(35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total

E2 Other lintels (including other steel lintels)	18.6400	0.0500	0.9320	
E3 Sill	13.7900	0.0500	0.6895	
E4 Jamb	38.5800	0.0220	0.8488	
E5 Ground floor (normal)	34.0600	0.1600	5.4496	
E6 Intermediate floor within a dwelling	34.0600	0.0030	0.1022	
E10 Eaves (insulation at ceiling level)	13.8200	0.0600	0.8292	
E12 Gable (insulation at ceiling level)	20.2200	0.0600	1.2132	
E16 Corner (normal)	30.0000	0.0900	2.7000	
E17 Corner (inverted - internal area greater than external area)	10.0000	-0.0850	-0.8500	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 11.9144 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 84.5648 (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	65.0968	64.6958	64.3028	62.4570	62.1116	60.5039	60.5039	60.2062	61.1232	62.1116	62.8103	63.5407	(38)
Heat transfer coeff	149.6615	149.2606	148.8676	147.0217	146.6764	145.0687	145.0687	144.7709	145.6879	146.6764	147.3750	148.1054	(39)

Average = Sum(39)m / 12 = 147.0201

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1271	1.1241	1.1212	1.1073	1.1047	1.0925	1.0925	1.0903	1.0972	1.1047	1.1099	1.1154	(40)
HLP (average)												1.1072	
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 2.9019 (42)

Hot water usage for mixer showers

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
72.8744	71.7792	70.1834	67.1300	64.8766	62.3637	60.9354	62.5192	64.2553	66.9534	70.0724	72.5952	(42a)

Hot water usage for baths

31.4616	30.9943	30.3364	29.1232	28.2147	27.2074	26.6633	27.3167	28.0281	29.1060	30.3441	31.3552	(42b)

Hot water usage for other uses

44.3479	42.7352	41.1226	39.5099	37.8973	36.2846	36.2846	37.8973	39.5099	41.1226	42.7352	44.3479	(42c)

Average daily hot water use (litres/day) 136.6738 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	148.6839	145.5088	141.6423	135.7630	130.9886	125.8558	123.8834	127.7332	131.7934	137.1819	143.1518	148.2983	(44)
Energy conte	235.4789	207.2026	217.6989	185.8528	176.3359	154.7544	149.8262	158.1603	162.5144	186.1546	203.9459	232.1993	(45)

Energy content (annual) Total = Sum(45)m = 2270.1242

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

35.3218	31.0804	32.6548	27.8779	26.4504	23.2132	22.4739	23.7241	24.3772	27.9232	30.5919	34.8299	(46)

Water storage loss:

Store volume 210.0000 (47)

a) If manufacturer declared loss factor is known (kWh/day): 1.7000 (48)

Temperature factor from Table 2b 0.5400 (49)

Enter (49) or (54) in (55) 0.9180 (55)

Total storage loss

28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(56)

If cylinder contains dedicated solar storage

28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(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

287.1993	253.9178	269.4193	235.9048	228.0563	204.8064	201.5466	209.8807	212.5664	237.8750	253.9979	283.9197	(62)
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
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

287.1993	253.9178	269.4193	235.9048	228.0563	204.8064	201.5466	209.8807	212.5664	237.8750	253.9979	283.9197	(64)

Total per year (kWh/year) = Sum(64)m = 2879.0902 (64)

12Total per year (kWh/year) 2879 (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

119.6730	106.2670	113.7612	101.8377	100.0080	91.4974	91.1935	93.9646	94.0776	103.2727	107.8536	118.5826	(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	145.0927	145.0927	145.0927	145.0927	145.0927	145.0927	145.0927	145.0927	145.0927	145.0927	145.0927	145.0927	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	157.8155	174.7243	157.8155	163.0760	157.8155	163.0760	157.8155	157.8155	163.0760	157.8155	163.0760	157.8155	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	301.0409	304.1647	296.2927	279.5341	258.3793	238.4968	225.2141	222.0902	229.9623	246.7209	267.8757	287.7581	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.5093	37.5093	37.5093	37.5093	37.5093	37.5093	37.5093	37.5093	37.5093	37.5093	37.5093	37.5093	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-116.0741	-116.0741	-116.0741	-116.0741	-116.0741	-116.0741	-116.0741	-116.0741	-116.0741	-116.0741	-116.0741	-116.0741	(71)
Water heating gains (Table 5)	160.8509	158.1354	152.9049	141.4412	134.4194	127.0798	122.5719	126.2966	130.6634	138.8074	149.7967	159.3852	(72)
Total internal gains	689.2350	706.5522	676.5408	653.5791	620.1419	595.1804	572.1293	572.7301	590.2295	612.8716	650.2761	674.4866	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	2.2300	11.2829	0.6300	0.7000	0.7700	7.6895	(75)
Southeast	5.1900	36.7938	0.6300	0.7000	0.7700	58.3599	(77)
Northwest	9.1900	11.2829	0.6300	0.7000	0.7700	31.6891	(81)
Southeast	5.0500	36.7938	0.6300	0.7000	0.7700	56.7856	(77)

Solar gains	154.5241	276.2916	412.7770	569.6849	691.2480	709.6297	674.4289	580.1629	466.5514	314.7286	187.4662	130.6991	(83)
Total gains	843.7591	982.8438	1089.3178	1223.2640	1311.3900	1304.8101	1246.5582	1152.8930	1056.7808	927.6002	837.7423	805.1857	(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	40.8820	40.9918	41.1001	41.6161	41.7141	42.1763	42.1763	42.2631	41.9971	41.7141	41.5163	41.3116	
alpha	3.7255	3.7328	3.7400	3.7744	3.7809	3.8118	3.8118	3.8175	3.7998	3.7809	3.7678	3.7541	
util living area	0.9883	0.9787	0.9601	0.9087	0.8061	0.6419	0.4918	0.5453	0.7714	0.9341	0.9794	0.9902	(86)
MIT	19.1578	19.4046	19.7673	20.2582	20.6586	20.8986	20.9718	20.9584	20.7882	20.2670	19.6357	19.1241	(87)
Th 2	19.9787	19.9812	19.9836	19.9949	19.9970	20.0069	20.0069	20.0088	20.0031	19.9970	19.9927	19.9883	(88)
util rest of house	0.9857	0.9739	0.9508	0.8870	0.7603	0.5634	0.3894	0.4408	0.7035	0.9139	0.9739	0.9879	(89)
MIT 2	17.8286	18.1434	18.6025	19.2158	19.6832	19.9365	19.9942	19.9884	19.8364	19.2396	18.4472	17.7919	(90)
Living area fraction										fLA = Living area / (4) =		0.1321	(91)
MIT	18.0042	18.3100	18.7564	19.3535	19.8120	20.0636	20.1233	20.1165	19.9622	19.3753	18.6042	17.9679	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8542	18.1600	18.6064	19.2035	19.6620	19.9136	19.9733	19.9665	19.8122	19.2253	18.4542	17.8179	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9774	0.9617	0.9337	0.8657	0.7427	0.5554	0.3857	0.4361	0.6885	0.8933	0.9617	0.9806	(94)
Useful gains	824.6899	945.1967	1017.1258	1059.0107	974.0242	724.7453	480.8535	502.7643	727.6363	828.5920	805.6971	789.5872	(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	2028.5449	1979.1954	1802.2466	1514.8425	1167.8373	770.8309	489.3671	516.3266	832.1947	1265.1349	1673.3304	2016.8871	(97)
Space heating kWh	895.6681	694.8472	584.1299	328.1989	144.1969	0.0000	0.0000	0.0000	0.0000	324.7880	624.6960	913.1112	(98a)
Space heating requirement - total per year (kWh/year)												4509.6361	
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	895.6681	694.8472	584.1299	328.1989	144.1969	0.0000	0.0000	0.0000	0.0000	324.7880	624.6960	913.1112	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4509.6361	
Space heating per m2											(98c) / (4) =	33.9632	(99)

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

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

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

Efficiency of main space heating system 1 (in %) 88.6000 (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	895.6681	694.8472	584.1299	328.1989	144.1969	0.0000	0.0000	0.0000	0.0000	324.7880	624.6960	913.1112	(98)
Space heating efficiency (main heating system 1)	88.6000	88.6000	88.6000	88.6000	88.6000	0.0000	0.0000	0.0000	0.0000	88.6000	88.6000	88.6000	(210)
Space heating fuel (main heating system)	1010.9121	784.2519	659.2888	370.4277	162.7505	0.0000	0.0000	0.0000	0.0000	366.5778	705.0745	1030.5995	(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	287.1993	253.9178	269.4193	235.9048	228.0563	204.8064	201.5466	209.8807	212.5664	237.8750	253.9979	283.9197	(64)
Efficiency of water heater												79.6000	(216)
(217)m	86.2327	85.9977	85.5469	84.5998	82.8604	79.6000	79.6000	79.6000	79.6000	84.5581	85.7959	86.2860	(217)
Fuel for water heating, kWh/month	333.0514	295.2610	314.9374	278.8478	275.2294	257.2944	253.1992	263.6693	267.0432	281.3154	296.0489	329.0448	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	32.1207	25.7684	23.2016	16.9985	13.1301	10.7274	11.9777	15.5691	20.2227	26.5333	29.9693	33.0134	(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 5089.8828 (211)

Space heating fuel - main system 2 0.0000 (213)

Space heating fuel - secondary 0.0000 (215)

Efficiency of water heater 79.6000

Water heating fuel used 3444.9423 (219)

Space cooling fuel 0.0000 (221)

Electricity for pumps and fans:

central heating pump 41.0000 (230c)

main heating flue fan 45.0000 (230e)

Total electricity for the above, kWh/year	86.0000	(231)
Electricity for lighting (calculated in Appendix L)	259.2325	(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	8880.0576	(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	5089.8828	0.2100	1068.8754	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3444.9423	0.2100	723.4379	(264)
Space and water heating			1792.3133	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	259.2325	0.1443	37.4153	(268)
Total CO2, kg/year			1841.6578	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			13.8700	(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	5089.8828	1.1300	5751.5675	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3444.9423	1.1300	3892.7848	(278)
Space and water heating			9644.3524	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	259.2325	1.5338	397.6195	(282)
Total Primary energy kWh/year			10172.0726	(286)
Dwelling Primary energy Rate (DPER)			76.6100	(287)

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Main dwelling						
Ground floor	66.3900	(1b) x	2.4000	(2b) =	159.3360	(1b) - (3b)
First floor	66.3900	(1c) x	2.6000	(2c) =	172.6140	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	132.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		331.9500	(5)

2. Ventilation rate

	m3 per hour	
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	4 * 10 =	40.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)
	Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1205 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.3705 (18)
Number of sides sheltered		2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3149 (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	0.4015	0.3937	0.3858	0.3464	0.3385	0.2992	0.2992	0.2913	0.3149	0.3385	0.3543	0.3700	(22b)
Effective ac	0.5806	0.5775	0.5744	0.5600	0.5573	0.5448	0.5448	0.5424	0.5496	0.5573	0.5628	0.5685	(25)

3. Heat losses and heat loss parameter

Element	Gross	Openings	NetArea	U-value	A x U	K-value	A x K	
Main dwelling	m2	m2	m2	W/m2K	W/K	kJ/m2K	kJ/K	
TER Semi-glazed door			5.0800	1.0000	5.0800			(26a)
TER Opening Type			21.6600	1.1450	24.8015			(27)
Heatloss Floor 1			66.3900	0.1300	8.6307			(28a)
Cavity Wall	170.1800	26.7400	143.4400	0.1800	25.8192			(29a)
External Roof 1	66.3900		66.3900	0.1100	7.3029			(30)
Total net area of external elements Aum(A, m2)			302.9600					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.6343			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 165.8870 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	18.6400	0.0500	0.9320
E3 Sill	13.7900	0.0500	0.6895
E4 Jamb	38.5800	0.0500	1.9290
E5 Ground floor (normal)	34.0600	0.1600	5.4496
E6 Intermediate floor within a dwelling	34.0600	0.0000	0.0000
E10 Eaves (insulation at ceiling level)	13.8200	0.0600	0.8292
E12 Gable (insulation at ceiling level)	20.2200	0.0600	1.2132
E16 Corner (normal)	30.0000	0.0900	2.7000
E17 Corner (inverted - internal area greater than external area)	10.0000	-0.0900	-0.9000

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 12.8425 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 84.4768 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	63.6024	63.2595	62.9234	61.3446	61.0493	59.6743	59.6743	59.4196	60.2039	61.0493	61.6468	62.2715	(38)
Heat transfer coeff	148.0792	147.7363	147.4002	145.8215	145.5261	144.1511	144.1511	143.8965	144.6807	145.5261	146.1236	146.7483	(39)
Average = Sum(39)m / 12 =												145.8201	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1152	1.1126	1.1101	1.0982	1.0960	1.0856	1.0856	1.0837	1.0896	1.0960	1.1005	1.1052	(40)
HLP (average)												1.0982	
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 2.9019 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	72.8744	71.7792	70.1834	67.1300	64.8766	62.3637	60.9354	62.5192	64.2553	66.9534	70.0724	72.5952	(42a)
Hot water usage for baths	31.4616	30.9943	30.3364	29.1232	28.2147	27.2074	26.6633	27.3167	28.0281	29.1060	30.3441	31.3552	(42b)
Hot water usage for other uses	44.3479	42.7352	41.1226	39.5099	37.8973	36.2846	36.2846	37.8973	39.5099	41.1226	42.7352	44.3479	(42c)
Average daily hot water use (litres/day)												136.6738	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	148.6839	145.5088	141.6423	135.7630	130.9886	125.8558	123.8834	127.7332	131.7934	137.1819	143.1518	148.2983	(44)
Energy conte	235.4789	207.2026	217.6989	185.8528	176.3359	154.7544	149.8262	158.1603	162.5144	186.1546	203.9459	232.1993	(45)
Energy content (annual)										Total = Sum(45)m =		2270.1242	
Distribution loss (46)m = 0.15 x (45)m	35.3218	31.0804	32.6548	27.8779	26.4504	23.2132	22.4739	23.7241	24.3772	27.9232	30.5919	34.8299	(46)

Water storage loss:
Store volume 210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.7016 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 0.9188 (55)

Total storage loss	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(56)
If cylinder contains dedicated solar storage	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	287.2255	253.9414	269.4455	235.9302	228.0825	204.8317	201.5728	209.9069	212.5917	237.9012	254.0233	283.9459	(62)
WWHRS	-33.3151	-29.4642	-30.8532	-25.5477	-23.8095	-20.3740	-19.0973	-20.3081	-21.0797	-24.8506	-28.1527	-32.6982	(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	253.9103	224.4773	238.5923	210.3825	204.2730	184.4578	182.4754	189.5988	191.5121	213.0506	225.8705	251.2477	(64)
									Total per year (kWh/year) = Sum(64)m =			2569.8483	(64)
12Total per year (kWh/year)												2570	(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	119.6940	106.2859	113.7822	101.8579	100.0290	91.5177	91.2145	93.9856	94.0979	103.2937	107.8739	118.6035	(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	145.0927	145.0927	145.0927	145.0927	145.0927	145.0927	145.0927	145.0927	145.0927	145.0927	145.0927	145.0927	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	157.8155	174.7243	157.8155	163.0760	157.8155	163.0760	157.8155	157.8155	163.0760	157.8155	163.0760	157.8155	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	301.0409	304.1647	296.2927	279.5341	258.3793	238.4968	225.2141	222.0902	229.9623	246.7209	267.8757	287.7581	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.5093	37.5093	37.5093	37.5093	37.5093	37.5093	37.5093	37.5093	37.5093	37.5093	37.5093	37.5093	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-116.0741	-116.0741	-116.0741	-116.0741	-116.0741	-116.0741	-116.0741	-116.0741	-116.0741	-116.0741	-116.0741	-116.0741	(71)
Water heating gains (Table 5)	160.8790	158.1636	152.9330	141.4694	134.4475	127.1079	122.6001	126.3247	130.6915	138.8356	149.8249	159.4133	(72)
Total internal gains	689.2632	706.5804	676.5690	653.6072	620.1701	595.2085	572.1575	572.7582	590.2576	612.8998	650.3043	674.5148	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	2.2300	11.2829	0.6300	0.7000	0.7700	7.6895	(75)
Southeast	10.2400	36.7938	0.6300	0.7000	0.7700	115.1455	(77)
Northwest	9.1900	11.2829	0.6300	0.7000	0.7700	31.6891	(81)

Solar gains	154.5241	276.2916	412.7770	569.6849	691.2480	709.6297	674.4289	580.1629	466.5514	314.7286	187.4662	130.6991	(83)
Total gains	843.7872	982.8720	1089.3460	1223.2921	1311.4181	1304.8383	1246.5864	1152.9211	1056.8090	927.6284	837.7705	805.2138	(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	41.3189	41.4148	41.5092	41.9586	42.0438	42.4448	42.4448	42.5199	42.2894	42.0438	41.8718	41.6936	
alpha	3.7546	3.7610	3.7673	3.7972	3.8029	3.8297	3.8297	3.8347	3.8193	3.8029	3.7915	3.7796	
util living area	0.9883	0.9785	0.9597	0.9078	0.8041	0.6395	0.4893	0.5429	0.7694	0.9335	0.9792	0.9901	(86)
MIT	19.1816	19.4272	19.7871	20.2713	20.6668	20.9014	20.9728	20.9597	20.7932	20.2781	19.6518	19.1447	(87)
Th 2	19.9884	19.9905	19.9926	20.0023	20.0041	20.0126	20.0126	20.0142	20.0093	20.0041	20.0004	19.9966	(88)
util rest of house	0.9857	0.9738	0.9504	0.8859	0.7583	0.5614	0.3878	0.4391	0.7015	0.9132	0.9738	0.9879	(89)
MIT 2	17.8652	18.1781	18.6334	19.2371	19.6979	19.9441	20.0003	19.9944	19.8466	19.2581	18.4726	17.8235	(90)
Living area fraction										fLA = Living area / (4) =		0.1321	(91)
MIT	18.0391	18.3431	18.7858	19.3737	19.8259	20.0705	20.1288	20.1219	19.9716	19.3929	18.6284	17.9980	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.0391	18.3431	18.7858	19.3737	19.8259	20.0705	20.1288	20.1219	19.9716	19.3929	18.6284	17.9980	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9782	0.9628	0.9356	0.8692	0.7490	0.5663	0.4001	0.4511	0.6986	0.8971	0.9631	0.9813	(94)
Useful gains	825.3724	946.3571	1019.1524	1063.3029	982.2603	738.8678	498.8203	520.0279	738.3110	832.1849	806.8827	790.1674	(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	2034.4729	1986.0275	1810.9233	1527.2966	1182.5265	788.5854	508.6756	535.5682	849.5111	1279.5935	1684.5671	2024.8357	(97)
Space heating kWh	899.5707	698.6585	589.0776	334.0754	148.9980	0.0000	0.0000	0.0000	0.0000	332.8720	631.9328	918.5932	(98a)
Space heating requirement - total per year (kWh/year)												4553.7782	
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	899.5707	698.6585	589.0776	334.0754	148.9980	0.0000	0.0000	0.0000	0.0000	332.8720	631.9328	918.5932	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4553.7782	
Space heating per m2											(98c) / (4) =	34.2957	(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	899.5707	698.6585	589.0776	334.0754	148.9980	0.0000	0.0000	0.0000	0.0000	332.8720	631.9328	918.5932	(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)	974.6162	756.9431	638.2205	361.9452	161.4280	0.0000	0.0000	0.0000	0.0000	360.6413	684.6509	995.2256	(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	253.9103	224.4773	238.5923	210.3825	204.2730	184.4578	182.4754	189.5988	191.5121	213.0506	225.8705	251.2477	(64)
Efficiency of water heater												79.8000	(216)
(217)m	86.6488	86.4297	86.0039	85.0917	83.3635	79.8000	79.8000	79.8000	79.8000	85.0563	86.2390	86.6999	(217)
Fuel for water heating, kWh/month	293.0337	259.7225	277.4205	247.2420	245.0388	231.1501	228.6660	237.5925	239.9900	250.4818	261.9124	289.7899	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	32.7909	26.3061	23.6857	17.3532	13.4041	10.9513	12.2277	15.8940	20.6447	27.0870	30.5947	33.7023	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-58.7791	-81.2106	-114.3910	-125.8966	-133.4255	-123.6101	-121.9689	-116.2067	-105.8014	-91.4610	-63.9834	-51.0049	(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	-38.4289	-80.1865	-158.2322	-236.0637	-310.6801	-311.7312	-308.1645	-261.6706	-192.7268	-114.2602	-51.1605	-30.4477	(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	(235d)

Annual totals kWh/year		
Space heating fuel - main system 1	4933.6708	(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	3062.0403	(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)	264.6417	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-3281.4921	(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	5064.8606	(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	4933.6708	0.2100	1036.0709	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3062.0403	0.2100	643.0285	(264)
Space and water heating			1679.0993	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	264.6417	0.1443	38.1960	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1187.7392	0.1350	-160.4006	
PV Unit electricity exported	-2093.7529	0.1261	-263.9958	
Total			-424.3964	(269)
Total CO2, kg/year			1304.8282	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			9.8300	(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	4933.6708	1.1300	5575.0480	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3062.0403	1.1300	3460.1055	(278)
Space and water heating			9035.1535	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	264.6417	1.5338	405.9162	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1187.7392	1.4991	-1780.5831	
PV Unit electricity exported	-2093.7529	0.4628	-969.0630	
Total			-2749.6461	(283)
Total Primary energy kWh/year			6821.5244	(286)
Target Primary Energy Rate (TPER)			51.3700	(287)

Building Regulations England Part L (BREL) Compliance Report

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

Date: Fri 14 Mar 2025 09:30:52

Project Information			
Assessed By	Richard Millard	Building Type	House, Detached
OCDEA Registration	EES/025661	Assessment Date	2025-03-14

Dwelling Details			
Assessment Type	As designed	Total Floor Area	134 m^2
Site Reference	DV1+	Plot Reference	Proposed
Address	20		

Client Details	
Name	Ian White
Company	Cotswold Homes Ltd
Address	West House, Yate, Bristol, BS37 5NG

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

1a Target emission rate and dwelling emission rate		
Fuel for main heating system	Electricity	
Target carbon dioxide emission rate	*9.69 kgCO_2/m^2*	
Dwelling carbon dioxide emission rate	2.76 kgCO_2/m^2	OK
1b Target primary energy rate and dwelling primary energy		
Target primary energy	*50.62 kWh$_{PE}$/m^2*	
Dwelling primary energy	32.59 kWh$_{PE}$/m^2	OK
1c Target fabric energy efficiency and dwelling fabric energy efficiency		
Target fabric energy efficiency	*40.2 kWh/m^2*	
Dwelling fabric energy efficiency	38.8 kWh/m^2	OK

2a Fabric U-values				
Element	***Maximum permitted average U-Value [W/m^2K]***	**Dwelling average U-Value [W/m^2K]**	**Element with highest individual U-Value**	
External walls	*0.26*	0.18	Walls (1) (0.18)	OK
Party walls	*0.2*	N/A	N/A	**N/A**
Curtain walls	*1.6*	N/A	N/A	**N/A**
Floors	*0.18*	0.12	Heatloss Floor 1 (0.12)	OK
Roofs	*0.16*	0.11	Roof (2) (0.13)	OK
Windows, doors, and roof windows	*1.6*	1.2	WG01 (1.2)	OK
Rooflights	*2.2*	N/A	N/A	**N/A**

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))		
Name	**Net area [m^2]**	**U-Value [W/m^2K]**
Exposed wall: Walls (1)	142.5	0.18
Ground floor: Heatloss Floor 1, Heatloss Floor 1	68.01	0.12
Exposed roof: Roof (1)	66.39	0.11
Exposed roof: Roof (2)	1.62	0.13

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	**Area [m^2]**	**Orientation**	**Frame factor**	**U-Value [W/m^2K]**
WG01, Windows	2.12	North East	0.7	1.2
WG02, Windows	2.12	North East	0.7	1.2
WG03, Windows	1.64	South West	0.7	1.2
WG04, Windows	0.67	South East	0.7	1.2
WG05, Windows	1.56	South East	0.7	1.2
FG01, Windows	2.16	North East	0.7	1.2
FG02, Windows	0.67	North East	0.7	1.2
FG03, Windows	2.12	North East	0.7	1.2
FG04, Windows	1.45	South West	0.7	1.2
FG05, Windows	0.66	South West	0.7	1.2
FG06, Windows	1.44	South West	0.7	1.2
ED01, Doors	3.08	North East	N/A	1.2
ED02, Doors	2	South West	N/A	1.2

Name	Area [m^2]	Orientation	Frame factor	U-Value [W/m^2K]
ED03, Glazed Doors	5.05	South West	0.7	1.2
WG06, Windows	1.33	North West	0.7	1.2
WG07, Windows	2.62	South West	0.7	1.2
WG08, Windows	1.33	South East	0.7	1.2

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))				
Building part **1**: Thermal bridging calculated from linear thermal transmittances for each junction				
Main element	**Junction detail**	**Source**	**Psi value [W/mK]**	**Drawing / reference**
External wall	E1: Steel lintel with perforated steel base plate	Calculated by person with suitable expertise	0.241	EMPF125E101
External wall	E3: Sill	Calculated by person with suitable expertise	0.026 **(!)**	EMPF125E301
External wall	E4: Jamb	Calculated by person with suitable expertise	0.02 **(!)**	EMPF125E401
External wall	E5: Ground floor (normal)	Calculated by person with suitable expertise	0.045	EMPF125E504
External wall	E6: Intermediate floor within a dwelling	Calculated by person with suitable expertise	0.002 **(!)**	EMPF125E601
External wall	E10: Eaves (insulation at ceiling level)	Calculated by person with suitable expertise	0.05	EMPF125E1001
External wall	E12: Gable (insulation at ceiling level)	Calculated by person with suitable expertise	0.031 **(!)**	EMPF125E1201
External wall	E16: Corner (normal)	Calculated by person with suitable expertise	0.037 **(!)**	EMPF125E21601
External wall	E17: Corner (inverted - internal area greater than external area)	Calculated by person with suitable expertise	-0.09	EMPF125E21701

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

4 Space heating	
Main heating system 1: Heat pump with radiators or underfloor heating - Electricity	
Efficiency	243.8%
Emitter type	Radiators
Flow temperature	55°C
System type	Heat Pump
Manufacturer	Daikin Europe NV
Model	EDLA08EV3
Commissioning	
Secondary heating system: N/A	
Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water	
Cylinder/store - type: Cylinder	
Capacity	210 litres
Declared heat loss	2.1 kWh/day
Primary pipework insulated	Yes
Manufacturer	
Model	
Commissioning	
Waste water heat recovery system 1 - type: N/A	
Efficiency	
Manufacturer	
Model	

6 Controls		
Main heating 1 - type: Time and temperature zone control by arrangement of plumbing and electrical services		
Function		
Ecodesign class		
Manufacturer		
Model		
Water heating - type: Cylinder thermostat and HW separately timed		
Manufacturer		
Model		

7 Lighting		
Minimum permitted light source efficacy	*75 lm/W*	
Lowest light source efficacy	85 lm/W	**OK**
External lights control	N/A	

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

9 Local generation	
Technology type: **Photovoltaic system (1)**	
Peak power	2.01 kWp
Orientation	South East
Pitch	30°
Overshading	None or very little
Manufacturer	
MCS certificate	

10 Heat networks
N/A

11 Supporting documentary evidence
N/A

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

Full SAP Calculation Printout

Property Reference	DV1+	**Issued on Date**	14/03/2025
Assessment Reference	Proposed	**Prop Type Ref**	Proposed 20
Property	20		

SAP Rating	86 B	**DER**	2.76	**TER**	9.69
Environmental	97 A	**% DER < TER**			71.52
CO_2 Emissions (t/year)	0.32	**DFEE**	38.79	**TFEE**	40.25
Compliance Check	See BREL	**% DFEE < TFEE**			3.61
% DPER < TPER	35.62	**DPER**	32.59	**TPER**	50.62

Assessor Details	Mr. Richard Millard	**Assessor ID**	U367-0001
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)	
Main dwelling						
Ground floor	68.0100 (1b)	x	2.4000 (2b)	=	163.2240	(1b) - (3b)
First floor	66.3900 (1c)	x	2.6000 (2c)	=	172.6140	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	134.4000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	335.8380	(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		5 * 10 =	50.0000	(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) =		50.0000 / (5) =	0.1489	(8)
Pressure test			Yes	
Pressure Test Method			Blower Door	
Measured/design AP50			5.0000	(17)
Infiltration rate			0.3989	(18)
Number of sides sheltered			2	(19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor		(21) = (18) x (20) =	0.3390	(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	0.4323	0.4238	0.4153	0.3730	0.3645	0.3221	0.3221	0.3136	0.3390	0.3645	0.3814	0.3984	(22b)
Effective ac	0.5934	0.5898	0.5863	0.5695	0.5664	0.5519	0.5519	0.5492	0.5575	0.5664	0.5727	0.5794	(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	
Main dwelling								
Windows			21.8900	1.1450	25.0649			(27)
Glazed Doors			5.0500	1.1450	5.7824			(27)
Doors			5.0800	1.2000	6.0960			(26a)
Heatloss Floor 1			68.0100	0.1200	8.1612	75.0000	5100.7500	(28a)
Cavity Wall	174.5200	32.0200	142.5000	0.1800	25.6500	60.0000	8550.0003	(29a)
External Roof 1	66.3900		66.3900	0.1100	7.3029	9.0000	597.5100	(30)
External Roof 2	1.6200		1.6200	0.1300	0.2106	9.0000	14.5800	(30)
Total net area of external elements Aum(A, m2)			310.5400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		78.2680			(33)
Main dwelling								
Internal Wall 1 - Block			51.6900			75.0000	3876.7499	(32c)
Internal Wall 2 - Stud			34.7000			9.0000	312.3000	(32c)
Internal Wall 3 - Up			206.8600			9.0000	1861.7400	(32c)
Internal Floor 1			66.3900			18.0000	1195.0200	(32d)
Internal Ceiling 1			68.0100			9.0000	612.0900	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		22120.7402	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							164.5888	(35)
List of Thermal Bridges								

	Length	Psi-value	Total	
K1 Element				
E1 Steel lintel with perforated steel base plate	21.0300	0.2410	5.0682	
E3 Sill	16.1800	0.0260	0.4207	
E4 Jamb	41.9000	0.0200	0.8380	
E5 Ground floor (normal)	35.8700	0.0450	1.6141	
E6 Intermediate floor within a dwelling	34.0600	0.0020	0.0681	
E10 Eaves (insulation at ceiling level)	15.6000	0.0500	0.7800	
E12 Gable (insulation at ceiling level)	22.0300	0.0310	0.6829	
E16 Corner (normal)	34.8000	0.0370	1.2876	
E17 Corner (inverted - internal area greater than external area)	14.8000	-0.0900	-1.3320	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			9.4277	(36)
Point Thermal bridges		(36a) =	0.0000	
Total fabric heat loss		(33) + (36) + (36a) =	87.6957	(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	65.7685	65.3664	64.9722	63.1210	62.7746	61.1622	61.1622	60.8636	61.7833	62.7746	63.4753	64.2078	(38)
Heat transfer coeff	153.4642	153.0621	152.6680	150.8167	150.4703	148.8579	148.8579	148.5593	149.4790	150.4703	151.1710	151.9036	(39)
Average = Sum(39)m / 12 =												150.8150	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1418	1.1389	1.1359	1.1221	1.1196	1.1076	1.1076	1.1054	1.1122	1.1196	1.1248	1.1302	(40)
HLP (average)												1.1221	
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												2.9056	(42)
Hot water usage for mixer showers	72.9366	71.8405	70.2433	67.1873	64.9320	62.4170	60.9875	62.5726	64.3102	67.0106	70.1322	72.6572	(42a)
Hot water usage for baths	31.4884	31.0207	30.3622	29.1479	28.2387	27.2306	26.6860	27.3399	28.0520	29.1307	30.3700	31.3819	(42b)
Hot water usage for other uses	44.3859	42.7719	41.1578	39.5438	37.9298	36.3157	36.3157	37.9298	39.5438	41.1578	42.7719	44.3859	(42c)
Average daily hot water use (litres/day)												136.7906	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	148.8109	145.6331	141.7633	135.8790	131.1005	125.9633	123.9892	127.8423	131.9060	137.2991	143.2741	148.4250	(44)
Energy conte	235.6801	207.3796	217.8849	186.0116	176.4865	154.8866	149.9542	158.2955	162.6532	186.3136	204.1202	232.3977	(45)
Energy content (annual)										Total = Sum(45)m =		2272.0637	
Distribution loss (46)m = 0.15 x (45)m	35.3520	31.1069	32.6827	27.9017	26.4730	23.2330	22.4931	23.7443	24.3980	27.9470	30.6180	34.8596	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												2.1000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.1340	(55)
Total storage loss	35.1540	31.7520	35.1540	34.0200	35.1540	34.0200	35.1540	35.1540	34.0200	35.1540	34.0200	35.1540	(56)
If cylinder contains dedicated solar storage	35.1540	31.7520	35.1540	34.0200	35.1540	34.0200	35.1540	35.1540	34.0200	35.1540	34.0200	35.1540	(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	294.0965	260.1428	276.3013	242.5436	234.9029	211.4186	208.3706	216.7119	219.1852	244.7300	260.6522	290.8141	(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	294.0965	260.1428	276.3013	242.5436	234.9029	211.4186	208.3706	216.7119	219.1852	244.7300	260.6522	290.8141	(64)
										Total per year (kWh/year) = Sum(64)m =		2959.8697	(64)
12Total per year (kWh/year)												2960	(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	125.0967	111.1643	119.1799	107.0745	105.4149	96.7254	96.5929	99.3664	99.3078	108.6824	113.0956	124.0053	(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	145.2783	145.2783	145.2783	145.2783	145.2783	145.2783	145.2783	145.2783	145.2783	145.2783	145.2783	145.2783	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	153.8439	170.3272	153.8439	158.9720	153.8439	158.9720	153.8439	153.8439	158.9720	153.8439	158.9720	153.8439	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	302.9492	306.0929	298.1710	281.3061	260.0172	240.0087	226.6418	223.4981	231.4201	248.2849	269.5738	289.5823	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.5278	37.5278	37.5278	37.5278	37.5278	37.5278	37.5278	37.5278	37.5278	37.5278	37.5278	37.5278	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-116.2226	-116.2226	-116.2226	-116.2226	-116.2226	-116.2226	-116.2226	-116.2226	-116.2226	-116.2226	-116.2226	-116.2226	(71)
Water heating gains (Table 5)	168.1408	165.4230	160.1880	148.7145	141.6867	134.3408	129.8291	133.5569	137.9275	146.0785	157.0772	166.6738	(72)
Total internal gains	691.5174	708.4266	678.7864	655.5762	622.1313	599.9051	576.8984	577.4825	594.9031	614.7908	652.2065	676.6836	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	9.1900	11.2829	0.6300	0.7000	0.7700	31.6891	(75)
Southeast	3.5600	36.7938	0.6300	0.7000	0.7700	40.0310	(77)
Southwest	7.8100	36.7938	0.6300	0.7000	0.7700	87.8209	(79)
Northwest	1.3300	11.2829	0.6300	0.7000	0.7700	4.5861	(81)
Southwest	5.0500	36.7938	0.6300	0.7000	0.7700	56.7856	(79)

Solar gains	220.9127	388.3453	563.3557	751.6698	890.8973	905.9927	864.5105	757.3478	628.0515	437.8336	266.7968	187.6354	(83)
Total gains	912.4302	1096.7719	1242.1420	1407.2460	1513.0287	1505.8977	1441.4089	1334.8303	1222.9546	1052.6244	919.0033	864.3190	(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	40.0396	40.1448	40.2485	40.7425	40.8363	41.2786	41.2786	41.3616	41.1071	40.8363	40.6470	40.4510	
alpha	3.6693	3.6763	3.6832	3.7162	3.7224	3.7519	3.7519	3.7574	3.7405	3.7224	3.7098	3.6967	
util living area	0.9853	0.9710	0.9440	0.8767	0.7564	0.5856	0.4412	0.4909	0.7173	0.9116	0.9733	0.9878	(86)
Living	19.1782	19.4667	19.8584	20.3495	20.7194	20.9218	20.9790	20.9689	20.8299	20.3335	19.6729	19.1352	
Non living	17.8477	18.2139	18.7062	19.3116	19.7332	19.9418	19.9855	19.9817	19.8615	19.3079	18.4863	17.7991	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	20.0680	19.4667	19.8584	20.3495	20.7194	20.9218	20.9790	20.9689	20.8299	20.3335	19.6729	19.3960	(87)
Th 2	19.9668	19.9692	19.9716	19.9828	19.9849	19.9947	19.9947	19.9965	19.9909	19.9849	19.9806	19.9762	(88)
util rest of house	0.9821	0.9648	0.9317	0.8499	0.7062	0.5085	0.3461	0.3925	0.6453	0.8863	0.9664	0.9851	(89)
MIT 2	19.1220	18.2139	18.7062	19.3116	19.7332	19.9418	19.9855	19.9817	19.8615	19.3079	18.4863	18.1915	(90)
Living area fraction										fLA = Living area / (4) =		0.1426	(91)
MIT	19.2569	18.3925	18.8704	19.4595	19.8738	20.0815	20.1271	20.1225	19.9995	19.4541	18.6555	18.3632	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.2569	18.3925	18.8704	19.4595	19.8738	20.0815	20.1271	20.1225	19.9995	19.4541	18.6555	18.3632	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9793	0.9517	0.9149	0.8338	0.7002	0.5155	0.3590	0.4053	0.6459	0.8699	0.9540	0.9792	(94)
Useful gains	893.5531	1043.8147	1136.4280	1173.3120	1059.3689	776.2907	517.4279	541.0079	789.9656	915.6949	876.7541	846.3100	(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	2295.3438	2065.1954	1888.5664	1592.5517	1229.9180	815.9630	525.0399	553.0047	881.8557	1332.2778	1746.8548	2151.4372	(97)
Space heating kWh	1042.9322	686.3679	559.5909	301.8526	126.8886	0.0000	0.0000	0.0000	0.0000	309.9377	626.4725	971.0147	(98a)
Space heating requirement - total per year (kWh/year)												4625.0571	
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	1042.9322	686.3679	559.5909	301.8526	126.8886	0.0000	0.0000	0.0000	0.0000	309.9377	626.4725	971.0147	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4625.0571	
Space heating per m2											(98c) / (4) =	34.4126	(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 %)	243.8033	(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	1042.9322	686.3679	559.5909	301.8526	126.8886	0.0000	0.0000	0.0000	0.0000	309.9377	626.4725	971.0147	(98)
Space heating efficiency (main heating system 1)	243.8033	243.8033	243.8033	243.8033	243.8033	0.0000	0.0000	0.0000	0.0000	243.8033	243.8033	243.8033	(210)
Space heating fuel (main heating system)	427.7760	281.5252	229.5256	123.8099	52.0455	0.0000	0.0000	0.0000	0.0000	127.1261	256.9581	398.2779	(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	294.0965	260.1428	276.3013	242.5436	234.9029	211.4186	208.3706	216.7119	219.1852	244.7300	260.6522	290.8141	(64)
Efficiency of water heater												165.9344	(216)
(217)m	165.9344	165.9344	165.9344	165.9344	165.9344	165.9344	165.9344	165.9344	165.9344	165.9344	165.9344	165.9344	(217)
Fuel for water heating, kWh/month	177.2365	156.7745	166.5123	146.1683	141.5637	127.4109	125.5740	130.6009	132.0915	147.4860	157.0814	175.2584	(219)
Space cooling fuel requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(231)
Lighting	31.3124	25.1199	22.6177	16.5707	12.7997	10.4575	11.6763	15.1773	19.7138	25.8656	29.2151	32.1826	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-35.9160	-55.6507	-87.8905	-105.4778	-116.7930	-107.0358	-105.4115	-96.6536	-81.2724	-65.3261	-40.6388	-30.2496	(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	-8.3858	-20.2961	-45.9463	-78.9825	-114.4612	-121.4428	-119.5942	-97.8917	-67.6898	-33.0678	-12.3287	-6.5292	(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												1897.0443	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)

Efficiency of water heater	165.9344	
Water heating fuel used	1783.7586	(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)	252.7087	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-1654.9322	(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	2278.5793	(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	1897.0443	0.1558	295.4729	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1783.7586	0.1409	251.3533	(264)
Space and water heating			546.8262	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	252.7087	0.1443	36.4737	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-928.3161	0.1335	-123.9426	
PV Unit electricity exported	-726.6162	0.1221	-88.7489	
Total			-212.6915	(269)
Total CO2, kg/year			370.6084	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			2.7600	(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	1897.0443	1.5766	2990.8599	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1783.7586	1.5210	2713.1732	(278)
Space and water heating			5704.0331	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	252.7087	1.5338	387.6131	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-928.3161	1.4934	-1386.3440	
PV Unit electricity exported	-726.6162	0.4481	-325.6190	
Total			-1711.9631	(283)
Total Primary energy kWh/year			4379.6831	(286)
Dwelling Primary energy Rate (DPER)			32.5900	(287)

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Main dwelling						
Ground floor	68.0100	(1b) x	2.4000	(2b) =	163.2240	(1b) - (3b)
First floor	66.3900	(1c) x	2.6000	(2c) =	172.6140	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	134.4000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		335.8380	(5)

2. Ventilation rate

	m3 per hour		
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	4 * 10 =	40.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1191	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3691	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3137	(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	0.4000	0.3922	0.3843	0.3451	0.3373	0.2981	0.2981	0.2902	0.3137	0.3373	0.3530	0.3686	(22b)
Effective ac	0.5800	0.5769	0.5739	0.5596	0.5569	0.5444	0.5444	0.5421	0.5492	0.5569	0.5623	0.5679	(25)

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3. Heat losses and heat loss parameter

Element	Gross	Openings	NetArea	U-value	A x U	K-value	A x K	
Main dwelling	m2	m2	m2	W/m2K	W/K	kJ/m2K	kJ/K	
TER Semi-glazed door			5.0800	1.0000	5.0800			(26a)
TER Opening Type			26.9400	1.1450	30.8473			(27)
Heatloss Floor 1			68.0100	0.1300	8.8413			(28a)
Cavity Wall	174.5200	32.0200	142.5000	0.1800	25.6500			(29a)
External Roof 1	66.3900		66.3900	0.1100	7.3029			(30)
External Roof 2	1.6200		1.6200	0.1100	0.1782			(30)
Total net area of external elements Aum(A, m2)			310.5400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		77.8997			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 164.5888 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	21.0300	0.0500	1.0515
E3 Sill	16.1800	0.0500	0.8090
E4 Jamb	41.9000	0.0500	2.0950
E5 Ground floor (normal)	35.8700	0.1600	5.7392
E6 Intermediate floor within a dwelling	34.0600	0.0000	0.0000
E10 Eaves (insulation at ceiling level)	15.6000	0.0600	0.9360
E12 Gable (insulation at ceiling level)	22.0300	0.0600	1.3218
E16 Corner (normal)	34.8000	0.0900	3.1320
E17 Corner (inverted - internal area greater than external area)	14.8000	-0.0900	-1.3320

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 13.7525 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 91.6522 (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	64.2802	63.9359	63.5984	62.0132	61.7166	60.3359	60.3359	60.0802	60.8677	61.7166	62.3166	62.9438	(38)
Heat transfer coeff	155.9324	155.5881	155.2506	153.6654	153.3688	151.9881	151.9881	151.7325	152.5200	153.3688	153.9688	154.5961	(39)
Average = Sum(39)m / 12 =												153.6640	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1602	1.1576	1.1551	1.1433	1.1411	1.1309	1.1309	1.1290	1.1348	1.1411	1.1456	1.1503	(40)
HLP (average)												1.1433	
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 2.9056 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	72.9366	71.8405	70.2433	67.1873	64.9320	62.4170	60.9875	62.5726	64.3102	67.0106	70.1322	72.6572	(42a)
Hot water usage for baths	31.4884	31.0207	30.3622	29.1479	28.2387	27.2306	26.6860	27.3399	28.0520	29.1307	30.3700	31.3819	(42b)
Hot water usage for other uses	44.3859	42.7719	41.1578	39.5438	37.9298	36.3157	36.3157	37.9298	39.5438	41.1578	42.7719	44.3859	(42c)
Average daily hot water use (litres/day)												136.7906	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	148.8109	145.6331	141.7633	135.8790	131.1005	125.9633	123.9892	127.8423	131.9060	137.2991	143.2741	148.4250	(44)
Energy conte	235.6801	207.3796	217.8849	186.0116	176.4865	154.8866	149.9542	158.2955	162.6532	186.3136	204.1202	232.3977	(45)
Energy content (annual)										Total = Sum(45)m =		2272.0637	
Distribution loss (46)m = 0.15 x (45)m	35.3520	31.1069	32.6827	27.9017	26.4730	23.2330	22.4931	23.7443	24.3980	27.9470	30.6180	34.8596	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7016	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9188	(55)
Total storage loss	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(56)
If cylinder contains dedicated solar storage	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	287.4267	254.1185	269.6315	236.0889	228.2331	204.9639	201.7008	210.0421	212.7306	238.0602	254.1975	284.1442	(62)
WWHRS	-33.3436	-29.4893	-30.8795	-25.5695	-23.8298	-20.3914	-19.1136	-20.3254	-21.0977	-24.8718	-28.1768	-32.7261	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	254.0831	224.6291	238.7520	210.5195	204.4033	184.5726	182.5871	189.7166	191.6329	213.1884	226.0207	251.4181	(64)
										Total per year (kWh/year) = Sum(64)m =		2571.5234	(64)
12Total per year (kWh/year)												2572	(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	119.7609	106.3448	113.8440	101.9107	100.0790	91.5617	91.2570	94.0305	94.1441	103.3466	107.9318	118.6695	(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	145.2783	145.2783	145.2783	145.2783	145.2783	145.2783	145.2783	145.2783	145.2783	145.2783	145.2783	145.2783	(66)

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

	153.8439	170.3272	153.8439	158.9720	153.8439	158.9720	153.8439	153.8439	158.9720	153.8439	158.9720	153.8439	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	302.9492	306.0929	298.1710	281.3061	260.0172	240.0087	226.6418	223.4981	231.4201	248.2849	269.5738	289.5823	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.5278	37.5278	37.5278	37.5278	37.5278	37.5278	37.5278	37.5278	37.5278	37.5278	37.5278	37.5278	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-116.2226	-116.2226	-116.2226	-116.2226	-116.2226	-116.2226	-116.2226	-116.2226	-116.2226	-116.2226	-116.2226	-116.2226	(71)
Water heating gains (Table 5)													
	160.9689	158.2512	153.0161	141.5427	134.5148	127.1690	122.6573	126.3851	130.7557	138.9067	149.9053	159.5020	(72)
Total internal gains													
	687.3456	704.2548	674.6145	651.4043	617.9595	592.7332	569.7265	570.3106	587.7313	610.6190	648.0347	672.5117	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	9.1900	11.2829	0.6300	0.7000	0.7700	31.6891	(75)
Southeast	3.5600	36.7938	0.6300	0.7000	0.7700	40.0310	(77)
Southwest	12.8600	36.7938	0.6300	0.7000	0.7700	144.6065	(79)
Northwest	1.3300	11.2829	0.6300	0.7000	0.7700	4.5861	(81)

Solar gains	220.9127	388.3453	563.3557	751.6698	890.8973	905.9927	864.5105	757.3478	628.0515	437.8336	266.7968	187.6354	(83)
Total gains	908.2583	1092.6001	1237.9702	1403.0741	1508.8568	1498.7259	1434.2371	1327.6585	1215.7828	1048.4526	914.8315	860.1471	(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	39.4059	39.4931	39.5789	39.9872	40.0645	40.4285	40.4285	40.4966	40.2875	40.0645	39.9084	39.7465	
alpha	3.6271	3.6329	3.6386	3.6658	3.6710	3.6952	3.6952	3.6998	3.6858	3.6710	3.6606	3.6498	
util living area													
	0.9856	0.9717	0.9455	0.8804	0.7633	0.5959	0.4510	0.5014	0.7266	0.9145	0.9740	0.9881	(86)
MIT	19.1374	19.4259	19.8207	20.3170	20.6992	20.9126	20.9760	20.9646	20.8146	20.3033	19.6336	19.0908	(87)
Th 2	19.9520	19.9540	19.9561	19.9656	19.9674	19.9757	19.9757	19.9773	19.9725	19.9674	19.9638	19.9600	(88)
util rest of house													
	0.9824	0.9656	0.9334	0.8540	0.7130	0.5172	0.3525	0.3999	0.6541	0.8896	0.9673	0.9854	(89)
MIT 2	17.7864	18.1525	18.6488	19.2603	19.6973	19.9166	19.9652	19.9605	19.8311	19.2592	18.4257	17.7323	(90)
Living area fraction										fLA = Living area / (4) =		0.1426	(91)
MIT	17.9790	18.3341	18.8159	19.4110	19.8401	20.0586	20.1093	20.1036	19.9713	19.4081	18.5979	17.9260	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.9790	18.3341	18.8159	19.4110	19.8401	20.0586	20.1093	20.1036	19.9713	19.4081	18.5979	17.9260	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9735	0.9524	0.9164	0.8372	0.7061	0.5239	0.3658	0.4129	0.6540	0.8728	0.9548	0.9776	(94)
Useful gains	884.2226	1040.6217	1134.4450	1174.6866	1065.4193	785.2339	524.6274	548.2517	795.0981	915.0382	873.4805	840.9128	(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													
	2133.0008	2090.1807	1912.0441	1615.1716	1248.4443	829.6479	533.3739	561.9591	895.4908	1350.8844	1770.3141	2121.9844	(97)
Space heating kWh													
	929.0910	705.3036	578.5337	317.1491	136.1706	0.0000	0.0000	0.0000	0.0000	324.2695	645.7202	953.1173	(98a)
Space heating requirement - total per year (kWh/year)												4589.3552	
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													
	929.0910	705.3036	578.5337	317.1491	136.1706	0.0000	0.0000	0.0000	0.0000	324.2695	645.7202	953.1173	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4589.3552	
Space heating per m2											(98c) / (4) =	34.1470	(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													
	929.0910	705.3036	578.5337	317.1491	136.1706	0.0000	0.0000	0.0000	0.0000	324.2695	645.7202	953.1173	(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)													
	1006.5991	764.1426	626.7971	343.6069	147.5305	0.0000	0.0000	0.0000	0.0000	351.3213	699.5886	1032.6298	(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													
	254.0831	224.6291	238.7520	210.5195	204.4033	184.5726	182.5871	189.7166	191.6329	213.1884	226.0207	251.4181	(64)
Efficiency of water heater												79.8000	(216)
(217)m	86.7002	86.4450	85.9676	84.9764	83.1703	79.8000	79.8000	79.8000	79.8000	84.9975	86.2771	86.7577	(217)
Fuel for water heating, kWh/month													
	293.0595	259.8521	277.7231	247.7387	245.7647	231.2939	228.8059	237.7401	240.1415	250.8172	261.9707	289.7935	(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	31.9657	25.6441	23.0897	16.9165	13.0668	10.6757	11.9199	15.4940	20.1252	26.4053	29.8247	32.8542	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-59.8906	-82.5925	-116.1333	-127.5901	-135.0409	-125.0419	-123.3656	-117.6053	-107.2051	-92.8824	-65.1302	-51.9865	(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	-39.6894	-82.7429	-163.1423	-243.2024	-319.9015	-320.9223	-317.2636	-269.4927	-198.6077	-117.8586	-52.8234	-31.4536	(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	4972.2158	(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	3064.7009	(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)	257.9817	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-3361.5647	(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	5019.3337	(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	4972.2158	0.2100	1044.1653	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3064.7009	0.2100	643.5872	(264)
Space and water heating			1687.7525	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	257.9817	0.1443	37.2347	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1204.4643	0.1351	-162.7060	
PV Unit electricity exported	-2157.1005	0.1261	-272.0311	
Total			-434.7372	(269)
Total CO2, kg/year			1302.1793	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			9.6900	(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	4972.2158	1.1300	5618.6038	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3064.7009	1.1300	3463.1120	(278)
Space and water heating			9081.7158	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	257.9817	1.5338	395.7010	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1204.4643	1.4993	-1805.8317	
PV Unit electricity exported	-2157.1005	0.4629	-998.5608	
Total			-2804.3926	(283)
Total Primary energy kWh/year			6803.1251	(286)
Target Primary Energy Rate (TPER)			50.6200	(287)

Building Regulations England Part L (BREL) Compliance Report

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

Date: Fri 14 Mar 2025 09:30:55

Project Information			
Assessed By	Richard Millard	Building Type	House, Detached
OCDEA Registration	EES/025661	Assessment Date	2025-03-14

Dwelling Details			
Assessment Type	As designed	Total Floor Area	134 m^2
Site Reference	DV1+	Plot Reference	Regulated (Baseline)
Address	20		

Client Details	
Name	Ian White
Company	Cotswold Homes Ltd
Address	West House, Yate, Bristol, BS37 5NG

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

1a Target emission rate and dwelling emission rate		
Fuel for main heating system	Mains gas	
Target carbon dioxide emission rate	*9.69 kgCO_2/m^2*	
Dwelling carbon dioxide emission rate	13.74 kgCO_2/m^2	**FAIL**
1b Target primary energy rate and dwelling primary energy		
Target primary energy	*50.62 kWh_{PE}/m^2*	
Dwelling primary energy	75.83 kWh_{PE}/m^2	**FAIL**
1c Target fabric energy efficiency and dwelling fabric energy efficiency		
Target fabric energy efficiency	*40.2 kWh/m^2*	
Dwelling fabric energy efficiency	40.2 kWh/m^2	**OK**

2a Fabric U-values				
Element	***Maximum permitted average U-Value [W/m^2K]***	**Dwelling average U-Value [W/m^2K]**	**Element with highest individual U-Value**	
External walls	*0.26*	0.18	Walls (1) (0.18)	**OK**
Party walls	*0.2*	N/A	N/A	**N/A**
Curtain walls	*1.6*	N/A	N/A	**N/A**
Floors	*0.18*	0.13	Heatloss Floor 1 (0.13)	**OK**
Roofs	*0.16*	0.11	Roof (1) (0.11)	**OK**
Windows, doors, and roof windows	*1.6*	1.2	WG01 (1.2)	**OK**
Rooflights	*2.2*	N/A	N/A	**N/A**

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))		
Name	**Net area [m^2]**	**U-Value [W/m^2K]**
Exposed wall: Walls (1)	142.5	0.18
Ground floor: Heatloss Floor 1, Heatloss Floor 1	68.01	0.13
Exposed roof: Roof (1)	66.39	0.11
Exposed roof: Roof (2)	1.62	0 **(!)**

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	**Area [m^2]**	**Orientation**	**Frame factor**	**U-Value [W/m^2K]**
WG01, Windows	2.12	North East	0.7	1.2
WG02, Windows	2.12	North East	0.7	1.2
WG03, Windows	1.64	South West	0.7	1.2
WG04, Windows	0.67	South East	0.7	1.2
WG05, Windows	1.56	South East	0.7	1.2
FG01, Windows	2.16	North East	0.7	1.2
FG02, Windows	0.67	North East	0.7	1.2
FG03, Windows	2.12	North East	0.7	1.2
FG04, Windows	1.45	South West	0.7	1.2
FG05, Windows	0.66	South West	0.7	1.2
FG06, Windows	1.44	South West	0.7	1.2
ED01, Doors	3.08	North East	N/A	1.2
ED02, Doors	2	South West	N/A	1.2

Name	Area [m^2]	Orientation	Frame factor	U-Value [W/m^2K]
ED03, Glazed Doors	5.05	South West	0.7	1.2
WG06, Windows	1.33	North West	0.7	1.2
WG07, Windows	2.62	South West	0.7	1.2
WG08, Windows	1.33	South East	0.7	1.2

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))

Building part **1**: Thermal bridging calculated from linear thermal transmittances for each junction

Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E2: Other lintels (including other steel lintels)	Calculated by person with suitable expertise	0.05	mpf125e2-04
External wall	E3: Sill	Calculated by person with suitable expertise	0.05	mpf125e3-01
External wall	E4: Jamb	Calculated by person with suitable expertise	0.022 **(!)**	mpf125e4-01
External wall	E5: Ground floor (normal)	Calculated by person with suitable expertise	0.16	mpf125e5-04
External wall	E6: Intermediate floor within a dwelling	Calculated by person with suitable expertise	0.003 **(!)**	mpf125e6-01
External wall	E10: Eaves (insulation at ceiling level)	Calculated by person with suitable expertise	0.06	mpf125e10-01
External wall	E12: Gable (insulation at ceiling level)	Calculated by person with suitable expertise	0.06	mpf125e12-01
External wall	E16: Corner (normal)	Calculated by person with suitable expertise	0.09	mpf125e16-01
External wall	E17: Corner (inverted - internal area greater than external area)	Calculated by person with suitable expertise	-0.085	mpf125e17-01

3 Air permeability (better than typically expected values are flagged with a subsequent (!))

Maximum permitted air permeability at 50Pa	*8 m^3/hm^2*	
Dwelling air permeability at 50Pa	5 m^3/hm^2, Design value	OK
Air permeability test certificate reference		

4 Space heating

Main heating system 1: Boiler with radiators or underfloor heating - Mains gas	
Efficiency	88.6%
Emitter type	Radiators
Flow temperature	45°C
System type	Regular boiler
Manufacturer	Bosch Thermotechnology
Model	Greenstar 8000 Life
Commissioning	
Secondary heating system: N/A	
Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water

Cylinder/store - type: Cylinder	
Capacity	210 litres
Declared heat loss	1.7 kWh/day
Primary pipework insulated	Yes
Manufacturer	
Model	
Commissioning	
Waste water heat recovery system 1 - type: N/A	
Efficiency	
Manufacturer	
Model	

6 Controls		
Main heating 1 - type: Time and temperature zone control by arrangement of plumbing and electrical services		
Function		
Ecodesign class		
Manufacturer		
Model		
Water heating - type: Cylinder thermostat and HW separately timed		
Manufacturer		
Model		

7 Lighting		
Minimum permitted light source efficacy	*75 lm/W*	
Lowest light source efficacy	85 lm/W	**OK**
External lights control	N/A	

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

9 Local generation
N/A

10 Heat networks
N/A

11 Supporting documentary evidence
N/A

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

Full SAP Calculation Printout

Property Reference	DV1+	**Issued on Date**	14/03/2025
Assessment Reference	Regulated (Baseline)	**Prop Type Ref**	Proposed 20
Property	20		

SAP Rating	85 B	**DER**	13.74	**TER**	9.69
Environmental	87 B	**% DER < TER**			-41.80
CO_2 Emissions (t/year)	1.73	**DFEE**	40.19	**TFEE**	40.25
Compliance Check	See BREL	**% DFEE < TFEE**			0.15
% DPER < TPER	-49.81	**DPER**	75.83	**TPER**	50.62

Assessor Details	Mr. Richard Millard	**Assessor ID**	U367-0001
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)	
Main dwelling						
Ground floor	68.0100 (1b)	x	2.4000 (2b)	=	163.2240	(1b) - (3b)
First floor	66.3900 (1c)	x	2.6000 (2c)	=	172.6140	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	134.4000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	335.8380	(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	5 * 10 =	50.0000	(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) =	50.0000 / (5) =	0.1489	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3989	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3390	(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	0.4323	0.4238	0.4153	0.3730	0.3645	0.3221	0.3221	0.3136	0.3390	0.3645	0.3814	0.3984	(22b)
Effective ac	0.5934	0.5898	0.5863	0.5695	0.5664	0.5519	0.5519	0.5492	0.5575	0.5664	0.5727	0.5794	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Main dwelling								
Windows			21.8900	1.1450	25.0649			(27)
Glazed Doors			5.0500	1.1450	5.7824			(27)
Doors			5.0800	1.2000	6.0960			(26a)
Heatloss Floor 1			68.0100	0.1300	8.8413	75.0000	5100.7500	(28a)
Cavity Wall	174.5200	32.0200	142.5000	0.1800	25.6500	60.0000	8550.0000	(29a)
External Roof 1	66.3900		66.3900	0.1100	7.3029	9.0000	597.5100	(30)
External Roof 2	1.6200		1.6200	0.0000	0.0000	9.0000	14.5800	(30)
Total net area of external elements Aum(A, m2)			308.9200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		78.7375			(33)
Main dwelling								
Internal Wall 1 - Block			51.6900			75.0000	3876.7500	(32c)
Internal Wall 2 - Stud			34.7000			9.0000	312.3000	(32c)
Internal Wall 3 - Up			206.8600			9.0000	1861.7400	(32c)
Internal Floor 1			66.3900			18.0000	1195.0200	(32d)
Internal Ceiling 1			68.0100			9.0000	612.0900	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		22120.7400	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							164.5888	(35)
List of Thermal Bridges								

	Length	Psi-value	Total	
K1 Element				
E2 Other lintels (including other steel lintels)	21.0300	0.0500	1.0515	
E3 Sill	16.1800	0.0500	0.8090	
E4 Jamb	41.9000	0.0220	0.9218	
E5 Ground floor (normal)	35.8700	0.1600	5.7392	
E6 Intermediate floor within a dwelling	34.0600	0.0030	0.1022	
E10 Eaves (insulation at ceiling level)	15.6000	0.0600	0.9360	
E12 Gable (insulation at ceiling level)	22.0300	0.0600	1.3218	
E16 Corner (normal)	34.8000	0.0900	3.1320	
E17 Corner (inverted - internal area greater than external area)	14.8000	-0.0850	-1.2580	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			12.7555	(36)
Point Thermal bridges		(36a) =	0.0000	
Total fabric heat loss		(33) + (36) + (36a) =	91.4930	(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	65.7685	65.3664	64.9722	63.1210	62.7746	61.1622	61.1622	60.8636	61.7833	62.7746	63.4753	64.2078	(38)
Heat transfer coeff	157.2615	156.8594	156.4652	154.6140	154.2676	152.6552	152.6552	152.3566	153.2763	154.2676	154.9683	155.7009	(39)
Average = Sum(39)m / 12 =												154.6123	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1701	1.1671	1.1642	1.1504	1.1478	1.1358	1.1358	1.1336	1.1404	1.1478	1.1530	1.1585	(40)
HLP (average)												1.1504	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Assumed occupancy												2.9056	(42)
Hot water usage for mixer showers	72.9366	71.8405	70.2433	67.1873	64.9320	62.4170	60.9875	62.5726	64.3102	67.0106	70.1322	72.6572	(42a)
Hot water usage for baths	31.4884	31.0207	30.3622	29.1479	28.2387	27.2306	26.6860	27.3399	28.0520	29.1307	30.3700	31.3819	(42b)
Hot water usage for other uses	44.3859	42.7719	41.1578	39.5438	37.9298	36.3157	36.3157	37.9298	39.5438	41.1578	42.7719	44.3859	(42c)
Average daily hot water use (litres/day)												136.7906	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	148.8109	145.6331	141.7633	135.8790	131.1005	125.9633	123.9892	127.8423	131.9060	137.2991	143.2741	148.4250	(44)
Energy conte	235.6801	207.3796	217.8849	186.0116	176.4865	154.8866	149.9542	158.2955	162.6532	186.3136	204.1202	232.3977	(45)
Energy content (annual)										Total = Sum(45)m =		2272.0637	
Distribution loss (46)m = 0.15 x (45)m	35.3520	31.1069	32.6827	27.9017	26.4730	23.2330	22.4931	23.7443	24.3980	27.9470	30.6180	34.8596	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9180	(55)
Total storage loss	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(56)
If cylinder contains dedicated solar storage	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	287.4005	254.0948	269.6053	236.0636	228.2069	204.9386	201.6746	210.0159	212.7052	238.0340	254.1722	284.1181	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	287.4005	254.0948	269.6053	236.0636	228.2069	204.9386	201.6746	210.0159	212.7052	238.0340	254.1722	284.1181	(64)
										Total per year (kWh/year) = Sum(64)m =		2881.0297	(64)
12Total per year (kWh/year)												2881	(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	119.7399	106.3259	113.8231	101.8905	100.0581	91.5414	91.2361	94.0096	94.1238	103.3256	107.9116	118.6485	(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	145.2783	145.2783	145.2783	145.2783	145.2783	145.2783	145.2783	145.2783	145.2783	145.2783	145.2783	145.2783	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	153.8439	170.3272	153.8439	158.9720	153.8439	158.9720	153.8439	153.8439	158.9720	153.8439	158.9720	153.8439	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	302.9492	306.0929	298.1710	281.3061	260.0172	240.0087	226.6418	223.4981	231.4201	248.2849	269.5738	289.5823	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.5278	37.5278	37.5278	37.5278	37.5278	37.5278	37.5278	37.5278	37.5278	37.5278	37.5278	37.5278	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-116.2226	-116.2226	-116.2226	-116.2226	-116.2226	-116.2226	-116.2226	-116.2226	-116.2226	-116.2226	-116.2226	-116.2226	(71)
Water heating gains (Table 5)	160.9408	158.2230	152.9880	141.5145	134.4867	127.1408	122.6291	126.3569	130.7275	138.8785	149.8772	159.4738	(72)
Total internal gains	687.3174	704.2266	674.5864	651.3762	617.9313	592.7051	569.6984	570.2825	587.7031	610.5908	648.0065	672.4836	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	9.1900	11.2829	0.6300	0.7000	0.7700	31.6891	(75)
Southeast	3.5600	36.7938	0.6300	0.7000	0.7700	40.0310	(77)
Southwest	7.8100	36.7938	0.6300	0.7000	0.7700	87.8209	(79)
Northwest	1.3300	11.2829	0.6300	0.7000	0.7700	4.5861	(81)
Southwest	5.0500	36.7938	0.6300	0.7000	0.7700	56.7856	(79)

Solar gains	220.9127	388.3453	563.3557	751.6698	890.8973	905.9927	864.5105	757.3478	628.0515	437.8336	266.7968	187.6354	(83)
Total gains	908.2302	1092.5719	1237.9420	1403.0460	1508.8286	1498.6977	1434.2089	1327.6303	1215.7546	1048.4244	914.8033	860.1190	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	39.0728	39.1730	39.2717	39.7419	39.8311	40.2518	40.2518	40.3307	40.0887	39.8311	39.6510	39.4645	
alpha	3.6049	3.6115	3.6181	3.6495	3.6554	3.6835	3.6835	3.6887	3.6726	3.6554	3.6434	3.6310	
util living area	0.9857	0.9719	0.9459	0.8814	0.7650	0.5977	0.4527	0.5030	0.7282	0.9151	0.9741	0.9881	(86)
MIT	19.1179	19.4075	19.8047	20.3071	20.6934	20.9109	20.9753	20.9638	20.8113	20.2949	19.6210	19.0745	(87)
Th 2	19.9440	19.9464	19.9488	19.9599	19.9620	19.9717	19.9717	19.9735	19.9679	19.9620	19.9578	19.9534	(88)
util rest of house	0.9825	0.9658	0.9339	0.8550	0.7146	0.5186	0.3536	0.4009	0.6556	0.8903	0.9674	0.9854	(89)
MIT 2	17.7565	18.1243	18.6240	19.2443	19.6866	19.9114	19.9609	19.9563	19.8240	19.2453	18.4059	17.7073	(90)
Living area fraction									fLA = Living area / (4) =			0.1426	(91)
MIT	17.9506	18.3073	18.7923	19.3958	19.8301	20.0539	20.1056	20.1000	19.9647	19.3949	18.5792	17.9022	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8006	18.1573	18.6423	19.2458	19.6801	19.9039	19.9556	19.9500	19.8147	19.2449	18.4292	17.7522	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9726	0.9510	0.9142	0.8332	0.6993	0.5130	0.3519	0.3985	0.6434	0.8683	0.9532	0.9769	(94)
Useful gains	883.3900	1039.0875	1131.6737	1168.9612	1055.0905	768.8510	504.7593	529.0088	782.2289	910.3358	871.9791	840.2180	(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	2123.1205	2079.5257	1899.8513	1599.6086	1231.0755	809.6682	512.2424	540.8605	875.9319	1333.6353	1755.6608	2110.0919	(97)
Space heating kWh	922.3595	699.1745	571.5241	310.0661	130.9329	0.0000	0.0000	0.0000	0.0000	314.9348	636.2508	944.7862	(98a)
Space heating requirement - total per year (kWh/year)												4530.0290	
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	922.3595	699.1745	571.5241	310.0661	130.9329	0.0000	0.0000	0.0000	0.0000	314.9348	636.2508	944.7862	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4530.0290	
Space heating per m2											(98c) / (4) =	33.7056	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												88.6000	(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	922.3595	699.1745	571.5241	310.0661	130.9329	0.0000	0.0000	0.0000	0.0000	314.9348	636.2508	944.7862	(98)
Space heating efficiency (main heating system 1)	88.6000	88.6000	88.6000	88.6000	88.6000	0.0000	0.0000	0.0000	0.0000	88.6000	88.6000	88.6000	(210)
Space heating fuel (main heating system)	1041.0379	789.1360	645.0611	349.9617	147.7798	0.0000	0.0000	0.0000	0.0000	355.4569	718.1161	1066.3501	(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	287.4005	254.0948	269.6053	236.0636	228.2069	204.9386	201.6746	210.0159	212.7052	238.0340	254.1722	284.1181	(64)
Efficiency of water heater												79.6000	(216)
(217)m	86.2824	86.0079	85.5014	84.4717	82.6612	79.6000	79.6000	79.6000	79.6000	84.4879	85.8299	86.3430	(217)
Fuel for water heating, kWh/month	333.0928	295.4319	315.3228	279.4589	276.0749	257.4605	253.3600	263.8390	267.2176	281.7374	296.1349	329.0575	(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	31.3124	25.1199	22.6177	16.5707	12.7997	10.4575	11.6763	15.1773	19.7138	25.8656	29.2151	32.1826	(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	5112.8996	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	79.6000	
Water heating fuel used	3448.1883	(219)
Space cooling fuel	0.0000	(221)

Electricity for pumps and fans:

central heating pump	41.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	86.0000	(231)
Electricity for lighting (calculated in Appendix L)	252.7087	(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	8899.7966	(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	5112.8996	0.2100	1073.7089	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3448.1883	0.2100	724.1195	(264)
Space and water heating			1797.8284	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	252.7087	0.1443	36.4737	(268)
Total CO2, kg/year			1846.2314	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			13.7400	(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	5112.8996	1.1300	5777.5765	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3448.1883	1.1300	3896.4527	(278)
Space and water heating			9674.0293	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	252.7087	1.5338	387.6131	(282)
Total Primary energy kWh/year			10191.7431	(286)
Dwelling Primary energy Rate (DPER)			75.8300	(287)

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

1. Overall dwelling characteristics

		Area (m2)		Storey height (m)		Volume (m3)	
Main dwelling							
Ground floor		68.0100 (1b)	x	2.4000 (2b)	=	163.2240	(1b) - (3b)
First floor		66.3900 (1c)	x	2.6000 (2c)	=	172.6140	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	134.4000						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	335.8380	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1191	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3691	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3137	(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	0.4000	0.3922	0.3843	0.3451	0.3373	0.2981	0.2981	0.2902	0.3137	0.3373	0.3530	0.3686	(22b)
Effective ac	0.5800	0.5769	0.5739	0.5596	0.5569	0.5444	0.5444	0.5421	0.5492	0.5569	0.5623	0.5679	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Main dwelling								
TER Semi-glazed door			5.0800	1.0000	5.0800			(26a)
TER Opening Type			26.9400	1.1450	30.8473			(27)
Heatloss Floor 1			68.0100	0.1300	8.8413			(28a)
Cavity Wall	174.5200	32.0200	142.5000	0.1800	25.6500			(29a)
External Roof 1	66.3900		66.3900	0.1100	7.3029			(30)
External Roof 2	1.6200		1.6200	0.1100	0.1782			(30)
Total net area of external elements Aum(A, m2)			310.5400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		77.8997			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 164.5888 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)	21.0300	0.0500	1.0515	
E3 Sill	16.1800	0.0500	0.8090	
E4 Jamb	41.9000	0.0500	2.0950	
E5 Ground floor (normal)	35.8700	0.1600	5.7392	
E6 Intermediate floor within a dwelling	34.0600	0.0000	0.0000	
E10 Eaves (insulation at ceiling level)	15.6000	0.0600	0.9360	
E12 Gable (insulation at ceiling level)	22.0300	0.0600	1.3218	
E16 Corner (normal)	34.8000	0.0900	3.1320	
E17 Corner (inverted - internal area greater than external area)	14.8000	-0.0900	-1.3320	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 13.7525 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 91.6522 (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	64.2802	63.9359	63.5984	62.0132	61.7166	60.3359	60.3359	60.0802	60.8677	61.7166	62.3166	62.9438	(38)
Heat transfer coeff	155.9324	155.5881	155.2506	153.6654	153.3688	151.9881	151.9881	151.7325	152.5200	153.3688	153.9688	154.5961	(39)
Average = Sum(39)m / 12 =												153.6640	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1602	1.1576	1.1551	1.1433	1.1411	1.1309	1.1309	1.1290	1.1348	1.1411	1.1456	1.1503	(40)
HLP (average)												1.1433	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.9056 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	72.9366	71.8405	70.2433	67.1873	64.9320	62.4170	60.9875	62.5726	64.3102	67.0106	70.1322	72.6572	(42a)
Hot water usage for baths	31.4884	31.0207	30.3622	29.1479	28.2387	27.2306	26.6860	27.3399	28.0520	29.1307	30.3700	31.3819	(42b)
Hot water usage for other uses	44.3859	42.7719	41.1578	39.5438	37.9298	36.3157	36.3157	37.9298	39.5438	41.1578	42.7719	44.3859	(42c)
Average daily hot water use (litres/day)												136.7906	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	148.8109	145.6331	141.7633	135.8790	131.1005	125.9633	123.9892	127.8423	131.9060	137.2991	143.2741	148.4250	(44)
Energy conte	235.6801	207.3796	217.8849	186.0116	176.4865	154.8866	149.9542	158.2955	162.6532	186.3136	204.1202	232.3977	(45)
Energy content (annual)										Total = Sum(45)m =		2272.0637	
Distribution loss (46)m = 0.15 x (45)m	35.3520	31.1069	32.6827	27.9017	26.4730	23.2330	22.4931	23.7443	24.3980	27.9470	30.6180	34.8596	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7016	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9188	(55)
Total storage loss	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(56)
If cylinder contains dedicated solar storage	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	287.4267	254.1185	269.6315	236.0889	228.2331	204.9639	201.7008	210.0421	212.7306	238.0602	254.1975	284.1442	(62)
WWHRS	-33.3436	-29.4893	-30.8795	-25.5695	-23.8298	-20.3914	-19.1136	-20.3254	-21.0977	-24.8718	-28.1768	-32.7261	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	254.0831	224.6291	238.7520	210.5195	204.4033	184.5726	182.5871	189.7166	191.6329	213.1884	226.0207	251.4181	(64)
										Total per year (kWh/year) = Sum(64)m =		2571.5234	(64)
12Total per year (kWh/year)												2572	(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	119.7609	106.3448	113.8440	101.9107	100.0790	91.5617	91.2570	94.0305	94.1441	103.3466	107.9318	118.6695	(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	145.2783	145.2783	145.2783	145.2783	145.2783	145.2783	145.2783	145.2783	145.2783	145.2783	145.2783	145.2783	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	153.8439	170.3272	153.8439	158.9720	153.8439	158.9720	153.8439	153.8439	158.9720	153.8439	158.9720	153.8439	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	302.9492	306.0929	298.1710	281.3061	260.0172	240.0087	226.6418	223.4981	231.4201	248.2849	269.5738	289.5823	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.5278	37.5278	37.5278	37.5278	37.5278	37.5278	37.5278	37.5278	37.5278	37.5278	37.5278	37.5278	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-116.2226	-116.2226	-116.2226	-116.2226	-116.2226	-116.2226	-116.2226	-116.2226	-116.2226	-116.2226	-116.2226	-116.2226	(71)
Water heating gains (Table 5)	160.9689	158.2512	153.0161	141.5427	134.5148	127.1690	122.6573	126.3851	130.7557	138.9067	149.9053	159.5020	(72)
Total internal gains	687.3456	704.2548	674.6145	651.4043	617.9595	592.7332	569.7265	570.3106	587.7313	610.6190	648.0347	672.5117	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	9.1900	11.2829	0.6300	0.7000	0.7700	31.6891	(75)
Southeast	3.5600	36.7938	0.6300	0.7000	0.7700	40.0310	(77)
Southwest	12.8600	36.7938	0.6300	0.7000	0.7700	144.6065	(79)
Northwest	1.3300	11.2829	0.6300	0.7000	0.7700	4.5861	(81)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	220.9127	388.3453	563.3557	751.6698	890.8973	905.9927	864.5105	757.3478	628.0515	437.8336	266.7968	187.6354	(83)
Total gains	908.2583	1092.6001	1237.9702	1403.0741	1508.8568	1498.7259	1434.2370	1327.6585	1215.7828	1048.4526	914.8315	860.1471	(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	39.4059	39.4931	39.5789	39.9872	40.0645	40.4285	40.4285	40.4966	40.2875	40.0645	39.9084	39.7465	
alpha	3.6271	3.6329	3.6386	3.6658	3.6710	3.6952	3.6952	3.6998	3.6858	3.6710	3.6606	3.6498	
util living area	0.9856	0.9717	0.9455	0.8804	0.7633	0.5959	0.4510	0.5014	0.7266	0.9145	0.9740	0.9881	(86)
MIT	19.1374	19.4259	19.8207	20.3170	20.6992	20.9126	20.9760	20.9646	20.8146	20.3033	19.6336	19.0908	(87)
Th 2	19.9520	19.9540	19.9561	19.9656	19.9674	19.9757	19.9757	19.9773	19.9725	19.9674	19.9638	19.9600	(88)
util rest of house	0.9824	0.9656	0.9334	0.8540	0.7130	0.5172	0.3525	0.3999	0.6541	0.8896	0.9673	0.9854	(89)
MIT 2	17.7864	18.1525	18.6488	19.2603	19.6973	19.9166	19.9652	19.9605	19.8311	19.2592	18.4257	17.7323	(90)
Living area fraction									fLA = Living area / (4) =			0.1426	(91)
MIT	17.9790	18.3341	18.8159	19.4110	19.8401	20.0586	20.1093	20.1036	19.9713	19.4081	18.5979	17.9260	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.9790	18.3341	18.8159	19.4110	19.8401	20.0586	20.1093	20.1036	19.9713	19.4081	18.5979	17.9260	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9735	0.9524	0.9164	0.8372	0.7061	0.5239	0.3658	0.4129	0.6540	0.8728	0.9548	0.9776	(94)
Useful gains	884.2226	1040.6217	1134.4450	1174.6866	1065.4193	785.2339	524.6274	548.2517	795.0981	915.0382	873.4805	840.9128	(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	2133.0008	2090.1806	1912.0441	1615.1716	1248.4443	829.6479	533.3739	561.9591	895.4908	1350.8843	1770.3141	2121.9844	(97)
Space heating kWh	929.0910	705.3036	578.5337	317.1491	136.1706	0.0000	0.0000	0.0000	0.0000	324.2695	645.7202	953.1173	(98a)
Space heating requirement - total per year (kWh/year)												4589.3551	
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	929.0910	705.3036	578.5337	317.1491	136.1706	0.0000	0.0000	0.0000	0.0000	324.2695	645.7202	953.1173	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4589.3551	
Space heating per m2											(98c) / (4) =	34.1470	(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	929.0910	705.3036	578.5337	317.1491	136.1706	0.0000	0.0000	0.0000	0.0000	324.2695	645.7202	953.1173	(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)	1006.5991	764.1426	626.7971	343.6069	147.5305	0.0000	0.0000	0.0000	0.0000	351.3212	699.5886	1032.6298	(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	254.0831	224.6291	238.7520	210.5195	204.4033	184.5726	182.5871	189.7166	191.6329	213.1884	226.0207	251.4181	(64)
Efficiency of water heater												79.8000	(216)
(217)m	86.7002	86.4450	85.9676	84.9764	83.1703	79.8000	79.8000	79.8000	79.8000	84.9975	86.2771	86.7577	(217)
Fuel for water heating, kWh/month	293.0595	259.8521	277.7231	247.7387	245.7647	231.2939	228.8059	237.7401	240.1415	250.8172	261.9707	289.7935	(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	31.9657	25.6441	23.0897	16.9165	13.0668	10.6757	11.9199	15.4940	20.1252	26.4053	29.8247	32.8542	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-59.8906	-82.5925	-116.1333	-127.5901	-135.0409	-125.0419	-123.3656	-117.6053	-107.2051	-92.8824	-65.1302	-51.9865	(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	-39.6894	-82.7429	-163.1423	-243.2024	-319.9015	-320.9222	-317.2636	-269.4927	-198.6077	-117.8586	-52.8234	-31.4536	(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	4972.2157	(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	3064.7009	(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)	257.9817	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-3361.5646	(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	5019.3337	(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	4972.2157	0.2100	1044.1653	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3064.7009	0.2100	643.5872	(264)
Space and water heating			1687.7525	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	257.9817	0.1443	37.2347	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1204.4642	0.1351	-162.7060	
PV Unit electricity exported	-2157.1004	0.1261	-272.0311	
Total			-434.7371	(269)
Total CO2, kg/year			1302.1793	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			9.6900	(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	4972.2157	1.1300	5618.6037	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3064.7009	1.1300	3463.1120	(278)
Space and water heating			9081.7158	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	257.9817	1.5338	395.7010	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1204.4642	1.4993	-1805.8317	
PV Unit electricity exported	-2157.1004	0.4629	-998.5608	
Total			-2804.3925	(283)
Total Primary energy kWh/year			6803.1251	(286)
Target Primary Energy Rate (TPER)			50.6200	(287)

Building Regulations England Part L (BREL) Compliance Report

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

Date: Fri 14 Mar 2025 09:30:50

Project Information			
Assessed By	Richard Millard	Building Type	House, Detached
OCDEA Registration	EES/025661	Assessment Date	2025-03-14

Dwelling Details			
Assessment Type	As designed	Total Floor Area	163 m^2
Site Reference	F	Plot Reference	Proposed
Address	6		

Client Details	
Name	Ian White
Company	Cotswold Homes Ltd
Address	West House, Yate, Bristol, BS37 5NG

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

1a Target emission rate and dwelling emission rate		
Fuel for main heating system	Electricity	
Target carbon dioxide emission rate	*8.35 kgCO_2/m^2*	
Dwelling carbon dioxide emission rate	2.72 kgCO_2/m^2	OK
1b Target primary energy rate and dwelling primary energy		
Target primary energy	*43.68 kWh$_{PE}$/m^2*	
Dwelling primary energy	30.64 kWh$_{PE}$/m^2	OK
1c Target fabric energy efficiency and dwelling fabric energy efficiency		
Target fabric energy efficiency	*37.2 kWh/m^2*	
Dwelling fabric energy efficiency	35.9 kWh/m^2	OK

2a Fabric U-values				
Element	***Maximum permitted average U-Value [W/m^2K]***	**Dwelling average U-Value [W/m^2K]**	**Element with highest individual U-Value**	
External walls	*0.26*	0.18	Walls (1) (0.18)	OK
Party walls	*0.2*	N/A	N/A	**N/A**
Curtain walls	*1.6*	N/A	N/A	**N/A**
Floors	*0.18*	0.12	Heatloss Floor 1 (0.12)	OK
Roofs	*0.16*	0.11	Roof (1) (0.11)	OK
Windows, doors, and roof windows	*1.6*	1.2	WG01 (1.2)	OK
Rooflights	*2.2*	N/A	N/A	**N/A**

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))		
Name	**Net area [m^2]**	**U-Value [W/m^2K]**
Exposed wall: Walls (1)	119.95	0.18
Ground floor: Heatloss Floor 1, Heatloss Floor 1	81.64	0.12
Exposed roof: Roof (1)	81.64	0.11

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	**Area [m^2]**	**Orientation**	**Frame factor**	**U-Value [W/m^2K]**
WG01, Windows	2.12	West	0.7	1.2
WG02, Windows	2.12	West	0.7	1.2
WG03, Windows	1.45	South	0.7	1.2
FG01, Windows	2.12	West	0.7	1.2
FG02, Windows	0.67	West	0.7	1.2
FG03, Windows	2.12	West	0.7	1.2
FG04, Windows	1.45	East	0.7	1.2
FG05, Windows	0.5	South	0.7	1.2
FG06, Windows	1.4	East	0.7	1.2
ED01, Doors	1.92	West	N/A	1.2
ED02, Glazed Doors	3.73	East	0.7	1.2
ED03, Glazed Doors	3.73	South	0.7	1.2
WG04, Windows	1.6	East	0.7	1.2
WG05, Windows	1.4	East	0.7	1.2

Name	Area [m^2]	Orientation	Frame factor	U-Value [W/m^2K]
WG06, Windows	0.95	North	0.7	1.2
FG07, Windows	1.4	East	0.7	1.2
ED04, Doors	2	North	N/A	1.2
FG08, Windows	0.95	North	0.7	1.2
FG09, Windows	0.95	North	0.7	1.2

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))				
Building part **1**: Thermal bridging calculated from linear thermal transmittances for each junction				
Main element	**Junction detail**	**Source**	**Psi value [W/mK]**	**Drawing / reference**
External wall	E1: Steel lintel with perforated steel base plate	Calculated by person with suitable expertise	0.241	EMPF125E101
External wall	E3: Sill	Calculated by person with suitable expertise	0.026 **(!)**	EMPF125E301
External wall	E4: Jamb	Calculated by person with suitable expertise	0.02 **(!)**	EMPF125E401
External wall	E5: Ground floor (normal)	Calculated by person with suitable expertise	0.045	EMPF125E504
External wall	E6: Intermediate floor within a dwelling	Calculated by person with suitable expertise	0.002 **(!)**	EMPF125E601
External wall	E10: Eaves (insulation at ceiling level)	Calculated by person with suitable expertise	0.05	EMPF125E1001
External wall	E12: Gable (insulation at ceiling level)	Calculated by person with suitable expertise	0.031 **(!)**	EMPF125E1201
External wall	E16: Corner (normal)	Calculated by person with suitable expertise	0.037 **(!)**	EMPF125E21601
External wall	E17: Corner (inverted - internal area greater than external area)	Calculated by person with suitable expertise	-0.09	EMPF125E21701

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

4 Space heating	
Main heating system 1: Heat pump with radiators or underfloor heating - Electricity	
Efficiency	246.9%
Emitter type	Radiators
Flow temperature	55°C
System type	Heat Pump
Manufacturer	Daikin Europe NV
Model	EDLA08EV3
Commissioning	
Secondary heating system: N/A	
Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water	
Cylinder/store - type: Cylinder	
Capacity	210 litres
Declared heat loss	1.7 kWh/day
Primary pipework insulated	Yes
Manufacturer	
Model	
Commissioning	
Waste water heat recovery system 1 - type: N/A	
Efficiency	
Manufacturer	
Model	

6 Controls		
Main heating 1 - type: Time and temperature zone control by arrangement of plumbing and electrical services		
Function		
Ecodesign class		
Manufacturer		
Model		
Water heating - type: Cylinder thermostat and HW separately timed		
Manufacturer		
Model		

7 Lighting		
Minimum permitted light source efficacy	*75 lm/W*	
Lowest light source efficacy	85 lm/W	**OK**
External lights control	N/A	

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

9 Local generation	
Technology type: **Photovoltaic system (1)**	
Peak power	2.01 kWp
Orientation	South
Pitch	30°
Overshading	Modest
Manufacturer	
MCS certificate	

10 Heat networks
N/A

11 Supporting documentary evidence
N/A

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

Full SAP Calculation Printout

Property Reference	F	**Issued on Date**	14/03/2025
Assessment Reference	Proposed	**Prop Type Ref**	Proposed 6
Property	6		

SAP Rating	86 B	**DER**	2.72	**TER**	8.35
Environmental	97 A	**% DER < TER**			67.43
CO_2 Emissions (t/year)	0.4	**DFEE**	35.91	**TFEE**	37.17
Compliance Check	See BREL	**% DFEE < TFEE**			3.39
% DPER < TPER	29.85	**DPER**	30.64	**TPER**	43.68

Assessor Details	Mr. Richard Millard	**Assessor ID**	U367-0001
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)	
Main dwelling						
Ground floor	81.6400 (1b)	x	2.4000 (2b)	=	195.9360	(1b) - (3b)
First floor	81.6400 (1c)	x	2.6000 (2c)	=	212.2640	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	163.2800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	408.2000	(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			6 * 10 =	60.0000	(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) =			60.0000 / (5) =	0.1470	(8)
Pressure test				Yes	
Pressure Test Method				Blower Door	
Measured/design AP50				5.0000	(17)
Infiltration rate				0.3970	(18)
Number of sides sheltered				2	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3374	(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	0.4302	0.4218	0.4134	0.3712	0.3627	0.3206	0.3206	0.3121	0.3374	0.3627	0.3796	0.3965	(22b)
Effective ac	0.5926	0.5890	0.5854	0.5689	0.5658	0.5514	0.5514	0.5487	0.5569	0.5658	0.5721	0.5786	(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	
Main dwelling								
Windows			21.2000	1.1450	24.2748			(27)
Glazed Doors			7.4600	1.1450	8.5420			(27)
Doors			3.9200	1.2000	4.7040			(26)
Heatloss Floor 1			81.6400	0.1200	9.7968	75.0000	6123.0000	(28a)
Cavity Wall	152.5300	32.5800	119.9500	0.1800	21.5910	60.0000	7196.9999	(29a)
External Roof 1	81.6400		81.6400	0.1100	8.9804	9.0000	734.7600	(30)
Total net area of external elements Aum(A, m2)			315.8100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		77.8890			(33)
Main dwelling								
Internal Wall 1 - Block			71.3800			75.0000	5353.4998	(32c)
Internal Wall 2 - Stud			47.4300			9.0000	426.8700	(32c)
Internal Wall 3 - Up			235.1900			9.0000	2116.7100	(32c)
Internal Floor 1			81.6400			18.0000	1469.5200	(32d)
Internal Ceiling 1			81.6400			9.0000	734.7600	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		24156.1197	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							147.9429	(35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total

E1 Steel lintel with perforated steel base plate	23.5300	0.2410	5.6707	
E3 Sill	18.0600	0.0260	0.4696	
E4 Jamb	51.2800	0.0200	1.0256	
E5 Ground floor (normal)	39.9100	0.0450	1.7959	
E6 Intermediate floor within a dwelling	39.9100	0.0020	0.0798	
E10 Eaves (insulation at ceiling level)	21.9700	0.0500	1.0985	
E12 Gable (insulation at ceiling level)	17.9400	0.0310	0.5561	
E16 Corner (normal)	25.0000	0.0370	0.9250	
E17 Corner (inverted - internal area greater than external area)	5.0000	-0.0900	-0.4500	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 11.1713 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 89.0603 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	79.8202	79.3360	78.8615	76.6327	76.2157	74.2744	74.2744	73.9149	75.0221	76.2157	77.0593	77.9412	(38)
Heat transfer coeff	168.8804	168.3963	167.9218	165.6930	165.2759	163.3347	163.3347	162.9752	164.0824	165.2759	166.1196	167.0015	(39)

Average = Sum(39)m / 12 = 165.6910

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0343	1.0313	1.0284	1.0148	1.0122	1.0003	1.0003	0.9981	1.0049	1.0122	1.0174	1.0228	(40)
HLP (average)												1.0148	
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 2.9535 (42)

Hot water usage for mixer showers

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
73.7397	72.6316	71.0167	67.9271	65.6470	63.1043	61.6590	63.2616	65.0183	67.7484	70.9045	73.4572	(42a)

Hot water usage for baths

31.8337	31.3609	30.6952	29.4676	28.5484	27.5292	26.9787	27.6398	28.3596	29.4502	30.7031	31.7261	(42b)

Hot water usage for other uses

44.8764	43.2446	41.6127	39.9808	38.3489	36.7171	36.7171	38.3489	39.9808	41.6127	43.2446	44.8764	(42c)

Average daily hot water use (litres/day) 138.2972 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	150.4499	147.2371	143.3246	137.3755	132.5444	127.3506	125.3548	129.2503	133.3588	138.8114	144.8521	150.0597	(44)
Energy conte	238.2758	209.6636	220.2846	188.0602	178.4302	156.5924	151.6057	160.0389	164.4447	188.3657	206.3683	234.9573	(45)

Energy content (annual) Total = Sum(45)m = 2297.0875

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

35.7414	31.4495	33.0427	28.2090	26.7645	23.4889	22.7409	24.0058	24.6667	28.2549	30.9553	35.2436	(46)

Water storage loss:

Store volume 210.0000 (47)

a) If manufacturer declared loss factor is known (kWh/day): 1.7000 (48)

Temperature factor from Table 2b 0.5400 (49)

Enter (49) or (54) in (55) 0.9180 (55)

Total storage loss

28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(56)

If cylinder contains dedicated solar storage

28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(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

289.9962	256.3788	272.0050	238.1122	230.1506	206.6444	203.3261	211.7593	214.4967	240.0861	256.4203	286.6777	(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

289.9962	256.3788	272.0050	238.1122	230.1506	206.6444	203.3261	211.7593	214.4967	240.0861	256.4203	286.6777	(64)

Total per year (kWh/year) = Sum(64)m = 2906.0535 (64)

12Total per year (kWh/year) 2906 (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

120.6030	107.0853	114.6209	102.5716	100.7044	92.1086	91.7852	94.5893	94.7195	104.0079	108.6591	119.4996	(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	147.6732	147.6732	147.6732	147.6732	147.6732	147.6732	147.6732	147.6732	147.6732	147.6732	147.6732	147.6732	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	173.1036	191.6504	173.1036	178.8738	173.1036	178.8738	173.1036	173.1036	178.8738	173.1036	178.8738	173.1036	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	334.6312	338.1036	329.3532	310.7247	287.2095	265.1085	250.3437	246.8712	255.6216	274.2502	297.7654	319.8664	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.7673	37.7673	37.7673	37.7673	37.7673	37.7673	37.7673	37.7673	37.7673	37.7673	37.7673	37.7673	(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)	-118.1386	-118.1386	-118.1386	-118.1386	-118.1386	-118.1386	-118.1386	-118.1386	-118.1386	-118.1386	-118.1386	-118.1386	(71)
Water heating gains (Table 5)	162.1008	159.3531	154.0604	142.4606	135.3553	127.9286	123.3672	127.1361	131.5548	139.7956	150.9154	160.6178	(72)
Total internal gains	737.1376	756.4092	723.8192	699.3610	662.9704	639.2127	614.1165	614.4129	633.3521	654.4514	694.8565	720.8897	(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	2.8500	10.6334	0.6300	0.7000	0.7700	9.2617	(74)
East	7.2500	19.6403	0.6300	0.7000	0.7700	43.5168	(76)
South	1.9500	46.7521	0.6300	0.7000	0.7700	27.8617	(78)
West	9.1500	19.6403	0.6300	0.7000	0.7700	54.9212	(80)
East	3.7300	19.6403	0.6300	0.7000	0.7700	22.3887	(76)
South	3.7300	46.7521	0.6300	0.7000	0.7700	53.2944	(78)

Solar gains	211.2444	386.9749	588.6386	807.3694	960.2250	973.7839	930.6005	816.1327	665.7426	444.8920	258.2797	177.2093	(83)
Total gains	948.3821	1143.3840	1312.4578	1506.7304	1623.1953	1612.9967	1544.7170	1430.5456	1299.0947	1099.3433	953.1362	898.0990	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	39.7324	39.8467	39.9593	40.4968	40.5990	41.0815	41.0815	41.1721	40.8943	40.5990	40.3928	40.1795	
alpha	3.6488	3.6564	3.6640	3.6998	3.7066	3.7388	3.7388	3.7448	3.7263	3.7066	3.6929	3.6786	
util living area	0.9875	0.9749	0.9493	0.8831	0.7656	0.5964	0.4506	0.5008	0.7312	0.9217	0.9773	0.9897	(86)
Living	19.1153	19.4015	19.8085	20.3217	20.7036	20.9158	20.9772	20.9664	20.8161	20.2897	19.6152	19.0761	
Non living	17.8383	18.2028	18.7166	19.3541	19.7968	20.0221	20.0718	20.0671	19.9306	19.3301	18.4849	17.7945	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	20.0359	19.4015	19.8085	20.3217	20.7036	20.9158	20.9772	20.9664	20.8161	20.2897	19.6152	19.3452	(87)
Th 2	20.0548	20.0573	20.0597	20.0710	20.0732	20.0831	20.0831	20.0849	20.0792	20.0732	20.0689	20.0644	(88)
util rest of house	0.9850	0.9700	0.9391	0.8599	0.7208	0.5261	0.3627	0.4102	0.6668	0.9009	0.9719	0.9876	(89)
MIT 2	19.1712	18.2028	18.7166	19.3541	19.7968	20.0221	20.0718	20.0671	19.9306	19.3301	18.4849	18.2035	(90)
Living area fraction									fLA = Living area / (4) =			0.1673	(91)
MIT	19.3158	18.4033	18.8992	19.5160	19.9485	20.1716	20.2233	20.2175	20.0787	19.4906	18.6740	18.3945	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.3158	18.4033	18.8992	19.5160	19.9485	20.1716	20.2233	20.2175	20.0787	19.4906	18.6740	18.3945	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9825	0.9580	0.9229	0.8435	0.7141	0.5332	0.3765	0.4238	0.6668	0.8846	0.9608	0.9823	(94)
Useful gains	931.8052	1095.4099	1211.2507	1270.9595	1159.1794	860.0492	581.5904	606.2964	866.2139	972.5245	915.7375	882.2295	(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	2535.8747	2273.9022	2082.1009	1758.9914	1363.2731	910.0315	591.8040	622.1573	981.0032	1469.4018	1922.6665	2370.5009	(97)
Space heating kWh	1193.4277	791.9468	647.9125	351.3830	151.8457	0.0000	0.0000	0.0000	0.0000	369.6767	724.9888	1107.2739	(98a)
Space heating requirement - total per year (kWh/year)												5338.4552	
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	1193.4277	791.9468	647.9125	351.3830	151.8457	0.0000	0.0000	0.0000	0.0000	369.6767	724.9888	1107.2739	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												5338.4552	
Space heating per m2											(98c) / (4) =	32.6951	(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 %)	246.9331	(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	1193.4277	791.9468	647.9125	351.3830	151.8457	0.0000	0.0000	0.0000	0.0000	369.6767	724.9888	1107.2739	(98)
Space heating efficiency (main heating system 1)	246.9331	246.9331	246.9331	246.9331	246.9331	0.0000	0.0000	0.0000	0.0000	246.9331	246.9331	246.9331	(210)
Space heating fuel (main heating system)	483.3000	320.7131	262.3839	142.2989	61.4927	0.0000	0.0000	0.0000	0.0000	149.7072	293.5973	448.4105	(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	289.9962	256.3788	272.0050	238.1122	230.1506	206.6444	203.3261	211.7593	214.4967	240.0861	256.4203	286.6777	(64)
Efficiency of water heater												166.2595	(216)
(217)m	166.2595	166.2595	166.2595	166.2595	166.2595	166.2595	166.2595	166.2595	166.2595	166.2595	166.2595	166.2595	(217)
Fuel for water heating, kWh/month	174.4239	154.2041	163.6027	143.2173	138.4286	124.2903	122.2945	127.3668	129.0132	144.4045	154.2290	172.4279	(219)
Space cooling fuel requirement	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)
(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	(231)
Pumps and Fa	35.2324	28.2647	25.4492	18.6452	14.4021	11.7666	13.1381	17.0774	22.1818	29.1037	32.8726	36.2116	(232)
Lighting													
Electricity generated by PVs (Appendix M) (negative quantity)	-33.2679	-50.8220	-78.9057	-94.0847	-104.5370	-96.0194	-94.6677	-86.7774	-73.3663	-59.5623	-37.5565	-28.1800	(233a)
(233a)m													
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
(234a)m													
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
(235a)m													
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	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)
(235c)m													
Electricity generated by PVs (Appendix M) (negative quantity)	-7.0016	-16.3763	-35.5407	-59.2960	-84.9520	-90.2784	-89.1682	-73.8409	-52.4301	-26.3418	-10.2089	-5.5188	(233b)
(233b)m													
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
(234b)m													
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
(235b)m													
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	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)
(235d)m													

Annual totals kWh/year

Space heating fuel - main system 1	2161.9036	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)

Efficiency of water heater	166.2595	
Water heating fuel used	1747.9027	(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)	284.3453	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-1388.7005	(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	2805.4511	(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	2161.9036	0.1556	336.4868	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1747.9027	0.1410	246.4152	(264)
Space and water heating			582.9020	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	284.3453	0.1443	41.0398	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-837.7468	0.1336	-111.9448	
PV Unit electricity exported	-550.9537	0.1227	-67.5897	
Total			-179.5345	(269)
Total CO2, kg/year			444.4073	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			2.7200	(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	2161.9036	1.5762	3407.5522	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1747.9027	1.5213	2659.0634	(278)
Space and water heating			6066.6156	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	284.3453	1.5338	436.1383	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-837.7468	1.4938	-1251.4398	
PV Unit electricity exported	-550.9537	0.4501	-247.9966	
Total			-1499.4364	(283)
Total Primary energy kWh/year			5003.3175	(286)
Dwelling Primary energy Rate (DPER)			30.6400	(287)

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Main dwelling						
Ground floor	81.6400 (1b)	x	2.4000 (2b)	=	195.9360	(1b) - (3b)
First floor	81.6400 (1c)	x	2.6000 (2c)	=	212.2640	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 163.2800						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	408.2000	(5)

2. Ventilation rate

	m3 per hour		
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	4 * 10 =	40.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0980	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3480	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2958	(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													
	0.3771	0.3697	0.3623	0.3254	0.3180	0.2810	0.2810	0.2736	0.2958	0.3180	0.3328	0.3476	(22b)
Effective ac	0.5711	0.5684	0.5656	0.5529	0.5506	0.5395	0.5395	0.5374	0.5437	0.5506	0.5554	0.5604	(25)

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3. Heat losses and heat loss parameter

Element	Gross	Openings	NetArea	U-value	A x U	K-value	A x K	
Main dwelling	m2	m2	m2	W/m2K	W/K	kJ/m2K	kJ/K	
TER Opaque door			3.9200	1.0000	3.9200			(26)
TER Opening Type			28.6600	1.1450	32.8168			(27)
Heatloss Floor 1			81.6400	0.1300	10.6132			(28a)
Cavity Wall	152.5300	32.5800	119.9500	0.1800	21.5910			(29a)
External Roof 1	81.6400		81.6400	0.1100	8.9804			(30)
Total net area of external elements Aum(A, m2)			315.8100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		77.9214			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 147.9429 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	23.5300	0.0500	1.1765
E3 Sill	18.0600	0.0500	0.9030
E4 Jamb	51.2800	0.0500	2.5640
E5 Ground floor (normal)	39.9100	0.1600	6.3856
E6 Intermediate floor within a dwelling	39.9100	0.0000	0.0000
E10 Eaves (insulation at ceiling level)	21.9700	0.0600	1.3182
E12 Gable (insulation at ceiling level)	17.9400	0.0600	1.0764
E16 Corner (normal)	25.0000	0.0900	2.2500
E17 Corner (inverted - internal area greater than external area)	5.0000	-0.0900	-0.4500

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 15.2237 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 93.1451 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	76.9327	76.5607	76.1961	74.4834	74.1630	72.6714	72.6714	72.3951	73.2459	74.1630	74.8112	75.4889	(38)
Heat transfer coeff													
	170.0778	169.7058	169.3412	167.6285	167.3081	165.8165	165.8165	165.5402	166.3910	167.3081	167.9563	168.6340	(39)
Average = Sum(39)m / 12 =												167.6270	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0416	1.0394	1.0371	1.0266	1.0247	1.0155	1.0155	1.0138	1.0191	1.0247	1.0286	1.0328	(40)
HLP (average)												1.0266	
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 2.9535 (42)

Hot water usage for mixer showers

73.7397	72.6316	71.0167	67.9271	65.6470	63.1043	61.6590	63.2616	65.0183	67.7484	70.9045	73.4572	(42a)

Hot water usage for baths

31.8337	31.3609	30.6952	29.4676	28.5484	27.5292	26.9787	27.6398	28.3596	29.4502	30.7031	31.7261	(42b)

Hot water usage for other uses

44.8764	43.2446	41.6127	39.9808	38.3489	36.7171	36.7171	38.3489	39.9808	41.6127	43.2446	44.8764	(42c)

Average daily hot water use (litres/day) 138.2972 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	150.4499	147.2371	143.3246	137.3755	132.5444	127.3506	125.3548	129.2503	133.3588	138.8114	144.8521	150.0597	(44)
Energy conte	238.2758	209.6636	220.2846	188.0602	178.4302	156.5924	151.6057	160.0389	164.4447	188.3657	206.3683	234.9573	(45)
Energy content (annual)										Total = Sum(45)m =		2297.0875	
Distribution loss (46)m = 0.15 x (45)m													
	35.7414	31.4495	33.0427	28.2090	26.7645	23.4889	22.7409	24.0058	24.6667	28.2549	30.9553	35.2436	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7016	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9188	(55)
Total storage loss													
	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(56)
If cylinder contains dedicated solar storage													
	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(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													
	290.0224	256.4025	272.0312	238.1376	230.1768	206.6697	203.3523	211.7855	214.5220	240.1123	256.4457	286.7039	(62)
WWHRS	-33.7107	-29.8140	-31.2195	-25.8510	-24.0922	-20.6159	-19.3241	-20.5492	-21.3300	-25.1457	-28.4870	-33.0865	(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													
	256.3117	226.5884	240.8116	212.2866	206.0846	186.0538	184.0282	191.2362	193.1920	214.9666	227.9587	253.6174	(64)
										Total per year (kWh/year) = Sum(64)m =		2593.1359	(64)
12Total per year (kWh/year)												2593	(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													
	120.6240	107.1042	114.6419	102.5919	100.7253	92.1288	91.8062	94.6102	94.7397	104.0289	108.6793	119.5206	(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	147.6732	147.6732	147.6732	147.6732	147.6732	147.6732	147.6732	147.6732	147.6732	147.6732	147.6732	147.6732	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	173.1036	191.6504	173.1036	178.8738	173.1036	178.8738	173.1036	173.1036	178.8738	173.1036	178.8738	173.1036	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	334.6312	338.1036	329.3532	310.7247	287.2095	265.1085	250.3437	246.8712	255.6216	274.2502	297.7654	319.8664	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.7673	37.7673	37.7673	37.7673	37.7673	37.7673	37.7673	37.7673	37.7673	37.7673	37.7673	37.7673	(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)													
	-118.1386	-118.1386	-118.1386	-118.1386	-118.1386	-118.1386	-118.1386	-118.1386	-118.1386	-118.1386	-118.1386	-118.1386	(71)
Water heating gains (Table 5)													
	162.1290	159.3813	154.0886	142.4888	135.3835	127.9567	123.3954	127.1643	131.5830	139.8237	150.9435	160.6459	(72)
Total internal gains													
	740.1658	759.4373	726.8474	702.3891	665.9985	639.2409	614.1446	614.4411	633.3803	657.4795	697.8847	723.9179	(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	2.8500	10.6334	0.6300	0.7000	0.7700	9.2617	(74)
East	10.9800	19.6403	0.6300	0.7000	0.7700	65.9055	(76)
South	5.6800	46.7521	0.6300	0.7000	0.7700	81.1561	(78)
West	9.1500	19.6403	0.6300	0.7000	0.7700	54.9212	(80)

Solar gains	211.2444	386.9749	588.6386	807.3694	960.2250	973.7839	930.6005	816.1327	665.7426	444.8920	258.2797	177.2093	(83)
Total gains	951.4102	1146.4122	1315.4860	1509.7586	1626.2235	1613.0248	1544.7451	1430.5738	1299.1229	1102.3715	956.1644	901.1272	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	39.4527	39.5392	39.6243	40.0292	40.1058	40.4666	40.4666	40.5342	40.3269	40.1058	39.9511	39.7905	
alpha	3.6302	3.6359	3.6416	3.6686	3.6737	3.6978	3.6978	3.7023	3.6885	3.6737	3.6634	3.6527	
util living area													
	0.9874	0.9749	0.9494	0.8843	0.7683	0.6023	0.4563	0.5069	0.7357	0.9223	0.9772	0.9896	(86)
MIT	19.1020	19.3868	19.7938	20.3050	20.6926	20.9097	20.9751	20.9634	20.8067	20.2744	19.5969	19.0569	(87)
Th 2	20.0488	20.0507	20.0525	20.0612	20.0628	20.0704	20.0704	20.0718	20.0675	20.0628	20.0595	20.0561	(88)
util rest of house													
	0.9848	0.9699	0.9392	0.8611	0.7234	0.5310	0.3664	0.4144	0.6710	0.9015	0.9719	0.9874	(89)
MIT 2	17.8175	18.1799	18.6933	19.3267	19.7761	20.0051	20.0582	20.0525	19.9112	19.3041	18.4556	17.7647	(90)
Living area fraction										fLA = Living area / (4) =		0.1673	(91)
MIT	18.0324	18.3818	18.8774	19.4903	19.9294	20.1564	20.2116	20.2048	20.0610	19.4664	18.6465	17.9809	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.0324	18.3818	18.8774	19.4903	19.9294	20.1564	20.2116	20.2048	20.0610	19.4664	18.6465	17.9809	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9769	0.9578	0.9228	0.8444	0.7164	0.5379	0.3804	0.4282	0.6705	0.8850	0.9605	0.9805	(94)
Useful gains	929.4244	1098.0804	1213.9901	1274.8751	1164.9969	867.6649	587.6960	612.5782	871.0746	975.5711	918.4265	883.5812	(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													
	2335.5703	2287.9341	2096.0024	1775.2382	1376.8486	921.3391	598.8553	629.8554	991.8546	1483.4239	1939.3085	2323.9236	(97)
Space heating kWh													
	1046.1726	799.5817	656.2172	360.2615	157.6177	0.0000	0.0000	0.0000	0.0000	377.8425	735.0350	1071.6148	(98a)
Space heating requirement - total per year (kWh/year)												5204.3429	
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													
	1046.1726	799.5817	656.2172	360.2615	157.6177	0.0000	0.0000	0.0000	0.0000	377.8425	735.0350	1071.6148	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												5204.3429	
Space heating per m2											(98c) / (4) =	31.8737	(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													
	1046.1726	799.5817	656.2172	360.2615	157.6177	0.0000	0.0000	0.0000	0.0000	377.8425	735.0350	1071.6148	(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)													
	1133.4481	866.2857	710.9612	390.3158	170.7667	0.0000	0.0000	0.0000	0.0000	409.3635	796.3543	1161.0128	(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													
	256.3117	226.5884	240.8116	212.2866	206.0846	186.0538	184.0282	191.2362	193.1920	214.9666	227.9587	253.6174	(64)
Efficiency of water heater												79.8000	(216)
(217)m	86.8720	86.6423	86.1904	85.2357	83.4660	79.8000	79.8000	79.8000	79.8000	85.3110	86.4909	86.9239	(217)
Fuel for water heating, kWh/month													
	295.0453	261.5217	279.3949	249.0582	246.9083	233.1502	230.6118	239.6444	242.0953	251.9799	263.5637	291.7696	(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	35.9675	28.8545	25.9803	19.0342	14.7026	12.0122	13.4122	17.4337	22.6446	29.7110	33.5585	36.9672	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-70.2380	-96.0359	-133.8767	-145.7510	-153.1324	-141.3536	-139.4218	-133.4472	-122.5169	-107.3321	-76.0713	-61.0651	(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	-49.2990	-102.4347	-201.3690	-299.3527	-392.9857	-393.9870	-389.5146	-331.2298	-244.5843	-145.6439	-65.5215	-39.0974	(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	5638.5080	(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	3084.7433	(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)	290.2785	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-4035.2615	(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	5064.2683	(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	5638.5080	0.2100	1184.0867	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3084.7433	0.2100	647.7961	(264)
Space and water heating			1831.8828	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	290.2785	0.1443	41.8962	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1380.2420	0.1353	-186.7225	
PV Unit electricity exported	-2655.0195	0.1262	-335.0417	
Total			-521.7642	(269)
Total CO2, kg/year			1363.9440	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			8.3500	(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	5638.5080	1.1300	6371.5140	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3084.7433	1.1300	3485.7600	(278)
Space and water heating			9857.2740	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	290.2785	1.5338	445.2388	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1380.2420	1.5000	-2070.3902	
PV Unit electricity exported	-2655.0195	0.4632	-1229.8666	
Total			-3300.2568	(283)
Total Primary energy kWh/year			7132.3568	(286)
Target Primary Energy Rate (TPER)			43.6800	(287)

Building Regulations England Part L (BREL) Compliance Report

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

Date: Fri 14 Mar 2025 09:30:55

Project Information			
Assessed By	Richard Millard	Building Type	House, Detached
OCDEA Registration	EES/025661	Assessment Date	2025-03-14

Dwelling Details			
Assessment Type	As designed	Total Floor Area	163 m^2
Site Reference	F	Plot Reference	Regulated (Baseline)
Address	6		

Client Details	
Name	Ian White
Company	Cotswold Homes Ltd
Address	West House, Yate, Bristol, BS37 5NG

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

1a Target emission rate and dwelling emission rate		
Fuel for main heating system	Mains gas	
Target carbon dioxide emission rate	*8.34 $kgCO_2/m^2$*	
Dwelling carbon dioxide emission rate	12.39 $kgCO_2/m^2$	**FAIL**
1b Target primary energy rate and dwelling primary energy		
Target primary energy	*43.62 kWh_{PE}/m^2*	
Dwelling primary energy	68.38 kWh_{PE}/m^2	**FAIL**
1c Target fabric energy efficiency and dwelling fabric energy efficiency		
Target fabric energy efficiency	*37.2 kWh/m^2*	
Dwelling fabric energy efficiency	37.0 kWh/m^2	**OK**

2a Fabric U-values				
Element	***Maximum permitted average U-Value [W/m^2K]***	**Dwelling average U-Value [W/m^2K]**	**Element with highest individual U-Value**	
External walls	*0.26*	0.18	Walls (1) (0.18)	**OK**
Party walls	*0.2*	N/A	N/A	**N/A**
Curtain walls	*1.6*	N/A	N/A	**N/A**
Floors	*0.18*	0.13	Heatloss Floor 1 (0.13)	**OK**
Roofs	*0.16*	0.11	Roof (1) (0.11)	**OK**
Windows, doors, and roof windows	*1.6*	1.2	WG01 (1.2)	**OK**
Rooflights	*2.2*	N/A	N/A	**N/A**

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))		
Name	**Net area [m^2]**	**U-Value [W/m^2K]**
Exposed wall: Walls (1)	119.95	0.18
Ground floor: Heatloss Floor 1, Heatloss Floor 1	81.64	0.13
Exposed roof: Roof (1)	81.64	0.11

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	**Area [m^2]**	**Orientation**	**Frame factor**	**U-Value [W/m^2K]**
WG01, Windows	2.12	West	0.7	1.2
WG02, Windows	2.12	West	0.7	1.2
WG03, Windows	1.45	South	0.7	1.2
FG01, Windows	2.12	West	0.7	1.2
FG02, Windows	0.67	West	0.7	1.2
FG03, Windows	2.12	West	0.7	1.2
FG04, Windows	1.45	East	0.7	1.2
FG05, Windows	0.5	South	0.7	1.2
FG06, Windows	1.4	East	0.7	1.2
ED01, Doors	1.92	West	N/A	1.2
ED02, Glazed Doors	3.73	East	0.7	1.2
ED03, Glazed Doors	3.73	South	0.7	1.2
WG04, Windows	1.6	East	0.7	1.2
WG05, Windows	1.4	East	0.7	1.2

Name	Area [m^2]	Orientation	Frame factor	U-Value [W/m^2K]
WG06, Windows	0.95	North	0.7	1.2
FG07, Windows	1.4	East	0.7	1.2
ED04, Doors	2	North	N/A	1.2
FG08, Windows	0.95	North	0.7	1.2
FG09, Windows	0.95	North	0.7	1.2

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))				
Building part **1**: Thermal bridging calculated from linear thermal transmittances for each junction				
Main element	**Junction detail**	**Source**	**Psi value [W/mK]**	**Drawing / reference**
External wall	E2: Other lintels (including other steel lintels)	Calculated by person with suitable expertise	0.05	mpf125e2-04
External wall	E3: Sill	Calculated by person with suitable expertise	0.05	mpf125e3-01
External wall	E4: Jamb	Calculated by person with suitable expertise	0.022 **(!)**	mpf125e4-01
External wall	E5: Ground floor (normal)	Calculated by person with suitable expertise	0.16	mpf125e5-04
External wall	E6: Intermediate floor within a dwelling	Calculated by person with suitable expertise	0.003 **(!)**	mpf125e6-01
External wall	E10: Eaves (insulation at ceiling level)	Calculated by person with suitable expertise	0.06	mpf125e10-01
External wall	E12: Gable (insulation at ceiling level)	Calculated by person with suitable expertise	0.06	mpf125e12-01
External wall	E16: Corner (normal)	Calculated by person with suitable expertise	0.09	mpf125e16-01
External wall	E17: Corner (inverted - internal area greater than external area)	Calculated by person with suitable expertise	-0.085	mpf125e17-01

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

4 Space heating	
Main heating system 1: Boiler with radiators or underfloor heating - Mains gas	
Efficiency	88.6%
Emitter type	Radiators
Flow temperature	45°C
System type	Regular boiler
Manufacturer	Bosch Thermotechnology
Model	Greenstar 8000 Life
Commissioning	
Secondary heating system: N/A	
Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water	
Cylinder/store - type: Cylinder	
Capacity	200 litres
Declared heat loss	2.09 kWh/day
Primary pipework insulated	Yes
Manufacturer	
Model	
Commissioning	
Waste water heat recovery system 1 - type: N/A	
Efficiency	
Manufacturer	
Model	

6 Controls		
Main heating 1 - type: Time and temperature zone control by arrangement of plumbing and electrical services		
Function		
Ecodesign class		
Manufacturer		
Model		
Water heating - type: Cylinder thermostat and HW separately timed		
Manufacturer		
Model		

7 Lighting		
Minimum permitted light source efficacy	*75 lm/W*	
Lowest light source efficacy	85 lm/W	**OK**
External lights control	N/A	

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

9 Local generation
N/A

10 Heat networks
N/A

11 Supporting documentary evidence
N/A

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

Full SAP Calculation Printout

Property Reference	F	**Issued on Date**	14/03/2025
Assessment Reference	Regulated (Baseline)	**Prop Type Ref**	Proposed 6
Property	6		

SAP Rating	86 B	**DER**	12.39	**TER**	8.34
Environmental	87 B	**% DER < TER**			-48.56
CO_2 Emissions (t/year)	1.89	**DFEE**	37.02	**TFEE**	37.17
Compliance Check	See BREL	**% DFEE < TFEE**			0.42
% DPER < TPER	-56.76	**DPER**	68.38	**TPER**	43.62

Assessor Details	Mr. Richard Millard	**Assessor ID**	U367-0001
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)	
Main dwelling						
Ground floor	81.6400 (1b)	x	2.4000 (2b)	=	195.9360	(1b) - (3b)
First floor	81.6400 (1c)	x	2.6000 (2c)	=	212.2640	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	163.2800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	408.2000	(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		6 * 10 =	60.0000	(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) =		60.0000 / (5) =	0.1470	(8)
Pressure test			Yes	
Pressure Test Method			Blower Door	
Measured/design AP50			5.0000	(17)
Infiltration rate			0.3970	(18)
Number of sides sheltered			2	(19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor		(21) = (18) x (20) =	0.3374	(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	0.4302	0.4218	0.4134	0.3712	0.3627	0.3206	0.3206	0.3121	0.3374	0.3627	0.3796	0.3965	(22b)
Effective ac	0.5926	0.5890	0.5854	0.5689	0.5658	0.5514	0.5514	0.5487	0.5569	0.5658	0.5721	0.5786	(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	
Main dwelling								
Windows			21.2000	1.1450	24.2748			(27)
Glazed Doors			7.4600	1.1450	8.5420			(27)
Doors			3.9200	1.2000	4.7040			(26)
Heatloss Floor 1			81.6400	0.1300	10.6132	75.0000	6123.0000	(28a)
Cavity Wall	152.5300	32.5800	119.9500	0.1800	21.5910	60.0000	7197.0000	(29a)
External Roof 1	81.6400		81.6400	0.1100	8.9804	9.0000	734.7600	(30)
Total net area of external elements Aum(A, m2)			315.8100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		78.7054			(33)
Main dwelling								
Internal Wall 1 - Block			71.3800			75.0000	5353.5000	(32c)
Internal Wall 2 - Stud			47.4300			9.0000	426.8700	(32c)
Internal Wall 3 - Up			235.1900			9.0000	2116.7100	(32c)
Internal Floor 1			81.6400			18.0000	1469.5200	(32d)
Internal Ceiling 1			81.6400			9.0000	734.7600	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		24156.1200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							147.9429	(35)
List of Thermal Bridges								
K1 Element					Length	Psi-value	Total	

E2 Other lintels (including other steel lintels)	23.5300	0.0500	1.1765	
E3 Sill	18.0600	0.0500	0.9030	
E4 Jamb	51.2800	0.0220	1.1282	
E5 Ground floor (normal)	39.9100	0.1600	6.3856	
E6 Intermediate floor within a dwelling	39.9100	0.0030	0.1197	
E10 Eaves (insulation at ceiling level)	21.9700	0.0600	1.3182	
E12 Gable (insulation at ceiling level)	17.9400	0.0600	1.0764	
E16 Corner (normal)	25.0000	0.0900	2.2500	
E17 Corner (inverted - internal area greater than external area)	5.0000	-0.0850	-0.4250	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 13.9326 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 92.6380 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	79.8202	79.3360	78.8615	76.6327	76.2157	74.2744	74.2744	73.9149	75.0221	76.2157	77.0593	77.9412	(38)
Heat transfer coeff	172.4581	171.9740	171.4995	169.2706	168.8536	166.9124	166.9124	166.5529	167.6601	168.8536	169.6972	170.5792	(39)

Average = Sum(39)m / 12 = 169.2687

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0562	1.0532	1.0503	1.0367	1.0341	1.0222	1.0222	1.0200	1.0268	1.0341	1.0393	1.0447	(40)
HLP (average)												1.0367	
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 2.9535 (42)

Hot water usage for mixer showers

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
73.7397	72.6316	71.0167	67.9271	65.6470	63.1043	61.6590	63.2616	65.0183	67.7484	70.9045	73.4572	(42a)

Hot water usage for baths

31.8337	31.3609	30.6952	29.4676	28.5484	27.5292	26.9787	27.6398	28.3596	29.4502	30.7031	31.7261	(42b)

Hot water usage for other uses

44.8764	43.2446	41.6127	39.9808	38.3489	36.7171	36.7171	38.3489	39.9808	41.6127	43.2446	44.8764	(42c)

Average daily hot water use (litres/day) 138.2972 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	150.4499	147.2371	143.3246	137.3755	132.5444	127.3506	125.3548	129.2503	133.3588	138.8114	144.8521	150.0597	(44)
Energy conte	238.2758	209.6636	220.2846	188.0602	178.4302	156.5924	151.6057	160.0389	164.4447	188.3657	206.3683	234.9573	(45)
Energy content (annual)										Total = Sum(45)m =		2297.0875	
Distribution loss (46)m = 0.15 x (45)m	35.7414	31.4495	33.0427	28.2090	26.7645	23.4889	22.7409	24.0058	24.6667	28.2549	30.9553	35.2436	(46)

Water storage loss:

Store volume 200.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 2.0900 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 1.1286 (55)

Total storage loss

34.9866	31.6008	34.9866	33.8580	34.9866	33.8580	34.9866	34.9866	33.8580	34.9866	33.8580	34.9866	(56)

If cylinder contains dedicated solar storage

34.9866	31.6008	34.9866	33.8580	34.9866	33.8580	34.9866	34.9866	33.8580	34.9866	33.8580	34.9866	(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

296.5248	262.2756	278.5336	244.4302	236.6792	212.9624	209.8547	218.2879	220.8147	246.6147	262.7383	293.2063	(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

296.5248	262.2756	278.5336	244.4302	236.6792	212.9624	209.8547	218.2879	220.8147	246.6147	262.7383	293.2063	(64)

Total per year (kWh/year) = Sum(64)m = 2982.9225 (64)

12Total per year (kWh/year) 2983 (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

125.8259	111.8028	119.8438	107.6260	105.9273	97.1630	97.0081	99.8121	99.7739	109.2308	113.7135	124.7225	(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	147.6732	147.6732	147.6732	147.6732	147.6732	147.6732	147.6732	147.6732	147.6732	147.6732	147.6732	147.6732	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	173.1036	191.6505	173.1036	178.8738	173.1036	178.8738	173.1036	173.1036	178.8738	173.1036	178.8738	173.1036	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	334.6312	338.1036	329.3532	310.7247	287.2095	265.1085	250.3437	246.8712	255.6216	274.2502	297.7654	319.8664	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.7673	37.7673	37.7673	37.7673	37.7673	37.7673	37.7673	37.7673	37.7673	37.7673	37.7673	37.7673	(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)	-118.1386	-118.1386	-118.1386	-118.1386	-118.1386	-118.1386	-118.1386	-118.1386	-118.1386	-118.1386	-118.1386	-118.1386	(71)
Water heating gains (Table 5)	169.1208	166.3731	161.0804	149.4806	142.3753	134.9486	130.3872	134.1561	138.5748	146.8156	157.9354	167.6378	(72)
Total internal gains	747.1576	766.4292	733.8392	709.3810	672.9904	646.2327	621.1365	621.4329	640.3721	664.4714	704.8765	730.9097	(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	2.8500	10.6334	0.6300	0.7000	0.7700	9.2617	(74)
East	7.2500	19.6403	0.6300	0.7000	0.7700	43.5168	(76)
South	1.9500	46.7521	0.6300	0.7000	0.7700	27.8617	(78)
West	9.1500	19.6403	0.6300	0.7000	0.7700	54.9212	(80)
East	3.7300	19.6403	0.6300	0.7000	0.7700	22.3887	(76)
South	3.7300	46.7521	0.6300	0.7000	0.7700	53.2944	(78)

Solar gains	211.2444	386.9749	588.6386	807.3694	960.2250	973.7839	930.6005	816.1327	665.7426	444.8920	258.2797	177.2093	(83)
Total gains	958.4021	1153.4040	1322.4779	1516.7504	1633.2153	1620.0167	1551.7370	1437.5656	1306.1147	1109.3633	963.1562	908.1190	(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	38.9082	39.0177	39.1257	39.6409	39.7388	40.2009	40.2009	40.2877	40.0216	39.7388	39.5412	39.3368	
alpha	3.5939	3.6012	3.6084	3.6427	3.6493	3.6801	3.6801	3.6858	3.6681	3.6493	3.6361	3.6225	
util living area	0.9871	0.9746	0.9493	0.8845	0.7692	0.6028	0.4569	0.5071	0.7358	0.9219	0.9768	0.9893	(86)
MIT	19.0768	19.3632	19.7735	20.2935	20.6858	20.9080	20.9745	20.9627	20.8036	20.2662	19.5833	19.0374	(87)
Th 2	20.0368	20.0392	20.0416	20.0529	20.0550	20.0648	20.0648	20.0667	20.0610	20.0550	20.0507	20.0462	(88)
util rest of house	0.9845	0.9696	0.9390	0.8612	0.7241	0.5312	0.3664	0.4142	0.6708	0.9009	0.9714	0.9871	(89)
MIT 2	17.7777	18.1425	18.6605	19.3066	19.7622	19.9983	20.0523	20.0470	19.9025	19.2885	18.4327	17.7336	(90)
Living area fraction									fLA = Living area / (4) =			0.1673	(91)
MIT	17.9950	18.3466	18.8467	19.4717	19.9167	20.1505	20.2066	20.2002	20.0532	19.4520	18.6251	17.9517	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8450	18.1966	18.6967	19.3217	19.7667	20.0005	20.0566	20.0502	19.9032	19.3020	18.4751	17.8017	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9756	0.9560	0.9200	0.8396	0.7088	0.5259	0.3656	0.4125	0.6586	0.8795	0.9583	0.9794	(94)
Useful gains	935.0148	1102.6117	1216.6933	1273.4197	1157.5573	851.9917	567.3475	592.9755	860.1639	975.7204	923.0361	889.3908	(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	2335.9401	2286.6747	2091.7224	1764.0879	1362.0840	901.4035	576.9465	607.9465	972.9631	1469.3652	1930.3290	2320.1638	(97)
Space heating kWh	1042.2884	795.6903	651.0217	353.2811	152.1679	0.0000	0.0000	0.0000	0.0000	367.2717	725.2509	1064.4951	(98a)
Space heating requirement - total per year (kWh/year)												5151.4672	
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	1042.2884	795.6903	651.0217	353.2811	152.1679	0.0000	0.0000	0.0000	0.0000	367.2717	725.2509	1064.4951	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												5151.4672	
Space heating per m2											(98c) / (4) =	31.5499	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												88.6000	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement	1042.2884	795.6903	651.0217	353.2811	152.1679	0.0000	0.0000	0.0000	0.0000	367.2717	725.2509	1064.4951	(98)
Space heating efficiency (main heating system 1)	88.6000	88.6000	88.6000	88.6000	88.6000	0.0000	0.0000	0.0000	0.0000	88.6000	88.6000	88.6000	(210)
Space heating fuel (main heating system)	1176.3978	898.0704	734.7875	398.7371	171.7470	0.0000	0.0000	0.0000	0.0000	414.5279	818.5677	1201.4618	(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	296.5248	262.2756	278.5336	244.4302	236.6792	212.9624	209.8547	218.2879	220.8147	246.6147	262.7383	293.2063	(64)
Efficiency of water heater												79.6000	(216)
(217)m	86.4355	86.1843	85.6967	84.6844	82.8952	79.6000	79.6000	79.6000	79.6000	84.7505	86.0138	86.4882	(217)
Fuel for water heating, kWh/month	343.0592	304.3195	325.0226	288.6366	285.5162	267.5407	263.6366	274.2310	277.4054	290.9890	305.4608	339.0131	(219)
Space cooling fuel requirement	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	35.2324	28.2647	25.4492	18.6452	14.4021	11.7666	13.1381	17.0774	22.1818	29.1037	32.8726	36.2116	(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												5814.2971	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												79.6000	
Water heating fuel used												3564.8307	(219)
Space cooling fuel												0.0000	(221)

Electricity for pumps and fans:

central heating pump	41.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	86.0000	(231)
Electricity for lighting (calculated in Appendix L)	284.3453	(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	9749.4731	(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	5814.2971	0.2100	1221.0024	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3564.8307	0.2100	748.6144	(264)
Space and water heating			1969.6168	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	284.3453	0.1443	41.0398	(268)
Total CO2, kg/year			2022.5859	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			12.3900	(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	5814.2971	1.1300	6570.1557	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3564.8307	1.1300	4028.2587	(278)
Space and water heating			10598.4144	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	284.3453	1.5338	436.1383	(282)
Total Primary energy kWh/year			11164.6535	(286)
Dwelling Primary energy Rate (DPER)			68.3800	(287)

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

1. Overall dwelling characteristics

		Area (m2)		Storey height (m)		Volume (m3)	
Main dwelling							
Ground floor		81.6400 (1b)	x	2.4000 (2b)	=	195.9360	(1b) - (3b)
First floor		81.6400 (1c)	x	2.6000 (2c)	=	212.2640	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	163.2800						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	408.2000	(5)

2. Ventilation rate

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	4 * 10 =	40.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0980	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3480	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2958	(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	0.3771	0.3697	0.3623	0.3254	0.3180	0.2810	0.2810	0.2736	0.2958	0.3180	0.3328	0.3476	(22b)
Effective ac	0.5711	0.5684	0.5656	0.5529	0.5506	0.5395	0.5395	0.5374	0.5437	0.5506	0.5554	0.5604	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Main dwelling								
TER Opaque door			3.9200	1.0000	3.9200			(26)
TER Opening Type			28.6600	1.1450	32.8168			(27)
Heatloss Floor 1			81.6400	0.1300	10.6132			(28a)
Cavity Wall	152.5300	32.5800	119.9500	0.1800	21.5910			(29a)
External Roof 1	81.6400		81.6400	0.1100	8.9804			(30)
Total net area of external elements Aum(A, m2)			315.8100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		77.9214			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 147.9429 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	23.5300	0.0500	1.1765
E3 Sill	18.0600	0.0500	0.9030
E4 Jamb	51.2800	0.0500	2.5640
E5 Ground floor (normal)	39.9100	0.1600	6.3856
E6 Intermediate floor within a dwelling	39.9100	0.0000	0.0000
E10 Eaves (insulation at ceiling level)	21.9700	0.0600	1.3182
E12 Gable (insulation at ceiling level)	17.9400	0.0600	1.0764
E16 Corner (normal)	25.0000	0.0900	2.2500
E17 Corner (inverted - internal area greater than external area)	5.0000	-0.0900	-0.4500

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 15.2237 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 93.1451 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	76.9327	76.5607	76.1961	74.4834	74.1630	72.6714	72.6714	72.3951	73.2459	74.1630	74.8112	75.4889	(38)
Heat transfer coeff	170.0778	169.7058	169.3412	167.6285	167.3081	165.8165	165.8165	165.5402	166.3910	167.3081	167.9563	168.6340	(39)

Average = Sum(39)m / 12 = 167.6270

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0416	1.0394	1.0371	1.0266	1.0247	1.0155	1.0155	1.0138	1.0191	1.0247	1.0286	1.0328	(40)
HLP (average)												1.0266	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.9535 (42)

Hot water usage for mixer showers

73.7397	72.6316	71.0167	67.9271	65.6470	63.1043	61.6590	63.2616	65.0183	67.7484	70.9045	73.4572	(42a)

Hot water usage for baths

31.8337	31.3609	30.6952	29.4676	28.5484	27.5292	26.9787	27.6398	28.3596	29.4502	30.7031	31.7261	(42b)

Hot water usage for other uses

44.8764	43.2446	41.6127	39.9808	38.3489	36.7171	36.7171	38.3489	39.9808	41.6127	43.2446	44.8764	(42c)

Average daily hot water use (litres/day) 138.2972 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	150.4499	147.2371	143.3246	137.3755	132.5444	127.3506	125.3548	129.2503	133.3588	138.8114	144.8521	150.0597	(44)
Energy conte	238.2758	209.6636	220.2846	188.0602	178.4302	156.5924	151.6057	160.0389	164.4447	188.3657	206.3683	234.9573	(45)
Energy content (annual)										Total = Sum(45)m =		2297.0875	
Distribution loss (46)m = 0.15 x (45)m	35.7414	31.4495	33.0427	28.2090	26.7645	23.4889	22.7409	24.0058	24.6667	28.2549	30.9553	35.2436	(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)
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	289.2019	255.6614	271.2107	237.3435	229.3563	205.8757	202.5318	210.9650	213.7280	239.2918	255.6516	285.8833	(62)
WWHRS	-33.7107	-29.8140	-31.2195	-25.8510	-24.0922	-20.6159	-19.3241	-20.5492	-21.3300	-25.1457	-28.4870	-33.0865	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	255.4912	225.8473	239.9911	211.4925	205.2641	185.2598	183.2077	190.4157	192.3980	214.1461	227.1646	252.7969	(64)
									Total per year (kWh/year) = Sum(64)m =			2583.4749	(64)
12Total per year (kWh/year)												2583	(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	119.9676	106.5113	113.9855	101.9567	100.0689	91.4936	91.1498	93.9538	94.1045	103.3725	108.0441	118.8641	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	147.6732	147.6732	147.6732	147.6732	147.6732	147.6732	147.6732	147.6732	147.6732	147.6732	147.6732	147.6732	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	173.1036	191.6505	173.1036	178.8738	173.1036	178.8738	173.1036	173.1036	178.8738	173.1036	178.8738	173.1036	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	334.6312	338.1036	329.3532	310.7247	287.2095	265.1085	250.3437	246.8712	255.6216	274.2502	297.7654	319.8664	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.7673	37.7673	37.7673	37.7673	37.7673	37.7673	37.7673	37.7673	37.7673	37.7673	37.7673	37.7673	(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)	-118.1386	-118.1386	-118.1386	-118.1386	-118.1386	-118.1386	-118.1386	-118.1386	-118.1386	-118.1386	-118.1386	-118.1386	(71)
Water heating gains (Table 5)	161.2467	158.4990	153.2063	141.6065	134.5012	127.0745	122.5131	126.2820	130.7007	138.9415	150.0613	159.7636	(72)
Total internal gains	739.2835	758.5551	725.9651	701.5069	665.1163	638.3586	613.2624	613.5588	632.4980	656.5972	697.0024	723.0356	(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	2.8500	10.6334	0.6300	0.7000	0.7700	9.2617	(74)
East	10.9800	19.6403	0.6300	0.7000	0.7700	65.9055	(76)
South	5.6800	46.7521	0.6300	0.7000	0.7700	81.1561	(78)
West	9.1500	19.6403	0.6300	0.7000	0.7700	54.9212	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	211.2444	386.9749	588.6386	807.3694	960.2250	973.7839	930.6005	816.1327	665.7426	444.8920	258.2797	177.2093	(83)
Total gains	950.5279	1145.5299	1314.6037	1508.8763	1625.3412	1612.1426	1543.8629	1429.6915	1298.2406	1101.4892	955.2821	900.2449	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	39.4527	39.5392	39.6243	40.0292	40.1058	40.4666	40.4666	40.5342	40.3269	40.1058	39.9511	39.7905	
alpha	3.6302	3.6359	3.6416	3.6686	3.6737	3.6978	3.6978	3.7023	3.6885	3.6737	3.6634	3.6527	
util living area	0.9874	0.9749	0.9495	0.8845	0.7686	0.6025	0.4565	0.5071	0.7359	0.9224	0.9773	0.9896	(86)
MIT	19.1012	19.3860	19.7931	20.3044	20.6923	20.9096	20.9751	20.9633	20.8064	20.2738	19.5961	19.0561	(87)
Th 2	20.0488	20.0507	20.0525	20.0612	20.0628	20.0704	20.0704	20.0718	20.0675	20.0628	20.0595	20.0561	(88)
util rest of house	0.9849	0.9700	0.9393	0.8613	0.7237	0.5312	0.3666	0.4147	0.6713	0.9017	0.9719	0.9875	(89)
MIT 2	17.8165	18.1789	18.6925	19.3261	19.7758	20.0050	20.0582	20.0525	19.9110	19.3034	18.4546	17.7637	(90)
Living area fraction										fLA = Living area / (4) =		0.1673	(91)
MIT	18.0313	18.3808	18.8765	19.4897	19.9291	20.1563	20.2115	20.2048	20.0607	19.4657	18.6455	17.9798	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.0313	18.3808	18.8765	19.4897	19.9291	20.1563	20.2115	20.2048	20.0607	19.4657	18.6455	17.9798	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9770	0.9579	0.9230	0.8446	0.7166	0.5381	0.3807	0.4284	0.6708	0.8852	0.9606	0.9806	(94)
Useful gains	928.6190	1097.3306	1213.3321	1274.3910	1164.7245	867.5713	587.6722	612.5399	870.8608	975.0027	917.6697	882.7648	(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	2335.3965	2287.7707	2095.8583	1775.1349	1376.7942	921.3221	598.8511	629.8486	991.8132	1483.3013	1939.1450	2323.7490	(97)
Space heating kWh	1046.6425	799.9757	656.5995	360.5356	157.7799	0.0000	0.0000	0.0000	0.0000	378.1742	735.4622	1072.0923	(98a)
Space heating requirement - total per year (kWh/year)												5207.2618	
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	1046.6425	799.9757	656.5995	360.5356	157.7799	0.0000	0.0000	0.0000	0.0000	378.1742	735.4622	1072.0923	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												5207.2618	
Space heating per m2											(98c) / (4) =	31.8916	(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	1046.6425	799.9757	656.5995	360.5356	157.7799	0.0000	0.0000	0.0000	0.0000	378.1742	735.4622	1072.0923	(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)	1133.9572	866.7126	711.3754	390.6128	170.9425	0.0000	0.0000	0.0000	0.0000	409.7228	796.8171	1161.5301	(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	255.4912	225.8473	239.9911	211.4925	205.2641	185.2598	183.2077	190.4157	192.3980	214.1461	227.1646	252.7969	(64)
Efficiency of water heater												79.8000	(216)
(217)m	86.8775	86.6485	86.1978	85.2454	83.4770	79.8000	79.8000	79.8000	79.8000	85.3210	86.4979	86.9293	(217)
Fuel for water heating, kWh/month	294.0821	260.6477	278.4190	248.0984	245.8931	232.1551	229.5836	238.6162	241.1002	250.9886	262.6245	290.8074	(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	35.9675	28.8545	25.9803	19.0342	14.7026	12.0122	13.4122	17.4337	22.6446	29.7110	33.5585	36.9672	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-70.2380	-96.0359	-133.8767	-145.7510	-153.1324	-141.3536	-139.4218	-133.4472	-122.5169	-107.3321	-76.0713	-61.0651	(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	-49.2990	-102.4347	-201.3690	-299.3527	-392.9857	-393.9870	-389.5146	-331.2298	-244.5843	-145.6439	-65.5215	-39.0974	(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	(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	(235d)

Annual totals kWh/year		
Space heating fuel - main system 1	5641.6705	(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	3073.0159	(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)	290.2785	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-4035.2615	(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	5055.7032	(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	5641.6705	0.2100	1184.7508	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3073.0159	0.2100	645.3333	(264)
Space and water heating			1830.0841	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	290.2785	0.1443	41.8962	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1380.2420	0.1353	-186.7225	
PV Unit electricity exported	-2655.0195	0.1262	-335.0417	
Total			-521.7642	(269)
Total CO2, kg/year			1362.1454	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			8.3400	(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	5641.6705	1.1300	6375.0876	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3073.0159	1.1300	3472.5079	(278)
Space and water heating			9847.5956	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	290.2785	1.5338	445.2388	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1380.2420	1.5000	-2070.3902	
PV Unit electricity exported	-2655.0195	0.4632	-1229.8667	
Total			-3300.2568	(283)
Total Primary energy kWh/year			7122.6783	(286)
Target Primary Energy Rate (TPER)			43.6200	(287)

Building Regulations England Part L (BREL) Compliance Report

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

Date: Fri 14 Mar 2025 09:30:52

Project Information			
Assessed By	Richard Millard	Building Type	House, Detached
OCDEA Registration	EES/025661	Assessment Date	2025-03-14

Dwelling Details			
Assessment Type	As designed	Total Floor Area	165 m^2
Site Reference	F+	Plot Reference	Proposed
Address	52		

Client Details	
Name	Ian White
Company	Cotswold Homes Ltd
Address	West House, Yate, Bristol, BS37 5NG

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

1a Target emission rate and dwelling emission rate		
Fuel for main heating system	Electricity	
Target carbon dioxide emission rate	*8.53 kgCO_2/m^2*	
Dwelling carbon dioxide emission rate	2.76 kgCO_2/m^2	OK
1b Target primary energy rate and dwelling primary energy		
Target primary energy	*44.62 kWh$_{PE}$/m^2*	
Dwelling primary energy	31.0 kWh$_{PE}$/m^2	OK
1c Target fabric energy efficiency and dwelling fabric energy efficiency		
Target fabric energy efficiency	*38.1 kWh/m^2*	
Dwelling fabric energy efficiency	36.8 kWh/m^2	OK

2a Fabric U-values				
Element	***Maximum permitted average U-Value [W/m^2K]***	**Dwelling average U-Value [W/m^2K]**	**Element with highest individual U-Value**	
External walls	*0.26*	0.18	Walls (1) (0.18)	OK
Party walls	*0.2*	N/A	N/A	**N/A**
Curtain walls	*1.6*	N/A	N/A	**N/A**
Floors	*0.18*	0.12	Heatloss Floor 1 (0.12)	OK
Roofs	*0.16*	0.11	Roof (2) (0.13)	OK
Windows, doors, and roof windows	*1.6*	1.2	WG01 (1.2)	OK
Rooflights	*2.2*	N/A	N/A	**N/A**

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))		
Name	**Net area [m^2]**	**U-Value [W/m^2K]**
Exposed wall: Walls (1)	119.96	0.18
Ground floor: Heatloss Floor 1, Heatloss Floor 1	83.26	0.12
Exposed roof: Roof (1)	81.64	0.11
Exposed roof: Roof (2)	1.62	0.13

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	**Area [m^2]**	**Orientation**	**Frame factor**	**U-Value [W/m^2K]**
WG01, Windows	2.12	North	0.7	1.2
WG02, Windows	2.12	North	0.7	1.2
WG03, Windows	1.45	West	0.7	1.2
FG01, Windows	2.12	North	0.7	1.2
FG02, Windows	0.67	North	0.7	1.2
FG03, Windows	2.12	North	0.7	1.2
FG04, Windows	1.45	South	0.7	1.2
FG05, Windows	0.5	West	0.7	1.2
FG06, Windows	1.4	South	0.7	1.2
ED01, Doors	1.92	North	N/A	1.2
ED02, Glazed Doors	3.73	South	0.7	1.2
ED03, Glazed Doors	3.73	West	0.7	1.2
WG04, Windows	1.6	South	0.7	1.2

Name	Area [m^2]	Orientation	Frame factor	U-Value [W/m^2K]
WG05, Windows	1.4	South	0.7	1.2
WG06, Windows	1.33	South	0.7	1.2
FG07, Windows	1.4	South	0.7	1.2
ED04, Doors	2	East	N/A	1.2
FG08, Windows	0.95	East	0.7	1.2
FG09, Windows	0.95	East	0.7	1.2
WG07, Windows	2.62	East	0.7	1.2
WG08, Windows	1.33	North	0.7	1.2

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))

Building part **1**: Thermal bridging calculated from linear thermal transmittances for each junction

Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E1: Steel lintel with perforated steel base plate	Calculated by person with suitable expertise	0.241	EMPF125E101
External wall	E3: Sill	Calculated by person with suitable expertise	0.026 **(!)**	EMPF125E301
External wall	E4: Jamb	Calculated by person with suitable expertise	0.02 **(!)**	EMPF125E401
External wall	E5: Ground floor (normal)	Calculated by person with suitable expertise	0.045	EMPF125E504
External wall	E6: Intermediate floor within a dwelling	Calculated by person with suitable expertise	0.002 **(!)**	EMPF125E601
External wall	E10: Eaves (insulation at ceiling level)	Calculated by person with suitable expertise	0.05	EMPF125E1001
External wall	E12: Gable (insulation at ceiling level)	Calculated by person with suitable expertise	0.031 **(!)**	EMPF125E1201
External wall	E16: Corner (normal)	Calculated by person with suitable expertise	0.037 **(!)**	EMPF125E21601
External wall	E17: Corner (inverted - internal area greater than external area)	Calculated by person with suitable expertise	-0.09	EMPF125E21701

3 Air permeability (better than typically expected values are flagged with a subsequent (!))

Maximum permitted air permeability at 50Pa	*8 m^3/hm^2*	
Dwelling air permeability at 50Pa	5 m^3/hm^2, Design value	OK
Air permeability test certificate reference		

4 Space heating

Main heating system 1: Heat pump with radiators or underfloor heating - Electricity	
Efficiency	248.5%
Emitter type	Radiators
Flow temperature	55°C
System type	Heat Pump
Manufacturer	Daikin Europe NV
Model	EDLA08EV3
Commissioning	
Secondary heating system: N/A	
Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water

Cylinder/store - type: Cylinder	
Capacity	210 litres
Declared heat loss	1.7 kWh/day
Primary pipework insulated	Yes
Manufacturer	
Model	
Commissioning	
Waste water heat recovery system 1 - type: N/A	
Efficiency	
Manufacturer	
Model	

6 Controls		
Main heating 1 - type: Time and temperature zone control by arrangement of plumbing and electrical services		
Function		
Ecodesign class		
Manufacturer		
Model		
Water heating - type: Cylinder thermostat and HW separately timed		
Manufacturer		
Model		

7 Lighting		
Minimum permitted light source efficacy	*75 lm/W*	
Lowest light source efficacy	85 lm/W	**OK**
External lights control	N/A	

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

9 Local generation	
Technology type: **Photovoltaic system (1)**	
Peak power	2.01 kWp
Orientation	South
Pitch	30°
Overshading	Modest
Manufacturer	
MCS certificate	

10 Heat networks
N/A

11 Supporting documentary evidence
N/A

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

Full SAP Calculation Printout

Property Reference	F+	**Issued on Date**	14/03/2025
Assessment Reference	Proposed	**Prop Type Ref**	Proposed 52
Property	52		

SAP Rating	86 B	**DER**	2.76	**TER**	8.53
Environmental	97 A	**% DER < TER**			67.64
CO_2 Emissions (t/year)	0.41	**DFEE**	36.78	**TFEE**	38.08
Compliance Check	See BREL	**% DFEE < TFEE**			3.41
% DPER < TPER	30.52	**DPER**	31.00	**TPER**	44.62

Assessor Details	Mr. Richard Millard	**Assessor ID**	U367-0001
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)	
Main dwelling						
Ground floor	81.6400 (1b)	x	2.4000 (2b)	=	195.9360	(1b) - (3b)
First floor	83.2600 (1c)	x	2.6000 (2c)	=	216.4760	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	164.9000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	412.4120	(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		6 * 10 =	60.0000	(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) =		60.0000 / (5) =	0.1455	(8)
Pressure test			Yes	
Pressure Test Method			Blower Door	
Measured/design AP50			5.0000	(17)
Infiltration rate			0.3955	(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) =	0.3658	(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	0.4664	0.4573	0.4481	0.4024	0.3933	0.3475	0.3475	0.3384	0.3658	0.3933	0.4116	0.4298	(22b)
Effective ac	0.6088	0.6046	0.6004	0.5810	0.5773	0.5604	0.5604	0.5573	0.5669	0.5773	0.5847	0.5924	(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	
Main dwelling								
Windows			25.5300	1.1450	29.2328			(27)
Glazed Doors			7.4600	1.1450	8.5420			(27)
Doors			3.9200	1.2000	4.7040			(26)
Heatloss Floor 1			83.2600	0.1200	9.9912	75.0000	6244.5000	(28a)
Cavity Wall	156.8700	36.9100	119.9600	0.1800	21.5928	60.0000	7197.5997	(29a)
External Roof 1	81.6400		81.6400	0.1100	8.9804	9.0000	734.7600	(30)
External Roof 2	1.6200		1.6200	0.1300	0.2106	9.0000	14.5800	(30)
Total net area of external elements Aum(A, m2)			323.3900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		83.2538			(33)
Main dwelling								
Internal Wall 1 - Block			71.3800			75.0000	5353.4998	(32c)
Internal Wall 2 - Stud			47.4300			9.0000	426.8700	(32c)
Internal Wall 3 - Up			235.1900			9.0000	2116.7100	(32c)
Internal Floor 1			81.6400			18.0000	1469.5200	(32d)
Internal Ceiling 1			83.2600			9.0000	749.3400	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		24307.3795	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							147.4068	(35)
List of Thermal Bridges								

	Length	Psi-value	Total	
K1 Element				
E1 Steel lintel with perforated steel base plate	25.9200	0.2410	6.2467	
E3 Sill	20.4500	0.0260	0.5317	
E4 Jamb	54.6000	0.0200	1.0920	
E5 Ground floor (normal)	41.7200	0.0450	1.8774	
E6 Intermediate floor within a dwelling	39.9100	0.0020	0.0798	
E10 Eaves (insulation at ceiling level)	23.7500	0.0500	1.1875	
E12 Gable (insulation at ceiling level)	19.7500	0.0310	0.6122	
E16 Corner (normal)	29.8000	0.0370	1.1026	
E17 Corner (inverted - internal area greater than external area)	9.8000	-0.0900	-0.8820	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			11.8480	(36)
Point Thermal bridges		(36a) =	0.0000	
Total fabric heat loss		(33) + (36) + (36a) =	95.1018	(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	82.8520	82.2772	81.7137	79.0671	78.5719	76.2668	76.2668	75.8399	77.1547	78.5719	79.5736	80.6209	(38)
Heat transfer coeff	177.9538	177.3790	176.8155	174.1689	173.6737	171.3686	171.3686	170.9417	172.2565	173.6737	174.6754	175.7227	(39)
Average = Sum(39)m / 12 =												174.1665	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0792	1.0757	1.0723	1.0562	1.0532	1.0392	1.0392	1.0366	1.0446	1.0532	1.0593	1.0656	(40)
HLP (average)												1.0562	
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												2.9557	(42)
Hot water usage for mixer showers	73.7770	72.6682	71.0526	67.9614	65.6801	63.1361	61.6901	63.2935	65.0511	67.7826	70.9403	73.4943	(42a)
Hot water usage for baths	31.8497	31.3767	30.7106	29.4824	28.5628	27.5431	26.9923	27.6537	28.3739	29.4650	30.7185	31.7421	(42b)
Hot water usage for other uses	44.8992	43.2665	41.6338	40.0011	38.3684	36.7357	36.7357	38.3684	40.0011	41.6338	43.2665	44.8992	(42c)
Average daily hot water use (litres/day)												138.3670	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	150.5258	147.3114	143.3970	137.4449	132.6113	127.4149	125.4180	129.3156	133.4261	138.8814	144.9252	150.1355	(44)
Energy conte	238.3961	209.7695	220.3958	188.1552	178.5203	156.6715	151.6823	160.1197	164.5277	188.4608	206.4725	235.0759	(45)
Energy content (annual)										Total = Sum(45)m =		2298.2473	
Distribution loss (46)m = 0.15 x (45)m	35.7594	31.4654	33.0594	28.2233	26.7780	23.5007	22.7523	24.0180	24.6792	28.2691	30.9709	35.2614	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9180	(55)
Total storage loss	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(56)
If cylinder contains dedicated solar storage	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(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	290.1165	256.4847	272.1162	238.2072	230.2407	206.7235	203.4027	211.8401	214.5797	240.1812	256.5245	286.7963	(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	290.1165	256.4847	272.1162	238.2072	230.2407	206.7235	203.4027	211.8401	214.5797	240.1812	256.5245	286.7963	(64)
										Total per year (kWh/year) = Sum(64)m =		2907.2133	(64)
12Total per year (kWh/year)												2907	(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	120.6430	107.1205	114.6579	102.6032	100.7343	92.1349	91.8107	94.6161	94.7471	104.0395	108.6937	119.5391	(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	147.7842	147.7842	147.7842	147.7842	147.7842	147.7842	147.7842	147.7842	147.7842	147.7842	147.7842	147.7842	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	170.8199	189.1221	170.8199	176.5139	170.8199	176.5139	170.8199	170.8199	176.5139	170.8199	176.5139	170.8199	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	336.3113	339.8012	331.0068	312.2847	288.6515	266.4395	251.6006	248.1107	256.9050	275.6271	299.2604	321.4724	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.7784	37.7784	37.7784	37.7784	37.7784	37.7784	37.7784	37.7784	37.7784	37.7784	37.7784	37.7784	(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)	-118.2274	-118.2274	-118.2274	-118.2274	-118.2274	-118.2274	-118.2274	-118.2274	-118.2274	-118.2274	-118.2274	-118.2274	(71)
Water heating gains (Table 5)	162.1546	159.4055	154.1101	142.5044	135.3956	127.9651	123.4014	127.1722	131.5931	139.8381	150.9635	160.6708	(72)
Total internal gains	736.6211	755.6640	723.2721	698.6384	662.2023	638.2538	613.1572	613.4381	632.3474	653.6204	694.0731	720.2983	(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	10.4800	10.6334	0.6300	0.7000	0.7700	34.0569	(74)
East	4.5200	19.6403	0.6300	0.7000	0.7700	27.1305	(76)
South	8.5800	46.7521	0.6300	0.7000	0.7700	122.5914	(78)
West	1.9500	19.6403	0.6300	0.7000	0.7700	11.7045	(80)
South	3.7300	46.7521	0.6300	0.7000	0.7700	53.2944	(78)

West				3.7300	19.6403	0.6300	0.7000	0.7700				22.3887	(80)
Solar gains	271.1663	472.9065	674.7644	880.0157	1023.9959	1032.9565	989.1053	879.5074	745.6701	530.2825	326.8369	230.7203	(83)
Total gains	1007.7874	1228.5705	1398.0365	1578.6541	1686.1981	1671.2102	1602.2625	1492.9455	1378.0175	1183.9029	1020.9100	951.0187	(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	37.9427	38.0657	38.1870	38.7673	38.8778	39.4008	39.4008	39.4991	39.1977	38.8778	38.6548	38.4245	
alpha	3.5295	3.5377	3.5458	3.5845	3.5919	3.6267	3.6267	3.6333	3.6132	3.5919	3.5770	3.5616	
util living area	0.9854	0.9705	0.9435	0.8786	0.7651	0.5992	0.4539	0.5011	0.7220	0.9118	0.9734	0.9879	(86)
Living	19.0588	19.3667	19.7765	20.2889	20.6788	20.9053	20.9735	20.9621	20.8082	20.2819	19.5853	19.0183	
Non living	17.7433	18.1348	18.6514	19.2883	19.7407	19.9826	20.0379	20.0331	19.8929	19.2948	18.4244	17.6988	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	20.0070	19.3667	19.7765	20.2889	20.6788	20.9053	20.9735	20.9621	20.8082	20.2819	19.5853	19.2955	(87)
Th 2	20.0179	20.0207	20.0236	20.0368	20.0392	20.0508	20.0508	20.0529	20.0463	20.0392	20.0342	20.0290	(88)
util rest of house	0.9824	0.9648	0.9322	0.8544	0.7193	0.5269	0.3627	0.4078	0.6557	0.8887	0.9672	0.9855	(89)
MIT 2	19.1111	18.1348	18.6514	19.2883	19.7407	19.9826	20.0379	20.0331	19.8929	19.2948	18.4244	18.1187	(90)
Living area fraction										fLA = Living area / (4) =		0.1754	(91)
MIT	19.2683	18.3509	18.8488	19.4638	19.9053	20.1445	20.2020	20.1961	20.0535	19.4680	18.6280	18.3252	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.2683	18.3509	18.8488	19.4638	19.9053	20.1445	20.2020	20.1961	20.0535	19.4680	18.6280	18.3252	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9796	0.9513	0.9147	0.8374	0.7122	0.5344	0.3777	0.4225	0.6562	0.8718	0.9546	0.9795	(94)
Useful gains	987.2556	1168.6794	1278.8356	1322.0002	1200.9902	893.0772	605.1899	630.7496	904.2911	1032.0862	974.5155	931.5214	(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	2663.6585	2385.9043	2183.4613	1839.8855	1425.0466	950.1452	617.2700	648.9046	1025.5212	1540.1353	2013.6668	2482.1112	(97)
Space heating kWh	1247.2437	817.9751	673.0415	372.8774	166.6980	0.0000	0.0000	0.0000	0.0000	377.9885	748.1890	1153.6388	(98a)
Space heating requirement - total per year (kWh/year)												5557.6521	
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	1247.2437	817.9751	673.0415	372.8774	166.6980	0.0000	0.0000	0.0000	0.0000	377.9885	748.1890	1153.6388	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												5557.6521	
Space heating per m2											(98c) / (4) =	33.7032	(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 %)												248.5070	(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	1247.2437	817.9751	673.0415	372.8774	166.6980	0.0000	0.0000	0.0000	0.0000	377.9885	748.1890	1153.6388	(98)
Space heating efficiency (main heating system 1)	248.5070	248.5070	248.5070	248.5070	248.5070	0.0000	0.0000	0.0000	0.0000	248.5070	248.5070	248.5070	(210)
Space heating fuel (main heating system)	501.8949	329.1558	270.8341	150.0471	67.0798	0.0000	0.0000	0.0000	0.0000	152.1038	301.0736	464.2280	(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	290.1165	256.4847	272.1162	238.2072	230.2407	206.7235	203.4027	211.8401	214.5797	240.1812	256.5245	286.7963	(64)
Efficiency of water heater												166.4203	(216)
(217)m	166.4203	166.4203	166.4203	166.4203	166.4203	166.4203	166.4203	166.4203	166.4203	166.4203	166.4203	166.4203	(217)
Fuel for water heating, kWh/month	174.3276	154.1186	163.5115	143.1359	138.3490	124.2177	122.2223	127.2922	128.9384	144.3221	154.1426	172.3325	(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	34.7675	27.8918	25.1135	18.3992	14.2121	11.6114	12.9647	16.8521	21.8892	28.7198	32.4389	35.7338	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-33.3268	-50.9032	-79.0813	-94.4078	-104.9325	-96.1087	-94.7534	-86.8448	-73.4125	-59.6218	-37.6045	-28.2220	(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	-6.9427	-16.2951	-35.3651	-58.9729	-84.5564	-90.1891	-89.0825	-73.7735	-52.3838	-26.2823	-10.1610	-5.4767	(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												2236.4171	(211)
Space heating fuel - main system 2												0.0000	(213)

Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	166.4203	
Water heating fuel used	1746.9105	(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)	280.5940	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-1388.7005	(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	2875.2212	(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	2236.4171	0.1556	348.0401	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1746.9105	0.1410	246.2757	(264)
Space and water heating			594.3158	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	280.5940	0.1443	40.4984	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-839.2193	0.1336	-112.1483	
PV Unit electricity exported	-549.4811	0.1226	-67.3782	
Total			-179.5265	(269)
Total CO2, kg/year			455.2877	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			2.7600	(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	2236.4171	1.5761	3524.8268	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1746.9105	1.5213	2657.5556	(278)
Space and water heating			6182.3824	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	280.5940	1.5338	430.3845	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-839.2193	1.4938	-1253.6648	
PV Unit electricity exported	-549.4811	0.4499	-247.2173	
Total			-1500.8822	(283)
Total Primary energy kWh/year			5111.8847	(286)
Dwelling Primary energy Rate (DPER)			31.0000	(287)

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Main dwelling						
Ground floor	81.6400	(1b) x	2.4000	(2b) =	195.9360	(1b) - (3b)
First floor	83.2600	(1c) x	2.6000	(2c) =	216.4760	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	164.9000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		412.4120	(5)

2. Ventilation rate

	m3 per hour		
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	4 * 10 =	40.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0970	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3470	(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) = 0.3210 (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	0.4092	0.4012	0.3932	0.3531	0.3450	0.3049	0.3049	0.2969	0.3210	0.3450	0.3611	0.3771	(22b)
Effective ac	0.5837	0.5805	0.5773	0.5623	0.5595	0.5465	0.5465	0.5441	0.5515	0.5595	0.5652	0.5711	(25)

3. Heat losses and heat loss parameter

Element	Gross	Openings	NetArea	U-value	A x U	K-value	A x K	
Main dwelling	m2	m2	m2	W/m2K	W/K	kJ/m2K	kJ/K	
TER Opaque door			3.9200	1.0000	3.9200			(26)
TER Opening Type			32.9900	1.1450	37.7748			(27)
Heatloss Floor 1			83.2600	0.1300	10.8238			(28a)
Cavity Wall	156.8700	36.9100	119.9600	0.1800	21.5928			(29a)
External Roof 1	81.6400		81.6400	0.1100	8.9804			(30)
External Roof 2	1.6200		1.6200	0.1100	0.1782			(30)
Total net area of external elements Aum(A, m2)			323.3900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		83.2700			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 147.4068 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	25.9200	0.0500	1.2960
E3 Sill	20.4500	0.0500	1.0225
E4 Jamb	54.6000	0.0500	2.7300
E5 Ground floor (normal)	41.7200	0.1600	6.6752
E6 Intermediate floor within a dwelling	39.9100	0.0000	0.0000
E10 Eaves (insulation at ceiling level)	23.7500	0.0600	1.4250
E12 Gable (insulation at ceiling level)	19.7500	0.0600	1.1850
E16 Corner (normal)	29.8000	0.0900	2.6820
E17 Corner (inverted - internal area greater than external area)	9.8000	-0.0900	-0.8820

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 16.1337 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 99.4037 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	79.4440	79.0015	78.5677	76.5304	76.1492	74.3747	74.3747	74.0461	75.0582	76.1492	76.9203	77.7265	(38)
Heat transfer coeff	178.8477	178.4052	177.9714	175.9341	175.5529	173.7784	173.7784	173.4498	174.4619	175.5529	176.3240	177.1302	(39)
Average = Sum(39)m / 12 =												175.9323	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0846	1.0819	1.0793	1.0669	1.0646	1.0538	1.0538	1.0518	1.0580	1.0646	1.0693	1.0742	(40)
HLP (average)												1.0669	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.9557 (42)

Hot water usage for mixer showers

73.7770	72.6682	71.0526	67.9614	65.6801	63.1361	61.6901	63.2935	65.0511	67.7826	70.9403	73.4943	(42a)

Hot water usage for baths

31.8497	31.3767	30.7106	29.4824	28.5628	27.5431	26.9923	27.6537	28.3739	29.4650	30.7185	31.7421	(42b)

Hot water usage for other uses

44.8992	43.2665	41.6338	40.0011	38.3684	36.7357	36.7357	38.3684	40.0011	41.6338	43.2665	44.8992	(42c)

Average daily hot water use (litres/day) 138.3670 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	150.5258	147.3114	143.3970	137.4449	132.6113	127.4149	125.4180	129.3156	133.4261	138.8814	144.9252	150.1355	(44)
Energy conte	238.3961	209.7695	220.3958	188.1552	178.5203	156.6715	151.6823	160.1197	164.5277	188.4608	206.4725	235.0759	(45)
Energy content (annual)										Total = Sum(45)m =		2298.2473	
Distribution loss (46)m = 0.15 x (45)m	35.7594	31.4654	33.0594	28.2233	26.7780	23.5007	22.7523	24.0180	24.6792	28.2691	30.9709	35.2614	(46)

Water storage loss:

Store volume	210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):	1.7016 (48)
Temperature factor from Table 2b	0.5400 (49)
Enter (49) or (54) in (55)	0.9188 (55)

Total storage loss

28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(56)

If cylinder contains dedicated solar storage

28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(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

290.1427	256.5083	272.1424	238.2325	230.2669	206.7488	203.4288	211.8663	214.6051	240.2074	256.5499	286.8225	(62)

WWHRS	-33.7277	-29.8291	-31.2353	-25.8641	-24.1044	-20.6263	-19.3339	-20.5596	-21.3408	-25.1584	-28.5014	-33.1032	(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

256.4150	226.6792	240.9071	212.3685	206.1625	186.1225	184.0950	191.3067	193.2643	215.0490	228.0485	253.7193	(64)
									Total per year (kWh/year) = Sum(64)m =		2594.1376	(64)
12Total per year (kWh/year)											2594	(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

120.6640	107.1394	114.6789	102.6235	100.7553	92.1551	91.8316	94.6371	94.7673	104.0605	108.7140	119.5600	(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	147.7842	147.7842	147.7842	147.7842	147.7842	147.7842	147.7842	147.7842	147.7842	147.7842	147.7842	147.7842	(66)

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

170.8199	189.1221	170.8199	176.5139	170.8199	176.5139	170.8199	170.8199	176.5139	170.8199	176.5139	170.8199	(67)

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

336.3113	339.8012	331.0068	312.2847	288.6515	266.4395	251.6006	248.1107	256.9050	275.6271	299.2604	321.4724	(68)

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

37.7784	37.7784	37.7784	37.7784	37.7784	37.7784	37.7784	37.7784	37.7784	37.7784	37.7784	37.7784	(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)

-118.2274	-118.2274	-118.2274	-118.2274	-118.2274	-118.2274	-118.2274	-118.2274	-118.2274	-118.2274	-118.2274	-118.2274	(71)

Water heating gains (Table 5)

162.1828	159.4337	154.1383	142.5326	135.4238	127.9932	123.4296	127.2004	131.6213	139.8663	150.9917	160.6989	(72)

Total internal gains

739.6493	758.6922	726.3003	701.6665	665.2304	638.2819	613.1854	613.4663	632.3755	656.6486	697.1013	723.3265	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	10.4800	10.6334	0.6300	0.7000	0.7700	34.0569	(74)
East	4.5200	19.6403	0.6300	0.7000	0.7700	27.1305	(76)
South	12.3100	46.7521	0.6300	0.7000	0.7700	175.8858	(78)
West	5.6800	19.6403	0.6300	0.7000	0.7700	34.0932	(80)

Solar gains	271.1663	472.9065	674.7644	880.0157	1023.9959	1032.9565	989.1053	879.5074	745.6701	530.2825	326.8369	230.7203	(83)
Total gains	1010.8156	1231.5987	1401.0647	1581.6823	1689.2263	1671.2384	1602.2906	1492.9737	1378.0456	1186.9311	1023.9381	954.0468	(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	37.7531	37.8467	37.9390	38.3783	38.4616	38.8544	38.8544	38.9280	38.7021	38.4616	38.2934	38.1191	
alpha	3.5169	3.5231	3.5293	3.5586	3.5641	3.5903	3.5903	3.5952	3.5801	3.5641	3.5529	3.5413	
util living area	0.9852	0.9704	0.9435	0.8796	0.7674	0.6045	0.4591	0.5067	0.7261	0.9123	0.9733	0.9878	(86)
MIT	19.0499	19.3560	19.7653	20.2741	20.6688	20.8993	20.9713	20.9591	20.7995	20.2683	19.5695	19.0026	(87)
Th 2	20.0134	20.0156	20.0178	20.0279	20.0298	20.0387	20.0387	20.0404	20.0353	20.0298	20.0260	20.0220	(88)
util rest of house	0.9823	0.9646	0.9322	0.8554	0.7215	0.5313	0.3661	0.4116	0.6594	0.8893	0.9671	0.9854	(89)
MIT 2	17.7291	18.1180	18.6335	19.2640	19.7220	19.9662	20.0248	20.0190	19.8748	19.2717	18.3991	17.6743	(90)
Living area fraction									fLA = Living area / (4) =			0.1754	(91)
MIT	17.9608	18.3352	18.8321	19.4412	19.8881	20.1299	20.1908	20.1839	20.0370	19.4465	18.6044	17.9074	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.9608	18.3352	18.8321	19.4412	19.8881	20.1299	20.1908	20.1839	20.0370	19.4465	18.6044	17.9074	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9732	0.9510	0.9146	0.8381	0.7141	0.5386	0.3813	0.4265	0.6596	0.8721	0.9543	0.9775	(94)
Useful gains	983.7177	1171.2942	1281.4657	1325.6600	1206.2319	900.1699	610.9419	636.7143	908.9046	1035.0846	977.1670	932.5449	(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	2443.2106	2396.9093	2194.7581	1854.5647	1437.4473	960.9721	624.0121	656.3216	1035.7842	1553.0296	2028.5035	2427.9905	(97)
Space heating kWh	1085.8627	823.6133	679.4895	380.8114	172.0243	0.0000	0.0000	0.0000	0.0000	385.3511	756.9623	1112.6115	(98a)
Space heating requirement - total per year (kWh/year)												5396.7262	
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	1085.8627	823.6133	679.4895	380.8114	172.0243	0.0000	0.0000	0.0000	0.0000	385.3511	756.9623	1112.6115	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												5396.7262	
Space heating per m2											(98c) / (4) =	32.7273	(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	1085.8627	823.6133	679.4895	380.8114	172.0243	0.0000	0.0000	0.0000	0.0000	385.3511	756.9623	1112.6115	(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)	1176.4493	892.3221	736.1750	412.5801	186.3752	0.0000	0.0000	0.0000	0.0000	417.4985	820.1109	1205.4296	(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	256.4150	226.6792	240.9071	212.3685	206.1625	186.1225	184.0950	191.3067	193.2643	215.0490	228.0485	253.7193	(64)
Efficiency of water heater												79.8000	(216)
(217)m	86.9272	86.6899	86.2538	85.3536	83.6567	79.8000	79.8000	79.8000	79.8000	85.3521	86.5403	86.9784	(217)
Fuel for water heating, kWh/month	294.9768	261.4830	279.3003	248.8102	246.4388	233.2362	230.6955	239.7327	242.1858	251.9550	263.5170	291.7038	(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	35.4930	28.4738	25.6375	18.7831	14.5086	11.8537	13.2353	17.2037	22.3459	29.3190	33.1158	36.4795	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-70.2994	-96.1563	-134.1016	-146.0650	-153.5225	-141.7343	-139.7876	-133.7552	-122.7477	-107.4809	-76.1457	-61.1131	(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	-49.2377	-102.3142	-201.1442	-299.0387	-392.5956	-393.6063	-389.1489	-330.9218	-244.3535	-145.4950	-65.4471	-39.0494	(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	5846.9407	(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	3084.0350	(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)	286.4489	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-4035.2615	(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	5268.1631	(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	5846.9407	0.2100	1227.8575	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3084.0350	0.2100	647.6474	(264)
Space and water heating			1875.5049	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	286.4489	0.1443	41.3434	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1382.9092	0.1353	-187.0708	
PV Unit electricity exported	-2652.3523	0.1262	-334.6984	
Total			-521.7692	(269)
Total CO2, kg/year			1407.0084	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			8.5300	(273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	5846.9407	1.1300	6607.0429	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3084.0350	1.1300	3484.9596	(278)
Space and water heating			10092.0025	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	286.4489	1.5338	439.3649	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1382.9092	1.5000	-2074.3441	
PV Unit electricity exported	-2652.3523	0.4632	-1228.6064	
Total			-3302.9504	(283)
Total Primary energy kWh/year			7358.5178	(286)
Target Primary Energy Rate (TPER)			44.6200	(287)

Building Regulations England Part L (BREL) Compliance Report

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

Date: Fri 14 Mar 2025 09:30:56

Project Information			
Assessed By	Richard Millard	Building Type	House, Detached
OCDEA Registration	EES/025661	Assessment Date	2025-03-14

Dwelling Details			
Assessment Type	As designed	Total Floor Area	165 m^2
Site Reference	F+	Plot Reference	Regulated (Baseline)
Address	52		

Client Details	
Name	Ian White
Company	Cotswold Homes Ltd
Address	West House, Yate, Bristol, BS37 5NG

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

1a Target emission rate and dwelling emission rate		
Fuel for main heating system	Mains gas	
Target carbon dioxide emission rate	*8.53 $kgCO_2/m^2$*	
Dwelling carbon dioxide emission rate	12.19 $kgCO_2/m^2$	**FAIL**
1b Target primary energy rate and dwelling primary energy		
Target primary energy	*44.62 kWh_{PE}/m^2*	
Dwelling primary energy	67.28 kWh_{PE}/m^2	**FAIL**
1c Target fabric energy efficiency and dwelling fabric energy efficiency		
Target fabric energy efficiency	*38.1 kWh/m^2*	
Dwelling fabric energy efficiency	36.6 kWh/m^2	**OK**

2a Fabric U-values				
Element	***Maximum permitted average U-Value [W/m^2K]***	**Dwelling average U-Value [W/m^2K]**	**Element with highest individual U-Value**	
External walls	*0.26*	0.18	Walls (1) (0.18)	**OK**
Party walls	*0.2*	N/A	N/A	**N/A**
Curtain walls	*1.6*	N/A	N/A	**N/A**
Floors	*0.18*	0.13	Heatloss Floor 1 (0.13)	**OK**
Roofs	*0.16*	0.11	Roof (1) (0.11)	**OK**
Windows, doors, and roof windows	*1.6*	1.2	WG01 (1.2)	**OK**
Rooflights	*2.2*	N/A	N/A	**N/A**

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))		
Name	**Net area [m^2]**	**U-Value [W/m^2K]**
Exposed wall: Walls (1)	119.96	0.18
Ground floor: Heatloss Floor 1, Heatloss Floor 1	83.26	0.13
Exposed roof: Roof (1)	81.64	0.11
Exposed roof: Roof (2)	1.62	0.11

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	**Area [m^2]**	**Orientation**	**Frame factor**	**U-Value [W/m^2K]**
WG01, Windows	2.12	North	0.7	1.2
WG02, Windows	2.12	North	0.7	1.2
WG03, Windows	1.45	West	0.7	1.2
FG01, Windows	2.12	North	0.7	1.2
FG02, Windows	0.67	North	0.7	1.2
FG03, Windows	2.12	North	0.7	1.2
FG04, Windows	1.45	South	0.7	1.2
FG05, Windows	0.5	West	0.7	1.2
FG06, Windows	1.4	South	0.7	1.2
ED01, Doors	1.92	North	N/A	1.2
ED02, Glazed Doors	3.73	South	0.7	1.2
ED03, Glazed Doors	3.73	West	0.7	1.2
WG04, Windows	1.6	South	0.7	1.2

Name	Area [m^2]	Orientation	Frame factor	U-Value [W/m^2K]
WG05, Windows	1.4	South	0.7	1.2
WG06, Windows	1.33	South	0.7	1.2
FG07, Windows	1.4	South	0.7	1.2
ED04, Doors	2	East	N/A	1.2
FG08, Windows	0.95	East	0.7	1.2
FG09, Windows	0.95	East	0.7	1.2
WG07, Windows	2.62	East	0.7	1.2
WG08, Windows	1.33	North	0.7	1.2

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))

Building part **1**: Thermal bridging calculated from linear thermal transmittances for each junction

Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E2: Other lintels (including other steel lintels)	Calculated by person with suitable expertise	0.05	mpf125e2-04
External wall	E3: Sill	Calculated by person with suitable expertise	0.05	mpf125e3-01
External wall	E4: Jamb	Calculated by person with suitable expertise	0.022 **(!)**	mpf125e4-01
External wall	E5: Ground floor (normal)	Calculated by person with suitable expertise	0.06	mpf125e5-04
External wall	E6: Intermediate floor within a dwelling	Calculated by person with suitable expertise	0.003 **(!)**	mpf125e6-01
External wall	E10: Eaves (insulation at ceiling level)	Calculated by person with suitable expertise	0.06	mpf125e10-01
External wall	E12: Gable (insulation at ceiling level)	Calculated by person with suitable expertise	0.06	mpf125e12-01
External wall	E16: Corner (normal)	Calculated by person with suitable expertise	0.09	mpf125e16-01
External wall	E17: Corner (inverted - internal area greater than external area)	Calculated by person with suitable expertise	-0.085	mpf125e17-01

3 Air permeability (better than typically expected values are flagged with a subsequent (!))

Maximum permitted air permeability at 50Pa	*8 m^3/hm^2*	
Dwelling air permeability at 50Pa	5 m^3/hm^2, Design value	OK
Air permeability test certificate reference		

4 Space heating

Main heating system 1: Boiler with radiators or underfloor heating - Mains gas	
Efficiency	88.6%
Emitter type	Radiators
Flow temperature	45°C
System type	Regular boiler
Manufacturer	Bosch Thermotechnology
Model	Greenstar 8000 Life
Commissioning	
Secondary heating system: N/A	
Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water

Cylinder/store - type: Cylinder	
Capacity	210 litres
Declared heat loss	1.7 kWh/day
Primary pipework insulated	Yes
Manufacturer	
Model	
Commissioning	
Waste water heat recovery system 1 - type: N/A	
Efficiency	
Manufacturer	
Model	

6 Controls		
Main heating 1 - type: Time and temperature zone control by arrangement of plumbing and electrical services		
Function		
Ecodesign class		
Manufacturer		
Model		
Water heating - type: Cylinder thermostat and HW separately timed		
Manufacturer		
Model		

7 Lighting		
Minimum permitted light source efficacy	*75 lm/W*	
Lowest light source efficacy	85 lm/W	**OK**
External lights control	N/A	

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

9 Local generation
N/A

10 Heat networks
N/A

11 Supporting documentary evidence
N/A

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

Full SAP Calculation Printout

Property Reference	F+	**Issued on Date**	14/03/2025
Assessment Reference	Regulated (Baseline)	**Prop Type Ref**	Proposed 52
Property	52		

SAP Rating	87 B	**DER**	12.19	**TER**	8.53
Environmental	87 B	**% DER < TER**			-42.91
CO_2 Emissions (t/year)	1.88	**DFEE**	36.65	**TFEE**	38.08
Compliance Check	See BREL	**% DFEE < TFEE**			3.77
% DPER < TPER	-50.79	**DPER**	67.28	**TPER**	44.62

Assessor Details	Mr. Richard Millard	**Assessor ID**	U367-0001
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)	
Main dwelling						
Ground floor	81.6400 (1b)	x	2.4000 (2b)	=	195.9360	(1b) - (3b)
First floor	83.2600 (1c)	x	2.6000 (2c)	=	216.4760	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	164.9000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	412.4120	(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			6 * 10 =	60.0000	(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) =			60.0000 / (5) =	0.1455	(8)
Pressure test				Yes	
Pressure Test Method				Blower Door	
Measured/design AP50				5.0000	(17)
Infiltration rate				0.3955	(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) =	0.3658	(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	0.4664	0.4573	0.4481	0.4024	0.3933	0.3475	0.3475	0.3384	0.3658	0.3933	0.4116	0.4298	(22b)
Effective ac	0.6088	0.6046	0.6004	0.5810	0.5773	0.5604	0.5604	0.5573	0.5669	0.5773	0.5847	0.5924	(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	
Main dwelling								
Windows			25.5300	1.1450	29.2328			(27)
Glazed Doors			7.4600	1.1450	8.5420			(27)
Doors			3.9200	1.2000	4.7040			(26)
Heatloss Floor 1			83.2600	0.1300	10.8238	75.0000	6244.5000	(28a)
Cavity Wall	156.8700	36.9100	119.9600	0.1800	21.5928	60.0000	7197.6000	(29a)
External Roof 1	81.6400		81.6400	0.1100	8.9804	9.0000	734.7600	(30)
External Roof 2	1.6200		1.6200	0.1100	0.1782	9.0000	14.5800	(30)
Total net area of external elements Aum(A, m2)			323.3900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		84.0540			(33)
Main dwelling								
Internal Wall 1 - Block			71.3800			75.0000	5353.5000	(32c)
Internal Wall 2 - Stud			47.4300			9.0000	426.8700	(32c)
Internal Wall 3 - Up			235.1900			9.0000	2116.7100	(32c)
Internal Floor 1			81.6400			18.0000	1469.5200	(32d)
Internal Ceiling 1			83.2600			9.0000	749.3400	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		24307.3800	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							147.4068	(35)
List of Thermal Bridges								

	Length	Psi-value	Total	
K1 Element				
E2 Other lintels (including other steel lintels)	25.9200	0.0500	1.2960	
E3 Sill	20.4500	0.0500	1.0225	
E4 Jamb	54.6000	0.0220	1.2012	
E5 Ground floor (normal)	41.7200	0.0600	2.5032	
E6 Intermediate floor within a dwelling	39.9100	0.0030	0.1197	
E10 Eaves (insulation at ceiling level)	23.7500	0.0600	1.4250	
E12 Gable (insulation at ceiling level)	19.7500	0.0600	1.1850	
E16 Corner (normal)	29.8000	0.0900	2.6820	
E17 Corner (inverted - internal area greater than external area)	9.8000	-0.0850	-0.8330	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			10.6016	(36)
Point Thermal bridges		(36a) =	0.0000	
Total fabric heat loss		(33) + (36) + (36a) =	94.6556	(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	82.8520	82.2772	81.7137	79.0671	78.5719	76.2668	76.2668	75.8399	77.1547	78.5719	79.5736	80.6209	(38)
Heat transfer coeff	177.5077	176.9328	176.3693	173.7227	173.2275	170.9224	170.9224	170.4955	171.8103	173.2275	174.2293	175.2765	(39)
Average = Sum(39)m / 12 =												173.7203	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0765	1.0730	1.0696	1.0535	1.0505	1.0365	1.0365	1.0339	1.0419	1.0505	1.0566	1.0629	(40)
HLP (average)												1.0535	
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												2.9557	(42)
Hot water usage for mixer showers													
	73.7770	72.6682	71.0526	67.9614	65.6801	63.1361	61.6901	63.2935	65.0511	67.7826	70.9403	73.4943	(42a)
Hot water usage for baths													
	31.8497	31.3767	30.7106	29.4824	28.5628	27.5431	26.9923	27.6537	28.3739	29.4650	30.7185	31.7421	(42b)
Hot water usage for other uses													
	44.8992	43.2665	41.6338	40.0011	38.3684	36.7357	36.7357	38.3684	40.0011	41.6338	43.2665	44.8992	(42c)
Average daily hot water use (litres/day)												138.3670	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	150.5258	147.3114	143.3970	137.4449	132.6113	127.4149	125.4180	129.3156	133.4261	138.8814	144.9252	150.1355	(44)
Energy conte	238.3961	209.7695	220.3958	188.1552	178.5203	156.6715	151.6823	160.1197	164.5277	188.4608	206.4725	235.0759	(45)
Energy content (annual)											Total = Sum(45)m =	2298.2473	
Distribution loss (46)m = 0.15 x (45)m													
	35.7594	31.4654	33.0594	28.2233	26.7780	23.5007	22.7523	24.0180	24.6792	28.2691	30.9709	35.2614	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9180	(55)
Total storage loss													
	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(56)
If cylinder contains dedicated solar storage													
	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(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													
	290.1165	256.4847	272.1162	238.2072	230.2407	206.7235	203.4027	211.8401	214.5797	240.1812	256.5245	286.7963	(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													
	290.1165	256.4847	272.1162	238.2072	230.2407	206.7235	203.4027	211.8401	214.5797	240.1812	256.5245	286.7963	(64)
											Total per year (kWh/year) = Sum(64)m =	2907.2133	(64)
12Total per year (kWh/year)												2907	(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													
	120.6430	107.1205	114.6579	102.6032	100.7343	92.1349	91.8107	94.6161	94.7471	104.0395	108.6937	119.5391	(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	147.7842	147.7842	147.7842	147.7842	147.7842	147.7842	147.7842	147.7842	147.7842	147.7842	147.7842	147.7842	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	170.8199	189.1221	170.8199	176.5139	170.8199	176.5139	170.8199	170.8199	176.5139	170.8199	176.5139	170.8199	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	336.3113	339.8012	331.0068	312.2847	288.6515	266.4395	251.6006	248.1107	256.9050	275.6271	299.2604	321.4724	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.7784	37.7784	37.7784	37.7784	37.7784	37.7784	37.7784	37.7784	37.7784	37.7784	37.7784	37.7784	(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)	-118.2274	-118.2274	-118.2274	-118.2274	-118.2274	-118.2274	-118.2274	-118.2274	-118.2274	-118.2274	-118.2274	-118.2274	(71)
Water heating gains (Table 5)	162.1546	159.4055	154.1101	142.5044	135.3956	127.9651	123.4014	127.1722	131.5931	139.8381	150.9635	160.6708	(72)
Total internal gains	739.6211	758.6640	726.2721	701.6384	665.2023	638.2538	613.1572	613.4381	632.3474	656.6204	697.0731	723.2983	(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	10.4800	10.6334	0.6300	0.7000	0.7700	34.0569	(74)
East	4.5200	19.6403	0.6300	0.7000	0.7700	27.1305	(76)
South	8.5800	46.7521	0.6300	0.7000	0.7700	122.5914	(78)
West	1.9500	19.6403	0.6300	0.7000	0.7700	11.7045	(80)
South	3.7300	46.7521	0.6300	0.7000	0.7700	53.2944	(78)

West				3.7300	19.6403	0.6300	0.7000	0.7700				22.3887	(80)
Solar gains	271.1663	472.9065	674.7644	880.0157	1023.9959	1032.9565	989.1053	879.5074	745.6701	530.2825	326.8369	230.7203	(83)
Total gains	1010.7874	1231.5705	1401.0365	1581.6541	1689.1981	1671.2102	1602.2625	1492.9455	1378.0175	1186.9029	1023.9100	954.0187	(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	38.0381	38.1617	38.2836	38.8668	38.9779	39.5036	39.5036	39.6025	39.2994	38.9779	38.7538	38.5223	
alpha	3.5359	3.5441	3.5522	3.5911	3.5985	3.6336	3.6336	3.6402	3.6200	3.5985	3.5836	3.5682	
util living area	0.9852	0.9703	0.9430	0.8777	0.7636	0.5982	0.4529	0.5001	0.7212	0.9109	0.9731	0.9878	(86)
MIT	19.0675	19.3750	19.7841	20.2948	20.6825	20.9065	20.9738	20.9626	20.8100	20.2877	19.5930	19.0270	(87)
Th 2	20.0201	20.0230	20.0258	20.0390	20.0415	20.0530	20.0530	20.0552	20.0486	20.0415	20.0365	20.0312	(88)
util rest of house	0.9822	0.9645	0.9316	0.8534	0.7178	0.5260	0.3621	0.4071	0.6549	0.8878	0.9668	0.9853	(89)
MIT 2	17.7556	18.1468	18.6623	19.2970	19.7465	19.9856	20.0403	20.0356	19.8965	19.3033	18.4355	17.7113	(90)
Living area fraction										fLA = Living area / (4) =		0.1754	(91)
MIT	17.9858	18.3623	18.8591	19.4720	19.9107	20.1471	20.2041	20.1982	20.0568	19.4760	18.6385	17.9421	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8358	18.2123	18.7091	19.3220	19.7607	19.9971	20.0541	20.0482	19.9068	19.3260	18.4885	17.7921	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9723	0.9494	0.9116	0.8317	0.7028	0.5215	0.3622	0.4064	0.6439	0.8659	0.9525	0.9768	(94)
Useful gains	982.8247	1169.2691	1277.2003	1315.4700	1187.1873	871.5445	580.3710	606.7600	887.3129	1027.7725	975.2836	931.8419	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	2402.7062	2355.3757	2153.3176	1810.5453	1396.3399	922.4930	590.3772	622.0039	997.6636	1511.5816	1984.2168	2382.3787	(97)
Space heating kWh	1056.3918	797.0637	651.8312	356.4542	155.6096	0.0000	0.0000	0.0000	0.0000	359.9540	726.4319	1079.1994	(98a)
Space heating requirement - total per year (kWh/year)												5182.9358	
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	1056.3918	797.0637	651.8312	356.4542	155.6096	0.0000	0.0000	0.0000	0.0000	359.9540	726.4319	1079.1994	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												5182.9358	
Space heating per m2											(98c) / (4) =	31.4308	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												88.6000	(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	1056.3918	797.0637	651.8312	356.4542	155.6096	0.0000	0.0000	0.0000	0.0000	359.9540	726.4319	1079.1994	(98)
Space heating efficiency (main heating system 1)	88.6000	88.6000	88.6000	88.6000	88.6000	0.0000	0.0000	0.0000	0.0000	88.6000	88.6000	88.6000	(210)
Space heating fuel (main heating system)	1192.3158	899.6204	735.7011	402.3185	175.6316	0.0000	0.0000	0.0000	0.0000	406.2686	819.9006	1218.0580	(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	290.1165	256.4847	272.1162	238.2072	230.2407	206.7235	203.4027	211.8401	214.5797	240.1812	256.5245	286.7963	(64)
Efficiency of water heater												79.6000	(216)
(217)m	86.4930	86.2266	85.7448	84.7611	83.0002	79.6000	79.6000	79.6000	79.6000	84.7644	86.0606	86.5455	(217)
Fuel for water heating, kWh/month	335.4221	297.4544	317.3561	281.0337	277.3978	259.7028	255.5310	266.1308	269.5725	283.3515	298.0743	331.3820	(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	34.7675	27.8918	25.1135	18.3992	14.2121	11.6114	12.9647	16.8521	21.8892	28.7198	32.4389	35.7338	(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												5849.8147	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												79.6000	
Water heating fuel used												3472.4089	(219)
Space cooling fuel												0.0000	(221)

Electricity for pumps and fans:		
central heating pump	41.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	86.0000	(231)
Electricity for lighting (calculated in Appendix L)	280.5940	(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	9688.8176	(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	5849.8147	0.2100	1228.4611	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3472.4089	0.2100	729.2059	(264)
Space and water heating			1957.6670	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	280.5940	0.1443	40.4984	(268)
Total CO2, kg/year			2010.0946	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			12.1900	(273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	5849.8147	1.1300	6610.2906	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3472.4089	1.1300	3923.8221	(278)
Space and water heating			10534.1127	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	280.5940	1.5338	430.3845	(282)
Total Primary energy kWh/year			11094.5980	(286)
Dwelling Primary energy Rate (DPER)			67.2800	(287)

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Main dwelling						
Ground floor	81.6400 (1b)	x	2.4000 (2b)	=	195.9360 (1b) - (3b)	
First floor	83.2600 (1c)	x	2.6000 (2c)	=	216.4760 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	164.9000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	412.4120	(5)

2. Ventilation rate

	m3 per hour		
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	4 * 10 =	40.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0970	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3470	(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) =	0.3210	(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	0.4092	0.4012	0.3932	0.3531	0.3450	0.3049	0.3049	0.2969	0.3210	0.3450	0.3611	0.3771	(22b)
Effective ac	0.5837	0.5805	0.5773	0.5623	0.5595	0.5465	0.5465	0.5441	0.5515	0.5595	0.5652	0.5711	(25)

3. Heat losses and heat loss parameter

Element	Gross	Openings	NetArea	U-value	A x U	K-value	A x K	
Main dwelling	m2	m2	m2	W/m2K	W/K	kJ/m2K	kJ/K	
TER Opaque door			3.9200	1.0000	3.9200			(26)
TER Opening Type			32.9900	1.1450	37.7748			(27)
Heatloss Floor 1			83.2600	0.1300	10.8238			(28a)
Cavity Wall	156.8700	36.9100	119.9600	0.1800	21.5928			(29a)
External Roof 1	81.6400		81.6400	0.1100	8.9804			(30)
External Roof 2	1.6200		1.6200	0.1100	0.1782			(30)
Total net area of external elements Aum(A, m2)			323.3900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		83.2700			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 147.4068 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	25.9200	0.0500	1.2960
E3 Sill	20.4500	0.0500	1.0225
E4 Jamb	54.6000	0.0500	2.7300
E5 Ground floor (normal)	41.7200	0.1600	6.6752
E6 Intermediate floor within a dwelling	39.9100	0.0000	0.0000
E10 Eaves (insulation at ceiling level)	23.7500	0.0600	1.4250
E12 Gable (insulation at ceiling level)	19.7500	0.0600	1.1850
E16 Corner (normal)	29.8000	0.0900	2.6820
E17 Corner (inverted - internal area greater than external area)	9.8000	-0.0900	-0.8820

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 16.1337 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 99.4037 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	79.4440	79.0015	78.5677	76.5304	76.1492	74.3747	74.3747	74.0461	75.0582	76.1492	76.9203	77.7265	(38)
Heat transfer coeff	178.8477	178.4052	177.9714	175.9341	175.5529	173.7784	173.7784	173.4498	174.4619	175.5529	176.3240	177.1302	(39)

Average = Sum(39)m / 12 = 175.9323

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0846	1.0819	1.0793	1.0669	1.0646	1.0538	1.0538	1.0518	1.0580	1.0646	1.0693	1.0742	(40)
HLP (average)												1.0669	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.9557 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	73.7770	72.6682	71.0526	67.9614	65.6801	63.1361	61.6901	63.2935	65.0511	67.7826	70.9403	73.4943	(42a)
Hot water usage for baths	31.8497	31.3767	30.7106	29.4824	28.5628	27.5431	26.9923	27.6537	28.3739	29.4650	30.7185	31.7421	(42b)
Hot water usage for other uses	44.8992	43.2665	41.6338	40.0011	38.3684	36.7357	36.7357	38.3684	40.0011	41.6338	43.2665	44.8992	(42c)

Average daily hot water use (litres/day) 138.3670 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	150.5258	147.3114	143.3970	137.4449	132.6113	127.4149	125.4180	129.3156	133.4261	138.8814	144.9252	150.1355	(44)
Energy conte	238.3961	209.7695	220.3958	188.1552	178.5203	156.6715	151.6823	160.1197	164.5277	188.4608	206.4725	235.0759	(45)
Energy content (annual)										Total = Sum(45)m =		2298.2473	
Distribution loss (46)m = 0.15 x (45)m	35.7594	31.4654	33.0594	28.2233	26.7780	23.5007	22.7523	24.0180	24.6792	28.2691	30.9709	35.2614	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7016	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9188	(55)
Total storage loss	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(56)
If cylinder contains dedicated solar storage	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(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	290.1427	256.5083	272.1424	238.2325	230.2669	206.7488	203.4288	211.8663	214.6051	240.2074	256.5499	286.8225	(62)
WWHRS	-33.7277	-29.8291	-31.2353	-25.8641	-24.1044	-20.6263	-19.3339	-20.5596	-21.3408	-25.1584	-28.5014	-33.1032	(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	256.4150	226.6792	240.9071	212.3685	206.1625	186.1225	184.0950	191.3067	193.2643	215.0490	228.0485	253.7193	(64)
										Total per year (kWh/year) = Sum(64)m =		2594.1376	(64)
12Total per year (kWh/year)												2594	(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	120.6640	107.1394	114.6789	102.6235	100.7553	92.1551	91.8316	94.6371	94.7673	104.0605	108.7140	119.5600	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	147.7842	147.7842	147.7842	147.7842	147.7842	147.7842	147.7842	147.7842	147.7842	147.7842	147.7842	147.7842	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	170.8199	189.1221	170.8199	176.5139	170.8199	176.5139	170.8199	170.8199	176.5139	170.8199	176.5139	170.8199	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	336.3113	339.8012	331.0068	312.2847	288.6515	266.4395	251.6006	248.1107	256.9050	275.6271	299.2604	321.4724	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.7784	37.7784	37.7784	37.7784	37.7784	37.7784	37.7784	37.7784	37.7784	37.7784	37.7784	37.7784	(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)	-118.2274	-118.2274	-118.2274	-118.2274	-118.2274	-118.2274	-118.2274	-118.2274	-118.2274	-118.2274	-118.2274	-118.2274	(71)
Water heating gains (Table 5)	162.1828	159.4337	154.1383	142.5326	135.4238	127.9932	123.4296	127.2004	131.6213	139.8663	150.9917	160.6989	(72)
Total internal gains	739.6493	758.6922	726.3003	701.6665	665.2304	638.2819	613.1854	613.4663	632.3755	656.6486	697.1013	723.3265	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	10.4800	10.6334	0.6300	0.7000	0.7700	34.0569	(74)
East	4.5200	19.6403	0.6300	0.7000	0.7700	27.1305	(76)
South	12.3100	46.7521	0.6300	0.7000	0.7700	175.8858	(78)
West	5.6800	19.6403	0.6300	0.7000	0.7700	34.0932	(80)

Solar gains	271.1663	472.9065	674.7644	880.0157	1023.9959	1032.9565	989.1053	879.5074	745.6701	530.2825	326.8369	230.7203	(83)
Total gains	1010.8156	1231.5987	1401.0647	1581.6823	1689.2263	1671.2384	1602.2906	1492.9737	1378.0456	1186.9311	1023.9381	954.0468	(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	37.7531	37.8467	37.9390	38.3783	38.4616	38.8544	38.8544	38.9280	38.7021	38.4616	38.2934	38.1191	
alpha	3.5169	3.5231	3.5293	3.5586	3.5641	3.5903	3.5903	3.5952	3.5801	3.5641	3.5529	3.5413	
util living area	0.9852	0.9704	0.9435	0.8796	0.7674	0.6045	0.4591	0.5067	0.7261	0.9123	0.9733	0.9878	(86)
MIT	19.0499	19.3560	19.7653	20.2741	20.6688	20.8993	20.9713	20.9591	20.7995	20.2683	19.5695	19.0026	(87)
Th 2	20.0134	20.0156	20.0178	20.0279	20.0298	20.0387	20.0387	20.0404	20.0353	20.0298	20.0260	20.0220	(88)
util rest of house	0.9823	0.9646	0.9322	0.8554	0.7215	0.5313	0.3661	0.4116	0.6594	0.8893	0.9671	0.9854	(89)
MIT 2	17.7291	18.1180	18.6335	19.2640	19.7220	19.9662	20.0248	20.0190	19.8748	19.2717	18.3991	17.6743	(90)
Living area fraction										fLA = Living area / (4) =		0.1754	(91)
MIT	17.9608	18.3352	18.8321	19.4412	19.8881	20.1299	20.1908	20.1839	20.0370	19.4465	18.6044	17.9074	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.9608	18.3352	18.8321	19.4412	19.8881	20.1299	20.1908	20.1839	20.0370	19.4465	18.6044	17.9074	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9732	0.9510	0.9146	0.8381	0.7141	0.5386	0.3813	0.4265	0.6596	0.8721	0.9543	0.9775	(94)
Useful gains	983.7177	1171.2942	1281.4657	1325.6600	1206.2319	900.1699	610.9419	636.7143	908.9046	1035.0846	977.1670	932.5449	(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	2443.2107	2396.9093	2194.7581	1854.5647	1437.4473	960.9721	624.0121	656.3216	1035.7842	1553.0296	2028.5035	2427.9905	(97)
Space heating kWh	1085.8627	823.6133	679.4895	380.8114	172.0243	0.0000	0.0000	0.0000	0.0000	385.3511	756.9623	1112.6115	(98a)
Space heating requirement - total per year (kWh/year)												5396.7262	
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	1085.8627	823.6133	679.4895	380.8114	172.0243	0.0000	0.0000	0.0000	0.0000	385.3511	756.9623	1112.6115	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												5396.7262	
Space heating per m2											(98c) / (4) =	32.7273	(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	1085.8627	823.6133	679.4895	380.8114	172.0243	0.0000	0.0000	0.0000	0.0000	385.3511	756.9623	1112.6115	(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)	1176.4493	892.3221	736.1750	412.5801	186.3752	0.0000	0.0000	0.0000	0.0000	417.4985	820.1109	1205.4296	(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	256.4150	226.6792	240.9071	212.3685	206.1625	186.1225	184.0950	191.3067	193.2643	215.0490	228.0485	253.7193	(64)
Efficiency of water heater												79.8000	(216)
(217)m	86.9272	86.6899	86.2538	85.3536	83.6567	79.8000	79.8000	79.8000	79.8000	85.3521	86.5403	86.9784	(217)
Fuel for water heating, kWh/month	294.9768	261.4830	279.3003	248.8102	246.4388	233.2362	230.6955	239.7327	242.1858	251.9550	263.5170	291.7038	(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	35.4930	28.4738	25.6375	18.7831	14.5086	11.8537	13.2353	17.2037	22.3459	29.3190	33.1158	36.4795	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-70.2994	-96.1563	-134.1016	-146.0650	-153.5225	-141.7343	-139.7876	-133.7552	-122.7477	-107.4809	-76.1457	-61.1131	(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	-49.2377	-102.3142	-201.1442	-299.0387	-392.5956	-393.6063	-389.1489	-330.9218	-244.3535	-145.4950	-65.4471	-39.0494	(233b)

Electricity generated by wind turbines (Appendix M) (negative quantity)

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

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

(235b)m	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	(235d)

Annual totals kWh/year		
Space heating fuel - main system 1	5846.9407	(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	3084.0350	(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)	286.4489	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-4035.2615	(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	5268.1631	(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	5846.9407	0.2100	1227.8575	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3084.0350	0.2100	647.6474	(264)
Space and water heating			1875.5049	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	286.4489	0.1443	41.3434	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1382.9092	0.1353	-187.0708	
PV Unit electricity exported	-2652.3523	0.1262	-334.6984	
Total			-521.7692	(269)
Total CO2, kg/year			1407.0084	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			8.5300	(273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	5846.9407	1.1300	6607.0430	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3084.0350	1.1300	3484.9596	(278)
Space and water heating			10092.0025	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	286.4489	1.5338	439.3649	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1382.9092	1.5000	-2074.3441	
PV Unit electricity exported	-2652.3523	0.4632	-1228.6064	
Total			-3302.9505	(283)
Total Primary energy kWh/year			7358.5178	(286)
Target Primary Energy Rate (TPER)			44.6200	(287)

Building Regulations England Part L (BREL) Compliance Report

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

Date: Fri 14 Mar 2025 09:30:51

Project Information			
Assessed By	Richard Millard	Building Type	House, Semi-detached
OCDEA Registration	EES/025661	Assessment Date	2025-03-14

Dwelling Details			
Assessment Type	As designed	Total Floor Area	97 m^2
Site Reference	K	Plot Reference	Proposed
Address	39		

Client Details	
Name	Ian White
Company	Cotswold Homes Ltd
Address	West House, Yate, Bristol, BS37 5NG

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

1a Target emission rate and dwelling emission rate		
Fuel for main heating system	Electricity	
Target carbon dioxide emission rate	*10.73 $kgCO_2/m^2$*	
Dwelling carbon dioxide emission rate	3.18 $kgCO_2/m^2$	OK
1b Target primary energy rate and dwelling primary energy		
Target primary energy	*55.92 kWh_{PE}/m^2*	
Dwelling primary energy	38.14 kWh_{PE}/m^2	OK
1c Target fabric energy efficiency and dwelling fabric energy efficiency		
Target fabric energy efficiency	*38.1 kWh/m^2*	
Dwelling fabric energy efficiency	36.6 kWh/m^2	OK

2a Fabric U-values				
Element	***Maximum permitted average U-Value [W/m^2K]***	**Dwelling average U-Value [W/m^2K]**	**Element with highest individual U-Value**	
External walls	*0.26*	0.18	Walls (1) (0.18)	OK
Party walls	*0.2*	0	Party Wall (1) (0)	**N/A**
Curtain walls	*1.6*	0	N/A	**N/A**
Floors	*0.18*	0.12	Ground Floor (0.12)	OK
Roofs	*0.16*	0.11	Roof (1) (0.11)	OK
Windows, doors, and roof windows	*1.6*	1.2	B-W01 (1.2)	OK
Rooflights	*2.2*	N/A	N/A	**N/A**

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))		
Name	**Net area [m^2]**	**U-Value [W/m^2K]**
Exposed wall: Walls (1)	91.27	0.18
Party wall: Party Wall (1)	28.76	0 **(!)**
Ground floor: Ground Floor , Ground Floor	48.49	0.12
Exposed roof: Roof (1)	48.49	0.11

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	**Area [m^2]**	**Orientation**	**Frame factor**	**U-Value [W/m^2K]**
B-W01, Windows/Glazed Doors	2.12	East	0.7	1.2
B-ED01, Solid Doors	1.98	East	N/A	1.2
B-W02, Windows/Glazed Doors	1.44	East	0.7	1.2
B-W03, Windows/Glazed Doors	1.26	West	0.7	1.2
B-ED02, Windows/Glazed Doors	3.78	West	0.7	1.2
B-W04, Windows/Glazed Doors	1.26	East	0.7	1.2
B-W05, Windows/Glazed Doors	1.26	East	0.7	1.2
B-W06, Windows/Glazed Doors	1.44	East	0.7	1.2
B-W07, Windows/Glazed Doors	1.44	West	0.7	1.2
B-W08, Windows/Glazed Doors	0.57	West	0.7	1.2
B-ED03, Windows/Glazed Doors	3.78	West	0.7	1.2
B-W09, Windows/Glazed Doors	1.44	West	0.7	1.2

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))				
Building part **1**: Thermal bridging calculated from linear thermal transmittances for each junction				
Main element	**Junction detail**	**Source**	**Psi value [W/mK]**	**Drawing / reference**
External wall	E1: Steel lintel with perforated steel base plate	Calculated by person with suitable expertise	0.241	EMPF125E101
External wall	E3: Sill	Calculated by person with suitable expertise	0.026 **(!)**	EMPF125E301
External wall	E4: Jamb	Calculated by person with suitable expertise	0.02 **(!)**	EMPF125E401
External wall	E5: Ground floor (normal)	Calculated by person with suitable expertise	0.045	EMPF125E504
External wall	E6: Intermediate floor within a dwelling	Calculated by person with suitable expertise	0.002 **(!)**	EMPF125E601
External wall	E10: Eaves (insulation at ceiling level)	Calculated by person with suitable expertise	0.05	EMPF125E1001
External wall	E12: Gable (insulation at ceiling level)	Calculated by person with suitable expertise	0.031 **(!)**	EMPF125E1201
External wall	E16: Corner (normal)	Calculated by person with suitable expertise	0.037 **(!)**	EMPF125E21601
Party wall	P1: Ground floor	Calculated by person with suitable expertise	0.051	MPWP104
Party wall	P2: Intermediate floor within a dwelling	SAP table default	0 **(!)**	
Party wall	P4: Roof (insulation at ceiling level)	Calculated by person with suitable expertise	0.04	MPWP101
External wall	E25: Staggered party wall between dwellings	Calculated by person with suitable expertise	0.036 **(!)**	MPF125E2502

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

4 Space heating	
Main heating system 1: Heat pump with radiators or underfloor heating - Electricity	
Efficiency	239.6%
Emitter type	Radiators
Flow temperature	55°C
System type	Heat Pump
Manufacturer	Daikin Europe NV
Model	EDLA08EV3
Commissioning	
Secondary heating system: N/A	
Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water	
Cylinder/store - type: Cylinder	
Capacity	210 litres
Declared heat loss	1.7 kWh/day
Primary pipework insulated	Yes
Manufacturer	
Model	
Commissioning	
Waste water heat recovery system 1 - type: N/A	
Efficiency	
Manufacturer	
Model	

6 Controls		
Main heating 1 - type: Time and temperature zone control by arrangement of plumbing and electrical services		
Function		
Ecodesign class		
Manufacturer		
Model		
Water heating - type: Cylinder thermostat and HW separately timed		
Manufacturer		
Model		

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

8 Mechanical ventilation		
System type: Decentralised mechanical extract		
Maximum permitted specific fan power	*0.7 W/(l/s)*	
Specific fan power	0.32 W/(l/s)	**OK**
Minimum permitted heat recovery efficiency	*N/A*	
Heat recovery efficiency	N/A	**N/A**
Manufacturer/Model	Eco dMEV+	
Commissioning		

9 Local generation	
Technology type: **Photovoltaic system (1)**	
Peak power	2.01 kWp
Orientation	West
Pitch	30°
Overshading	None or very little
Manufacturer	
MCS certificate	

10 Heat networks
N/A

11 Supporting documentary evidence
N/A

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

Full SAP Calculation Printout

Property Reference	K	**Issued on Date**	14/03/2025
Assessment Reference	Proposed	**Prop Type Ref**	Proposed 39
Property	39		

SAP Rating	85 B	**DER**	3.18	**TER**	10.73
Environmental	97 A	**% DER < TER**			70.36
CO_2 Emissions (t/year)	0.26	**DFEE**	36.63	**TFEE**	38.06
Compliance Check	See BREL	**% DFEE < TFEE**			3.76
% DPER < TPER	31.80	**DPER**	38.14	**TPER**	55.92

Assessor Details	Mr. Richard Millard	**Assessor ID**	U367-0001
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)	
Main dwelling						
Ground floor	48.4900	(1b)	x 2.4000	(2b) =	116.3760	(1b) - (3b)
First floor	48.4900	(1c)	x 2.6000	(2c) =	126.0740	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	96.9800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		242.4500	(5)

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2. Ventilation rate
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		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	4 * 10 =	40.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1650	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.4150	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3527	(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	0.4497	0.4409	0.4321	0.3880	0.3792	0.3351	0.3351	0.3263	0.3527	0.3792	0.3968	0.4145	(22b)

Mechanical extract ventilation - decentralised

If mechanical ventilation	0.5000	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000	(23b)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.6997	0.6909	0.6821	0.6380	0.6292	0.5851	0.5851	0.5763	0.6027	0.6292	0.6468	0.6645	(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	
Main dwelling								
Windows/Glazed Doors			19.7900	1.1450	22.6603			(27)
Solid Doors			1.9800	1.2000	2.3760			(26)
Ground Floor			48.4900	0.1200	5.8188	75.0000	3636.7500	(28a)
Cavity Wall	113.0400	21.7700	91.2700	0.1800	16.4286	60.0000	5476.2001	(29a)
Flat Ceiling	48.4900		48.4900	0.1100	5.3339	9.0000	436.4100	(30)
Total net area of external elements Aum(A, m2)			210.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	52.6176			(33)
Main dwelling								
Party Wall 1			28.7600	0.0000	0.0000	45.0000	1294.2000	(32)
Internal Wall 2			190.2900			9.0000	1712.6099	(32c)
Internal Wall 2			55.2500			75.0000	4143.7500	(32c)
Internal Floor 1			48.4900			18.0000	872.8200	(32d)
Internal Ceiling 1			48.4900			9.0000	436.4100	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			18009.1500	(34)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 185.6996 (35)
List of Thermal Bridges

	K1 Element	Length	Psi-value	Total
E1	Steel lintel with perforated steel base plate	14.7800	0.2410	3.5620
E3	Sill	10.2300	0.0260	0.2660
E4	Jamb	32.4000	0.0200	0.6480
E5	Ground floor (normal)	22.6100	0.0450	1.0174
E6	Intermediate floor within a dwelling	22.6100	0.0020	0.0452
E10	Eaves (insulation at ceiling level)	16.8600	0.0500	0.8430
E12	Gable (insulation at ceiling level)	5.7500	0.0310	0.1782
E16	Corner (normal)	10.0000	0.0370	0.3700
P1	Party wall - Ground floor	5.7500	0.0510	0.2932
P2	Party wall - Intermediate floor within a dwelling	5.7500	0.0000	0.0000
P4	Party wall - Roof (insulation at ceiling level)	5.7500	0.0400	0.2300
E25	Staggered party wall between dwellings	10.0000	0.0360	0.3600

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 7.8131 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 60.4307 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	55.9849	55.2794	54.5738	51.0461	50.3406	46.8128	46.8128	46.1073	48.2239	50.3406	51.7517	53.1627	(38)
Heat transfer coeff	116.4157	115.7101	115.0046	111.4768	110.7713	107.2436	107.2436	106.5380	108.6547	110.7713	112.1824	113.5935	(39)
Average = Sum(39)m / 12 =												111.3005	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2004	1.1931	1.1859	1.1495	1.1422	1.1058	1.1058	1.0986	1.1204	1.1422	1.1568	1.1713	(40)
HLP (average)												1.1477	
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 2.7098 (42)
Hot water usage for mixer showers

69.6535	68.6067	67.0814	64.1629	62.0092	59.6074	58.2422	59.7560	61.4153	63.9942	66.9753	69.3866	(42a)

Hot water usage for baths

30.0765	29.6298	29.0008	27.8410	26.9726	26.0096	25.4895	26.1141	26.7942	27.8246	29.0082	29.9748	(42b)

Hot water usage for other uses

42.3806	40.8395	39.2984	37.7573	36.2161	34.6750	34.6750	36.2161	37.7573	39.2984	40.8395	42.3806	(42c)

Average daily hot water use (litres/day) 130.6316 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	142.1105	139.0760	135.3805	129.7612	125.1979	120.2920	118.4067	122.0862	125.9668	131.1171	136.8230	141.7420	(44)
Energy conte	225.0684	198.0424	208.0748	177.6366	168.5404	147.9131	143.2026	151.1682	155.3296	177.9247	194.9295	221.9337	(45)
Energy content (annual)										Total = Sum(45)m =		2169.7640	
Distribution loss (46)m = 0.15 x (45)m	33.7603	29.7064	31.2112	26.6455	25.2811	22.1870	21.4804	22.6752	23.2994	26.6887	29.2394	33.2901	(46)

Water storage loss:
Store volume 210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.7000 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 0.9180 (55)
Total storage loss

28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(56)

If cylinder contains dedicated solar storage

28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(57)
Primary loss 23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)

Total heat required for water heating calculated for each month

276.7888	244.7576	259.7952	227.6886	220.2608	197.9651	194.9230	202.8886	205.3816	229.6451	244.9815	273.6541	(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

276.7888	244.7576	259.7952	227.6886	220.2608	197.9651	194.9230	202.8886	205.3816	229.6451	244.9815	273.6541	(64)
									Total per year (kWh/year) = Sum(64)m =		2778.7300	(64)
12Total per year (kWh/year)											2779	(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

116.2116	103.2212	110.5612	99.1058	97.4160	89.2227	88.9912	91.6397	91.6887	100.5363	104.8557	115.1693	(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	135.4877	135.4877	135.4877	135.4877	135.4877	135.4877	135.4877	135.4877	135.4877	135.4877	135.4877	135.4877	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	127.4201	141.0723	127.4201	131.6675	127.4201	131.6675	127.4201	127.4201	131.6675	127.4201	131.6675	127.4201	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	251.3510	253.9593	247.3866	233.3941	215.7312	199.1305	188.0402	185.4320	192.0047	205.9971	223.6601	240.2608	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.5488	36.5488	36.5488	36.5488	36.5488	36.5488	36.5488	36.5488	36.5488	36.5488	36.5488	36.5488	(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)	-108.3902	-108.3902	-108.3902	-108.3902	-108.3902	-108.3902	-108.3902	-108.3902	-108.3902	-108.3902	-108.3902	-108.3902	(71)
Water heating gains (Table 5)	156.1983	153.6030	148.6038	137.6469	130.9355	123.9204	119.6118	123.1717	127.3454	135.1294	145.6329	154.7974	(72)
Total internal gains	598.6158	612.2809	587.0568	566.3548	537.7331	518.3647	498.7185	499.6701	514.6639	532.1930	564.6067	586.1246	(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

East			7.5200		19.6403		0.6300		0.7000		0.7700		45.1374 (76)
West			12.2700		19.6403		0.6300		0.7000		0.7700		73.6485 (80)
Solar gains	118.7859	232.3704	382.6810	558.1175	683.9939	700.1895	666.6089	572.6072	445.0739	275.7271	148.1121	97.6838	(83)
Total gains	717.4017	844.6513	969.7378	1124.4723	1221.7270	1218.5542	1165.3274	1072.2773	959.7377	807.9201	712.7188	683.8084	(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	42.9714	43.2334	43.4986	44.8752	45.1610	46.6465	46.6465	46.9555	46.0407	45.1610	44.5929	44.0390	
alpha	3.8648	3.8822	3.8999	3.9917	4.0107	4.1098	4.1098	4.1304	4.0694	4.0107	3.9729	3.9359	
util living area	0.9865	0.9741	0.9457	0.8652	0.7271	0.5387	0.3990	0.4471	0.6935	0.9134	0.9753	0.9886	(86)
Living	19.3041	19.5709	19.9671	20.4782	20.8028	20.9581	20.9903	20.9850	20.8825	20.4245	19.8028	19.2985	
Non living	17.9606	18.3016	18.8005	19.4365	19.7981	19.9699	19.9923	19.9956	19.9003	19.3933	18.6180	17.9690	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	20.1324	19.5709	19.9671	20.4782	20.8028	20.9581	20.9903	20.9850	20.8825	20.4245	19.8028	19.5365	(87)
Th 2	19.9197	19.9255	19.9313	19.9606	19.9665	19.9961	19.9961	20.0020	19.9842	19.9665	19.9547	19.9430	(88)
util rest of house	0.9832	0.9679	0.9325	0.8347	0.6722	0.4629	0.3107	0.3546	0.6174	0.8864	0.9683	0.9858	(89)
MIT 2	19.1387	18.3016	18.8005	19.4365	19.7981	19.9699	19.9923	19.9956	19.9003	19.3933	18.6180	18.3247	(90)
Living area fraction									fLA = Living area / (4) =			0.2077	(91)
MIT	19.3450	18.5652	19.0428	19.6528	20.0067	20.1751	20.1995	20.2011	20.1042	19.6074	18.8641	18.5764	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.3450	18.5652	19.0428	19.6528	20.0067	20.1751	20.1995	20.2011	20.1042	19.6074	18.8641	18.5764	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9810	0.9572	0.9187	0.8244	0.6745	0.4769	0.3289	0.3734	0.6271	0.8750	0.9583	0.9808	(94)
Useful gains	703.7731	808.4644	890.9301	926.9862	824.0765	581.1288	383.2650	400.4132	601.8152	706.9001	682.9743	670.7100	(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	1751.4789	1581.2045	1442.4799	1198.6880	920.1495	597.8928	386.0283	404.9596	652.3894	997.7665	1319.7227	1633.0602	(97)
Space heating kWh	779.4931	519.2813	410.3531	195.6253	71.4783	0.0000	0.0000	0.0000	0.0000	216.4046	458.4588	715.9885	(98a)
Space heating requirement - total per year (kWh/year)												3367.0830	
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	779.4931	519.2813	410.3531	195.6253	71.4783	0.0000	0.0000	0.0000	0.0000	216.4046	458.4588	715.9885	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3367.0830	
Space heating per m2											(98c) / (4) =	34.7194	(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 %)	239.5965 (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	779.4931	519.2813	410.3531	195.6253	71.4783	0.0000	0.0000	0.0000	0.0000	216.4046	458.4588	715.9885	(98)
Space heating efficiency (main heating system 1)	239.5965	239.5965	239.5965	239.5965	239.5965	0.0000	0.0000	0.0000	0.0000	239.5965	239.5965	239.5965	(210)
Space heating fuel (main heating system)	325.3357	216.7316	171.2684	81.6478	29.8328	0.0000	0.0000	0.0000	0.0000	90.3204	191.3462	298.8309	(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	276.7888	244.7576	259.7952	227.6886	220.2608	197.9651	194.9230	202.8886	205.3816	229.6451	244.9815	273.6541	(64)
Efficiency of water heater												169.8115	(216)
(217)m	169.8115	169.8115	169.8115	169.8115	169.8115	169.8115	169.8115	169.8115	169.8115	169.8115	169.8115	169.8115	(217)
Fuel for water heating, kWh/month	162.9976	144.1348	152.9903	134.0831	129.7090	116.5793	114.7878	119.4787	120.9468	135.2353	144.2667	161.1517	(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	8.1205	7.3346	8.1205	7.8585	8.1205	7.8585	8.1205	8.1205	7.8585	8.1205	7.8585	8.1205	(231)
Lighting	26.4754	21.2395	19.1238	14.0110	10.8225	8.8420	9.8726	12.8328	16.6685	21.8700	24.7021	27.2112	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-26.1856	-43.2050	-73.1685	-92.4056	-105.4889	-98.8068	-96.9275	-87.1911	-70.3145	-52.3231	-30.2584	-21.6570	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-5.6460	-14.9215	-38.0279	-72.5066	-110.7085	-118.5313	-115.5417	-90.3849	-57.4283	-25.4067	-8.5130	-4.2815	(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												1405.3137	(211)

Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	169.8115	
Water heating fuel used	1636.3611	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
(MEVDecentralised, Database: total watage = 11.9600, total flow = 37.0000, SFP = 0.3232)		
mechanical ventilation fans (SFP = 0.3232)	95.6118	(230a)
Total electricity for the above, kWh/year	95.6118	(231)
Electricity for lighting (calculated in Appendix L)	213.6715	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-1459.8296	(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	1891.1285	(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	1405.3137	0.1561	219.4107	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1636.3611	0.1410	230.6452	(264)
Space and water heating			450.0559	(265)
Pumps, fans and electric keep-hot	95.6118	0.1387	13.2625	(267)
Energy for lighting	213.6715	0.1443	30.8394	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-797.9318	0.1325	-105.6889	
PV Unit electricity exported	-661.8978	0.1204	-79.6768	
Total			-185.3658	(269)
Total CO2, kg/year			308.7921	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			3.1800	(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	1405.3137	1.5780	2217.5565	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1636.3611	1.5212	2489.2077	(278)
Space and water heating			4706.7642	(279)
Pumps, fans and electric keep-hot	95.6118	1.5128	144.6415	(281)
Energy for lighting	213.6715	1.5338	327.7365	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-797.9318	1.4894	-1188.4549	
PV Unit electricity exported	-661.8978	0.4416	-292.2716	
Total			-1480.7265	(283)
Total Primary energy kWh/year			3698.4157	(286)
Dwelling Primary energy Rate (DPER)			38.1400	(287)

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Main dwelling						
Ground floor	48.4900 (1b)	x	2.4000 (2b)	=	116.3760	(1b) - (3b)
First floor	48.4900 (1c)	x	2.6000 (2c)	=	126.0740	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 96.9800						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	242.4500	(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) =	0.1237 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.3737 (18)

Number of sides sheltered 2 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 0.8500 (20)
Infiltration rate adjusted to include shelter factor (21) = (18) x (20) = 0.3177 (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	0.4050	0.3971	0.3892	0.3494	0.3415	0.3018	0.3018	0.2939	0.3177	0.3415	0.3574	0.3733	(22b)
Effective ac	0.5820	0.5788	0.5757	0.5611	0.5583	0.5455	0.5455	0.5432	0.5505	0.5583	0.5639	0.5697	(25)

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3. Heat losses and heat loss parameter

Element	Gross	Openings	NetArea	U-value	A x U	K-value	A x K	
	m2	m2	m2	W/m2K	W/K	kJ/m2K	kJ/K	
Main dwelling								
TER Opaque door			1.9800	1.0000	1.9800			(26)
TER Opening Type			19.7900	1.1450	22.6603			(27)
Ground Floor			48.4900	0.1300	6.3037			(28a)
Cavity Wall	113.0400	21.7700	91.2700	0.1800	16.4286			(29a)
Flat Ceiling	48.4900		48.4900	0.1100	5.3339			(30)
Total net area of external elements Aum(A, m2)			210.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	52.7065			(33)
Main dwelling								
Party Wall 1			28.7600	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 185.6996 (35)
List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	14.7800	0.0500	0.7390
E3 Sill	10.2300	0.0500	0.5115
E4 Jamb	32.4000	0.0500	1.6200
E5 Ground floor (normal)	22.6100	0.1600	3.6176
E6 Intermediate floor within a dwelling	22.6100	0.0000	0.0000
E10 Eaves (insulation at ceiling level)	16.8600	0.0600	1.0116
E12 Gable (insulation at ceiling level)	5.7500	0.0600	0.3450
E16 Corner (normal)	10.0000	0.0900	0.9000
P1 Party wall - Ground floor	5.7500	0.0800	0.4600
P2 Party wall - Intermediate floor within a dwelling	5.7500	0.0000	0.0000
P4 Party wall - Roof (insulation at ceiling level)	5.7500	0.1200	0.6900
E25 Staggered party wall between dwellings	10.0000	0.0600	0.6000

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 10.4947 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 63.2012 (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	46.5672	46.3123	46.0625	44.8892	44.6697	43.6478	43.6478	43.4585	44.0414	44.6697	45.1138	45.5781	(38)
Heat transfer coeff	109.7684	109.5135	109.2637	108.0904	107.8709	106.8490	106.8490	106.6598	107.2426	107.8709	108.3150	108.7793	(39)
Average = Sum(39)m / 12 =												108.0894	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1319	1.1292	1.1267	1.1146	1.1123	1.1018	1.1018	1.0998	1.1058	1.1123	1.1169	1.1217	(40)
HLP (average)												1.1146	
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 2.7098 (42)
Hot water usage for mixer showers

69.6535	68.6067	67.0814	64.1629	62.0092	59.6074	58.2422	59.7560	61.4153	63.9942	66.9753	69.3866	(42a)

Hot water usage for baths

30.0765	29.6298	29.0008	27.8410	26.9726	26.0096	25.4895	26.1141	26.7942	27.8246	29.0082	29.9748	(42b)

Hot water usage for other uses

42.3806	40.8395	39.2984	37.7573	36.2161	34.6750	34.6750	36.2161	37.7573	39.2984	40.8395	42.3806	(42c)

Average daily hot water use (litres/day) 130.6316 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	142.1105	139.0760	135.3805	129.7612	125.1979	120.2920	118.4067	122.0862	125.9668	131.1171	136.8230	141.7420	(44)
Energy conte	225.0684	198.0424	208.0748	177.6366	168.5404	147.9131	143.2026	151.1682	155.3296	177.9247	194.9295	221.9337	(45)
Energy content (annual)										Total = Sum(45)m =		2169.7640	
Distribution loss (46)m = 0.15 x (45)m	33.7603	29.7064	31.2112	26.6455	25.2811	22.1870	21.4804	22.6752	23.2994	26.6887	29.2394	33.2901	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7016	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9188	(55)
Total storage loss	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(56)
If cylinder contains dedicated solar storage	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	276.8150	244.7812	259.8214	227.7139	220.2870	197.9904	194.9492	202.9148	205.4070	229.6713	245.0068	273.6803	(62)
WWHRS	-31.8427	-28.1619	-29.4895	-24.4185	-22.7572	-19.4735	-18.2533	-19.4105	-20.1480	-23.7523	-26.9084	-31.2530	(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	244.9723	216.6193	230.3319	203.2954	197.5299	178.5169	176.6959	183.5043	185.2590	205.9190	218.0984	242.4273	(64)
									Total per year (kWh/year) = Sum(64)m =			2483.1697	(64)
12Total per year (kWh/year)												2483	(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	116.2325	103.2402	110.5822	99.1260	97.4370	89.2430	89.0121	91.6607	91.7090	100.5572	104.8759	115.1902	(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	135.4877	135.4877	135.4877	135.4877	135.4877	135.4877	135.4877	135.4877	135.4877	135.4877	135.4877	135.4877	(66)

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

	127.4201	141.0723	127.4201	131.6675	127.4201	131.6675	127.4201	127.4201	131.6675	127.4201	131.6675	127.4201	(67)

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

	251.3510	253.9593	247.3866	233.3941	215.7312	199.1305	188.0402	185.4320	192.0047	205.9971	223.6601	240.2608	(68)

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

	36.5488	36.5488	36.5488	36.5488	36.5488	36.5488	36.5488	36.5488	36.5488	36.5488	36.5488	36.5488	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)

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

	-108.3902	-108.3902	-108.3902	-108.3902	-108.3902	-108.3902	-108.3902	-108.3902	-108.3902	-108.3902	-108.3902	-108.3902	(71)

Water heating gains (Table 5)

	156.2265	153.6312	148.6319	137.6751	130.9637	123.9486	119.6400	123.1999	127.3736	135.1576	145.6610	154.8256	(72)
Total internal gains													
	601.6440	615.3091	590.0850	569.3830	540.7613	518.3929	498.7467	499.6983	514.6920	535.2211	567.6349	589.1528	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	7.5200	19.6403	0.6300	0.7000	0.7700	45.1374	(76)
West	12.2700	19.6403	0.6300	0.7000	0.7700	73.6485	(80)

Solar gains	118.7859	232.3704	382.6810	558.1175	683.9939	700.1895	666.6089	572.6072	445.0739	275.7271	148.1121	97.6838	(83)
Total gains	720.4299	847.6795	972.7660	1127.5004	1224.7552	1218.5823	1165.3556	1072.3055	959.7659	810.9482	715.7469	686.8365	(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	45.5736	45.6797	45.7841	46.2811	46.3753	46.8188	46.8188	46.9019	46.6470	46.3753	46.1851	45.9880	
alpha	4.0382	4.0453	4.0523	4.0854	4.0917	4.1213	4.1213	4.1268	4.1098	4.0917	4.0790	4.0659	
util living area													
	0.9859	0.9725	0.9415	0.8580	0.7164	0.5372	0.3977	0.4475	0.6885	0.9091	0.9741	0.9882	(86)
MIT	19.4356	19.6912	20.0676	20.5238	20.8240	20.9589	20.9906	20.9849	20.8891	20.4618	19.8699	19.3958	(87)
Th 2	19.9749	19.9770	19.9791	19.9890	19.9908	19.9994	19.9994	20.0010	19.9961	19.9908	19.9871	19.9832	(88)
util rest of house													
	0.9825	0.9660	0.9279	0.8271	0.6620	0.4617	0.3099	0.3548	0.6129	0.8816	0.9669	0.9854	(89)
MIT 2	18.1643	18.4882	18.9586	19.5115	19.8409	19.9737	19.9957	19.9945	19.9169	19.4555	18.7245	18.1194	(90)
Living area fraction									fLA = Living area / (4) =			0.2077	(91)
MIT	18.4283	18.7381	19.1889	19.7217	20.0450	20.1783	20.2023	20.2002	20.1188	19.6645	18.9624	18.3845	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4283	18.7381	19.1889	19.7217	20.0450	20.1783	20.2023	20.2002	20.1188	19.6645	18.9624	18.3845	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9753	0.9556	0.9148	0.8178	0.6652	0.4757	0.3280	0.3737	0.6229	0.8708	0.9571	0.9790	(94)
Useful gains	702.6099	810.0572	889.8837	922.1147	814.6752	579.6377	382.2113	400.7482	597.7911	706.1791	685.0241	672.4114	(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													
	1550.8376	1515.4544	1386.4379	1169.7211	900.1870	596.0401	384.9026	405.3292	645.4681	977.7931	1284.8740	1542.9742	(97)
Space heating kWh													
	631.0814	474.0269	369.4364	178.2766	63.6208	0.0000	0.0000	0.0000	0.0000	202.0808	431.8919	647.6988	(98a)
Space heating requirement - total per year (kWh/year)												2998.1135	
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													
	631.0814	474.0269	369.4364	178.2766	63.6208	0.0000	0.0000	0.0000	0.0000	202.0808	431.8919	647.6988	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2998.1135	
Space heating per m2											(98c) / (4) =	30.9148	(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													
	631.0814	474.0269	369.4364	178.2766	63.6208	0.0000	0.0000	0.0000	0.0000	202.0808	431.8919	647.6988	(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)													
	683.7285	513.5719	400.2561	193.1491	68.9283	0.0000	0.0000	0.0000	0.0000	218.9391	467.9219	701.7322	(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													
	244.9723	216.6193	230.3319	203.2954	197.5299	178.5169	176.6959	183.5043	185.2590	205.9190	218.0984	242.4273	(64)

Efficiency of water heater											79.8000	(216)
(217)m	86.0851	85.7661	85.1135	83.7666	81.8202	79.8000	79.8000	79.8000	79.8000	84.0176	85.5621	86.1537 (217)
Fuel for water heating, kWh/month												
	284.5699	252.5698	270.6172	242.6927	241.4194	223.7054	221.4235	229.9552	232.1541	245.0904	254.9008	281.3894 (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	26.4754	21.2395	19.1238	14.0110	10.8225	8.8420	9.8726	12.8328	16.6685	21.8700	24.7021	27.2112 (232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	-44.4766	-62.2552	-88.8501	-99.1551	-106.2747	-98.9307	-97.6590	-92.4746	-83.2794	-70.7827	-48.7173	-38.5014 (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	-26.5223	-55.6262	-110.2688	-165.2139	-218.0916	-219.0344	-216.5023	-183.5199	-134.7600	-79.4722	-35.3816	-20.9900 (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	3248.2270	(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	2980.4879	(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)	213.6715	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-2396.7398	(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	4131.6466	(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	3248.2270	0.2100	682.1277	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2980.4879	0.2100	625.9025	(264)
Space and water heating			1308.0301	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	213.6715	0.1443	30.8394	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-931.3566	0.1347	-125.4996	
PV Unit electricity exported	-1465.3832	0.1260	-184.5844	
Total			-310.0840	(269)
Total CO2, kg/year			1040.7148	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			10.7300	(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	3248.2270	1.1300	3670.4965	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2980.4879	1.1300	3367.9513	(278)
Space and water heating			7038.4478	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	213.6715	1.5338	327.7365	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-931.3566	1.4980	-1395.1903	
PV Unit electricity exported	-1465.3832	0.4624	-677.5558	
Total			-2072.7461	(283)
Total Primary energy kWh/year			5423.5391	(286)
Target Primary Energy Rate (TPER)			55.9200	(287)

Building Regulations England Part L (BREL) Compliance Report

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

Date: Fri 14 Mar 2025 09:30:56

Project Information			
Assessed By	Richard Millard	Building Type	House, Semi-detached
OCDEA Registration	EES/025661	Assessment Date	2025-03-14

Dwelling Details			
Assessment Type	As designed	Total Floor Area	97 m^2
Site Reference	K	Plot Reference	Regulated (Baseline)
Address	39		

Client Details	
Name	Ian White
Company	Cotswold Homes Ltd
Address	West House, Yate, Bristol, BS37 5NG

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

1a Target emission rate and dwelling emission rate		
Fuel for main heating system	Mains gas	
Target carbon dioxide emission rate	*10.73 $kgCO_2/m^2$*	
Dwelling carbon dioxide emission rate	15.37 $kgCO_2/m^2$	**FAIL**
1b Target primary energy rate and dwelling primary energy		
Target primary energy	*55.92 kWh_{PE}/m^2*	
Dwelling primary energy	80.33 kWh_{PE}/m^2	**FAIL**
1c Target fabric energy efficiency and dwelling fabric energy efficiency		
Target fabric energy efficiency	*38.1 kWh/m^2*	
Dwelling fabric energy efficiency	40.0 kWh/m^2	**FAIL**

2a Fabric U-values				
Element	***Maximum permitted average U-Value [W/m^2K]***	**Dwelling average U-Value [W/m^2K]**	**Element with highest individual U-Value**	
External walls	*0.26*	0.21	Walls (1) (0.21)	**OK**
Party walls	*0.2*	0	Party Wall (1) (0)	**N/A**
Curtain walls	*1.6*	0	N/A	**N/A**
Floors	*0.18*	0.13	Ground Floor (0.13)	**OK**
Roofs	*0.16*	0.09	Roof (1) (0.09)	**OK**
Windows, doors, and roof windows	*1.6*	1.2	B-W01 (1.2)	**OK**
Rooflights	*2.2*	N/A	N/A	**N/A**

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))		
Name	**Net area [m^2]**	**U-Value [W/m^2K]**
Exposed wall: Walls (1)	91.27	0.21
Party wall: Party Wall (1)	28.76	0 **(!)**
Ground floor: Ground Floor , Ground Floor	48.49	0.13
Exposed roof: Roof (1)	48.49	0.09 **(!)**

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	**Area [m^2]**	**Orientation**	**Frame factor**	**U-Value [W/m^2K]**
B-W01, Windows/Glazed Doors	2.12	East	0.7	1.2
B-ED01, Solid Doors	1.98	East	N/A	1.2
B-W02, Windows/Glazed Doors	1.44	East	0.7	1.2
B-W03, Windows/Glazed Doors	1.26	West	0.7	1.2
B-ED02, Windows/Glazed Doors	3.78	West	0.7	1.2
B-W04, Windows/Glazed Doors	1.26	East	0.7	1.2
B-W05, Windows/Glazed Doors	1.26	East	0.7	1.2
B-W06, Windows/Glazed Doors	1.44	East	0.7	1.2
B-W07, Windows/Glazed Doors	1.44	West	0.7	1.2
B-W08, Windows/Glazed Doors	0.57	West	0.7	1.2
B-ED03, Windows/Glazed Doors	3.78	West	0.7	1.2
B-W09, Windows/Glazed Doors	1.44	West	0.7	1.2

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))				
Building part **1**: Thermal bridging calculated from linear thermal transmittances for each junction				
Main element	**Junction detail**	**Source**	**Psi value [W/mK]**	**Drawing / reference**
External wall	E2: Other lintels (including other steel lintels)	Calculated by person with suitable expertise	0.05	CATNIC BROKEN LINTELS
External wall	E3: Sill	Calculated by person with suitable expertise	0.05	MPF125E301
External wall	E4: Jamb	Calculated by person with suitable expertise	0.022 **(!)**	MPF125E401
External wall	E5: Ground floor (normal)	Calculated by person with suitable expertise	0.16	MPF125E504
External wall	E6: Intermediate floor within a dwelling	Calculated by person with suitable expertise	0.003 **(!)**	MPF125E601
External wall	E10: Eaves (insulation at ceiling level)	Calculated by person with suitable expertise	0.06	MPF125E1001
External wall	E12: Gable (insulation at ceiling level)	Calculated by person with suitable expertise	0.06	MPF125E1201
External wall	E16: Corner (normal)	Calculated by person with suitable expertise	0.09	MPF125E1601
Party wall	P1: Ground floor	Calculated by person with suitable expertise	0.051	MPWP104
Party wall	P2: Intermediate floor within a dwelling	SAP table default	0 **(!)**	
Party wall	P4: Roof (insulation at ceiling level)	Calculated by person with suitable expertise	0.04	MPWP101
External wall	E25: Staggered party wall between dwellings	Calculated by person with suitable expertise	0.036 **(!)**	MPF125E2502

3 Air permeability (better than typically expected values are flagged with a subsequent (!))		
Maximum permitted air permeability at 50Pa	*8 m^3/hm^2*	
Dwelling air permeability at 50Pa	4.6 m^3/hm^2, Design value	**OK**
Air permeability test certificate reference		

4 Space heating	
Main heating system 1: Boiler with radiators or underfloor heating - Mains gas	
Efficiency	88.6%
Emitter type	Radiators
Flow temperature	45°C
System type	Regular boiler
Manufacturer	Bosch Thermotechnology
Model	Greenstar 8000 Life
Commissioning	
Secondary heating system: N/A	
Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water	
Cylinder/store - type: Cylinder	
Capacity	210 litres
Declared heat loss	1.7 kWh/day
Primary pipework insulated	Yes
Manufacturer	
Model	
Commissioning	
Waste water heat recovery system 1 - type: N/A	
Efficiency	
Manufacturer	
Model	

6 Controls		
Main heating 1 - type: Time and temperature zone control by arrangement of plumbing and electrical services		
Function		
Ecodesign class		
Manufacturer		
Model		
Water heating - type: Cylinder thermostat and HW separately timed		
Manufacturer		
Model		

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

8 Mechanical ventilation		
System type: Decentralised mechanical extract		
Maximum permitted specific fan power	*0.7 W/(l/s)*	
Specific fan power	0.32 W/(l/s)	**OK**
Minimum permitted heat recovery efficiency	*N/A*	
Heat recovery efficiency	N/A	**N/A**
Manufacturer/Model	Eco dMEV+	
Commissioning		

9 Local generation	
Technology type: **Photovoltaic system (1)**	
Peak power	2.01 kWp
Orientation	West
Pitch	30°
Overshading	None or very little
Manufacturer	
MCS certificate	

10 Heat networks
N/A

11 Supporting documentary evidence
N/A

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

Full SAP Calculation Printout

Property Reference	K	**Issued on Date**	14/03/2025
Assessment Reference	Regulated (Baseline)	**Prop Type Ref**	Proposed 39
Property	39		

SAP Rating	88 B	**DER**	15.37	**TER**	10.73
Environmental	86 B	**% DER < TER**			-43.24
CO_2 Emissions (t/year)	1.37	**DFEE**	39.95	**TFEE**	38.06
Compliance Check	See BREL	**% DFEE < TFEE**			-4.96
% DPER < TPER	-43.66	**DPER**	80.33	**TPER**	55.92

Assessor Details	Mr. Richard Millard	**Assessor ID**	U367-0001
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)	
Main dwelling						
Ground floor	48.4900 (1b)	x	2.4000 (2b)	=	116.3760	(1b) - (3b)
First floor	48.4900 (1c)	x	2.6000 (2c)	=	126.0740	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	96.9800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	242.4500	(5)

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2. Ventilation rate

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				m3 per hour	
Number of open chimneys			0 * 80 =	0.0000	(6a)
Number of open flues			0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire			0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler			0 * 20 =	0.0000	(6d)
Number of flues attached to other heater			0 * 35 =	0.0000	(6e)
Number of blocked chimneys			0 * 20 =	0.0000	(6f)
Number of intermittent extract fans			4 * 10 =	40.0000	(7a)
Number of passive vents			0 * 10 =	0.0000	(7b)
Number of flueless gas fires			0 * 40 =	0.0000	(7c)
				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =			40.0000 / (5) =	0.1650	(8)
Pressure test				Yes	
Pressure Test Method				Blower Door	
Measured/design AP50				4.6000	(17)
Infiltration rate				0.3950	(18)
Number of sides sheltered				2	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3357	(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	0.4281	0.4197	0.4113	0.3693	0.3609	0.3189	0.3189	0.3106	0.3357	0.3609	0.3777	0.3945	(22b)

Mechanical extract ventilation - decentralised

If mechanical ventilation	0.5000	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000	(23b)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.6781	0.6697	0.6613	0.6193	0.6109	0.5689	0.5689	0.5606	0.5857	0.6109	0.6277	0.6445	(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	
Main dwelling								
Windows/Glazed Doors			19.7900	1.1450	22.6603			(27)
Solid Doors			1.9800	1.2000	2.3760			(26)
Ground Floor			48.4900	0.1300	6.3037	75.0000	3636.7500	(28a)
Cavity Wall	113.0400	21.7700	91.2700	0.2100	19.1667	60.0000	5476.2000	(29a)
Flat Ceiling	48.4900		48.4900	0.0900	4.3641	9.0000	436.4100	(30)
Total net area of external elements Aum(A, m2)			210.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	54.8708			(33)
Main dwelling								
Party Wall 1			28.7600	0.0000	0.0000	45.0000	1294.2000	(32)
Internal Wall 2			190.2900			9.0000	1712.6100	(32c)
Internal Wall 2			55.2500			75.0000	4143.7500	(32c)
Internal Floor 1			48.4900			18.0000	872.8200	(32d)
Internal Ceiling 1			48.4900			9.0000	436.4100	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			18009.1500	(34)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 185.6996 (35)

List of Thermal Bridges

	K1 Element	Length	Psi-value	Total
E2	Other lintels (including other steel lintels)	14.7800	0.0500	0.7390
E3	Sill	10.2300	0.0500	0.5115
E4	Jamb	32.4000	0.0220	0.7128
E5	Ground floor (normal)	22.6100	0.1600	3.6176
E6	Intermediate floor within a dwelling	22.6100	0.0030	0.0678
E10	Eaves (insulation at ceiling level)	16.8600	0.0600	1.0116
E12	Gable (insulation at ceiling level)	5.7500	0.0600	0.3450
E16	Corner (normal)	10.0000	0.0900	0.9000
P1	Party wall - Ground floor	5.7500	0.0510	0.2932
P2	Party wall - Intermediate floor within a dwelling	5.7500	0.0000	0.0000
P4	Party wall - Roof (insulation at ceiling level)	5.7500	0.0400	0.2300
E25	Staggered party wall between dwellings	10.0000	0.0360	0.3600

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 8.7886 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 63.6594 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	54.2507	53.5792	52.9077	49.5500	48.8784	45.5207	45.5207	44.8492	46.8638	48.8784	50.2215	51.5646	(38)
Heat transfer coeff	117.9101	117.2386	116.5670	113.2093	112.5378	109.1801	109.1801	108.5085	110.5232	112.5378	113.8809	115.2240	(39)

Average = Sum(39)m / 12 = 113.0415

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2158	1.2089	1.2020	1.1673	1.1604	1.1258	1.1258	1.1189	1.1396	1.1604	1.1743	1.1881	(40)
HLP (average)												1.1656	
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 2.7098 (42)

Hot water usage for mixer showers

69.6535	68.6067	67.0814	64.1629	62.0092	59.6074	58.2422	59.7560	61.4153	63.9942	66.9753	69.3866	(42a)

Hot water usage for baths

30.0765	29.6298	29.0008	27.8410	26.9726	26.0096	25.4895	26.1141	26.7942	27.8246	29.0082	29.9748	(42b)

Hot water usage for other uses

42.3806	40.8395	39.2984	37.7573	36.2161	34.6750	34.6750	36.2161	37.7573	39.2984	40.8395	42.3806	(42c)

Average daily hot water use (litres/day) 130.6316 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	142.1105	139.0760	135.3805	129.7612	125.1979	120.2920	118.4067	122.0862	125.9668	131.1171	136.8230	141.7420	(44)
Energy conte	225.0684	198.0424	208.0748	177.6366	168.5404	147.9131	143.2026	151.1682	155.3296	177.9247	194.9295	221.9337	(45)

Energy content (annual) Total = Sum(45)m = 2169.7640

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

33.7603	29.7064	31.2112	26.6455	25.2811	22.1870	21.4804	22.6752	23.2994	26.6887	29.2394	33.2901	(46)

Water storage loss:

Store volume 210.0000 (47)

a) If manufacturer declared loss factor is known (kWh/day): 1.7000 (48)

Temperature factor from Table 2b 0.5400 (49)

Enter (49) or (54) in (55) 0.9180 (55)

Total storage loss

28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(56)

If cylinder contains dedicated solar storage

28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(57)
Primary loss 23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)

Total heat required for water heating calculated for each month

276.7888	244.7576	259.7952	227.6886	220.2608	197.9651	194.9230	202.8886	205.3816	229.6451	244.9815	273.6541	(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

276.7888	244.7576	259.7952	227.6886	220.2608	197.9651	194.9230	202.8886	205.3816	229.6451	244.9815	273.6541	(64)

Total per year (kWh/year) = Sum(64)m = 2778.7300 (64)

12Total per year (kWh/year) 2779 (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

116.2116	103.2212	110.5612	99.1058	97.4160	89.2227	88.9912	91.6397	91.6887	100.5363	104.8557	115.1693	(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	135.4877	135.4877	135.4877	135.4877	135.4877	135.4877	135.4877	135.4877	135.4877	135.4877	135.4877	135.4877	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	127.4201	141.0723	127.4201	131.6675	127.4201	131.6675	127.4201	127.4201	131.6675	127.4201	131.6675	127.4201	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	251.3510	253.9593	247.3866	233.3941	215.7312	199.1305	188.0402	185.4320	192.0047	205.9971	223.6601	240.2607	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.5488	36.5488	36.5488	36.5488	36.5488	36.5488	36.5488	36.5488	36.5488	36.5488	36.5488	36.5488	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-108.3902	-108.3902	-108.3902	-108.3902	-108.3902	-108.3902	-108.3902	-108.3902	-108.3902	-108.3902	-108.3902	-108.3902	(71)
Water heating gains (Table 5)	156.1983	153.6030	148.6038	137.6469	130.9355	123.9204	119.6118	123.1717	127.3454	135.1294	145.6329	154.7974	(72)
Total internal gains	601.6158	615.2809	590.0568	569.3548	540.7331	518.3647	498.7185	499.6701	514.6639	535.1930	567.6067	589.1246	(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

East			7.5200		19.6403		0.4500		0.7000		0.7700		32.2410 (76)
West			12.2700		19.6403		0.4500		0.7000		0.7700		52.6060 (80)
Solar gains	84.8471	165.9789	273.3436	398.6553	488.5671	500.1353	476.1492	409.0051	317.9099	196.9479	105.7943	69.7741	(83)
Total gains	686.4629	781.2598	863.4004	968.0101	1029.3002	1018.5000	974.8677	908.6753	832.5738	732.1409	673.4010	658.8987	(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	42.4267	42.6698	42.9156	44.1884	44.4521	45.8192	45.8192	46.1027	45.2624	44.4521	43.9278	43.4158	
alpha	3.8284	3.8447	3.8610	3.9459	3.9635	4.0546	4.0546	4.0735	4.0175	3.9635	3.9285	3.8944	
util living area	0.9884	0.9800	0.9620	0.9091	0.8051	0.6311	0.4782	0.5267	0.7641	0.9354	0.9797	0.9900	(86)
MIT	19.2359	19.4641	19.8213	20.3232	20.6984	20.9220	20.9802	20.9712	20.8242	20.3279	19.7261	19.2347	(87)
Th 2	19.9074	19.9129	19.9184	19.9462	19.9518	19.9798	19.9798	19.9854	19.9686	19.9518	19.9406	19.9295	(88)
util rest of house	0.9855	0.9750	0.9522	0.8855	0.7555	0.5488	0.3739	0.4203	0.6907	0.9135	0.9738	0.9875	(89)
MIT 2	17.8662	18.1591	18.6128	19.2486	19.6836	19.9289	19.9718	19.9727	19.8373	19.2704	18.5126	17.8791	(90)
Living area fraction										fLA = Living area / (4) =		0.2077	(91)
MIT	18.1506	18.4301	18.8638	19.4718	19.8943	20.1351	20.1812	20.1801	20.0422	19.4900	18.7646	18.1606	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.0006	18.2801	18.7138	19.3218	19.7443	19.9851	20.0312	20.0301	19.8922	19.3400	18.6146	18.0106	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9779	0.9644	0.9374	0.8683	0.7443	0.5492	0.3793	0.4252	0.6845	0.8968	0.9631	0.9808	(94)
Useful gains	671.3125	753.4213	809.3841	840.4890	766.1405	559.3867	369.8047	386.3742	569.8997	656.6125	648.5763	646.2744	(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	1615.4412	1568.6628	1423.7243	1179.8416	905.2934	587.9480	374.6167	393.8917	640.1744	983.5829	1311.2939	1591.3116	(97)
Space heating kWh	702.4317	547.8422	457.0692	244.3339	103.5298	0.0000	0.0000	0.0000	0.0000	243.2660	477.1567	703.1077	(98a)
Space heating requirement - total per year (kWh/year)												3478.7372	
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	702.4317	547.8422	457.0692	244.3339	103.5298	0.0000	0.0000	0.0000	0.0000	243.2660	477.1567	703.1077	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3478.7372	
Space heating per m2											(98c) / (4) =	35.8707	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												88.6000	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement	702.4317	547.8422	457.0692	244.3339	103.5298	0.0000	0.0000	0.0000	0.0000	243.2660	477.1567	703.1077	(98)
Space heating efficiency (main heating system 1)	88.6000	88.6000	88.6000	88.6000	88.6000	0.0000	0.0000	0.0000	0.0000	88.6000	88.6000	88.6000	(210)
Space heating fuel (main heating system)	792.8123	618.3321	515.8794	275.7719	116.8508	0.0000	0.0000	0.0000	0.0000	274.5666	538.5515	793.5753	(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	276.7888	244.7576	259.7952	227.6886	220.2608	197.9651	194.9230	202.8886	205.3816	229.6451	244.9815	273.6541	(64)
Efficiency of water heater												79.6000	(216)
(217)m	85.8561	85.6109	85.1125	84.0177	82.2722	79.6000	79.6000	79.6000	79.6000	83.9887	85.3271	85.8796	(217)
Fuel for water heating, kWh/month	322.3868	285.8953	305.2376	271.0006	267.7222	248.6998	244.8781	254.8852	258.0171	273.4239	287.1086	318.6486	(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	15.4246	13.9319	15.4246	14.9270	15.4246	14.9270	15.4246	15.4246	14.9270	15.4246	14.9270	15.4246	(231)
Lighting	26.4754	21.2395	19.1238	14.0110	10.8225	8.8420	9.8726	12.8328	16.6685	21.8700	24.7021	27.2112	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-23.4265	-37.4593	-61.5447	-77.1202	-88.4652	-84.3910	-82.9218	-75.2661	-62.1306	-45.7714	-26.9807	-19.5827	(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												3926.3399	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												79.6000	
Water heating fuel used												3337.9038	(219)
Space cooling fuel												0.0000	(221)

Electricity for pumps and fans:		
(MEVDecentralised, Database: total watage = 11.9600, total flow = 37.0000, SFP = 0.3232)		
mechanical ventilation fans (SFP = 0.3232)	95.6118	(230a)
central heating pump	41.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	181.6118	(231)
Electricity for lighting (calculated in Appendix L)	213.6715	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-685.0600	(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	6974.4670	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3926.3399	0.2100	824.5314	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3337.9038	0.2100	700.9598	(264)
Space and water heating			1525.4912	(265)
Pumps, fans and electric keep-hot	181.6118	0.1387	25.1918	(267)
Energy for lighting	213.6715	0.1443	30.8394	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-685.0600	0.1325	-90.7659	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-90.7659	(269)
Total CO2, kg/year			1490.7565	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			15.3700	(273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3926.3399	1.1300	4436.7641	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3337.9038	1.1300	3771.8313	(278)
Space and water heating			8208.5955	(279)
Pumps, fans and electric keep-hot	181.6118	1.5128	274.7423	(281)
Energy for lighting	213.6715	1.5338	327.7365	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-685.0600	1.4896	-1020.4376	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-1020.4376	(283)
Total Primary energy kWh/year			7790.6367	(286)
Dwelling Primary energy Rate (DPER)			80.3300	(287)

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Main dwelling						
Ground floor	48.4900	(1b) x	2.4000	(2b) =	116.3760	(1b) - (3b)
First floor	48.4900	(1c) x	2.6000	(2c) =	126.0740	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 96.9800						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		242.4500	(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) =	0.1237	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3737	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)

Infiltration rate adjusted to include shelter factor (21) = (18) x (20) = 0.3177 (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	0.4050	0.3971	0.3892	0.3494	0.3415	0.3018	0.3018	0.2939	0.3177	0.3415	0.3574	0.3733	(22b)
Effective ac	0.5820	0.5788	0.5757	0.5611	0.5583	0.5455	0.5455	0.5432	0.5505	0.5583	0.5639	0.5697	(25)

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3. Heat losses and heat loss parameter

Element	Gross	Openings	NetArea	U-value	A x U	K-value	A x K	
Main dwelling	m2	m2	m2	W/m2K	W/K	kJ/m2K	kJ/K	
TER Opaque door			1.9800	1.0000	1.9800			(26)
TER Opening Type			19.7900	1.1450	22.6603			(27)
Ground Floor			48.4900	0.1300	6.3037			(28a)
Cavity Wall	113.0400	21.7700	91.2700	0.1800	16.4286			(29a)
Flat Ceiling	48.4900		48.4900	0.1100	5.3339			(30)
Total net area of external elements Aum(A, m2)			210.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	52.7065			(33)
Main dwelling								
Party Wall 1			28.7600	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 185.6996 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	14.7800	0.0500	0.7390
E3 Sill	10.2300	0.0500	0.5115
E4 Jamb	32.4000	0.0500	1.6200
E5 Ground floor (normal)	22.6100	0.1600	3.6176
E6 Intermediate floor within a dwelling	22.6100	0.0000	0.0000
E10 Eaves (insulation at ceiling level)	16.8600	0.0600	1.0116
E12 Gable (insulation at ceiling level)	5.7500	0.0600	0.3450
E16 Corner (normal)	10.0000	0.0900	0.9000
P1 Party wall - Ground floor	5.7500	0.0800	0.4600
P2 Party wall - Intermediate floor within a dwelling	5.7500	0.0000	0.0000
P4 Party wall - Roof (insulation at ceiling level)	5.7500	0.1200	0.6900
E25 Staggered party wall between dwellings	10.0000	0.0600	0.6000

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 10.4947 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 63.2012 (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	46.5672	46.3123	46.0625	44.8892	44.6697	43.6478	43.6478	43.4585	44.0414	44.6697	45.1138	45.5781	(38)
Heat transfer coeff	109.7684	109.5135	109.2637	108.0904	107.8709	106.8490	106.8490	106.6597	107.2426	107.8709	108.3150	108.7793	(39)
Average = Sum(39)m / 12 =												108.0894	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1319	1.1292	1.1267	1.1146	1.1123	1.1018	1.1018	1.0998	1.1058	1.1123	1.1169	1.1217	(40)
HLP (average)												1.1146	
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 2.7098 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	69.6535	68.6067	67.0814	64.1629	62.0092	59.6074	58.2422	59.7560	61.4153	63.9942	66.9753	69.3866	(42a)
Hot water usage for baths	30.0765	29.6298	29.0008	27.8410	26.9726	26.0096	25.4895	26.1141	26.7942	27.8246	29.0082	29.9748	(42b)
Hot water usage for other uses	42.3806	40.8395	39.2984	37.7573	36.2161	34.6750	34.6750	36.2161	37.7573	39.2984	40.8395	42.3806	(42c)
Average daily hot water use (litres/day)												130.6316	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	142.1105	139.0760	135.3805	129.7612	125.1979	120.2920	118.4067	122.0862	125.9668	131.1171	136.8230	141.7420	(44)
Energy conte	225.0684	198.0424	208.0748	177.6366	168.5404	147.9131	143.2026	151.1682	155.3296	177.9247	194.9295	221.9337	(45)
Energy content (annual)										Total = Sum(45)m =		2169.7640	
Distribution loss (46)m = 0.15 x (45)m	33.7603	29.7064	31.2112	26.6455	25.2811	22.1870	21.4804	22.6752	23.2994	26.6887	29.2394	33.2901	(46)

Water storage loss:

Store volume 210.0000 (47)

a) If manufacturer declared loss factor is known (kWh/day): 1.7016 (48)

Temperature factor from Table 2b 0.5400 (49)

Enter (49) or (54) in (55) 0.9188 (55)

Total storage loss	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(56)
If cylinder contains dedicated solar storage	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	276.8150	244.7812	259.8214	227.7139	220.2870	197.9904	194.9492	202.9148	205.4070	229.6713	245.0068	273.6803	(62)
WWHRS	-31.8427	-28.1619	-29.4895	-24.4185	-22.7572	-19.4735	-18.2533	-19.4105	-20.1480	-23.7523	-26.9084	-31.2530	(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	244.9723	216.6193	230.3319	203.2954	197.5299	178.5169	176.6959	183.5043	185.2590	205.9190	218.0984	242.4273	(64)
										Total per year (kWh/year) = Sum(64)m =		2483.1697	(64)
12Total per year (kWh/year)												2483	(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	116.2325	103.2402	110.5822	99.1260	97.4370	89.2430	89.0121	91.6607	91.7090	100.5572	104.8759	115.1902	(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	135.4877	135.4877	135.4877	135.4877	135.4877	135.4877	135.4877	135.4877	135.4877	135.4877	135.4877	135.4877	(66)

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

	127.4201	141.0723	127.4201	131.6675	127.4201	131.6675	127.4201	127.4201	131.6675	127.4201	131.6675	127.4201	(67)

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

	251.3510	253.9593	247.3866	233.3941	215.7312	199.1305	188.0402	185.4320	192.0047	205.9971	223.6601	240.2607	(68)

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

	36.5488	36.5488	36.5488	36.5488	36.5488	36.5488	36.5488	36.5488	36.5488	36.5488	36.5488	36.5488	(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)

	-108.3902	-108.3902	-108.3902	-108.3902	-108.3902	-108.3902	-108.3902	-108.3902	-108.3902	-108.3902	-108.3902	-108.3902	(71)

Water heating gains (Table 5)

	156.2265	153.6312	148.6319	137.6751	130.9637	123.9486	119.6400	123.1999	127.3736	135.1576	145.6610	154.8256	(72)

Total internal gains

	601.6439	615.3091	590.0850	569.3830	540.7613	518.3929	498.7466	499.6983	514.6920	535.2211	567.6349	589.1528	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	7.5200	19.6403	0.6300	0.7000	0.7700	45.1374	(76)
West	12.2700	19.6403	0.6300	0.7000	0.7700	73.6485	(80)

Solar gains	118.7859	232.3704	382.6810	558.1175	683.9939	700.1895	666.6089	572.6072	445.0739	275.7271	148.1121	97.6838	(83)
Total gains	720.4299	847.6795	972.7660	1127.5004	1224.7552	1218.5823	1165.3556	1072.3055	959.7659	810.9482	715.7469	686.8365	(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	45.5736	45.6797	45.7841	46.2811	46.3753	46.8188	46.8188	46.9019	46.6470	46.3753	46.1851	45.9880	
alpha	4.0382	4.0453	4.0523	4.0854	4.0917	4.1213	4.1213	4.1268	4.1098	4.0917	4.0790	4.0659	
util living area	0.9859	0.9725	0.9415	0.8580	0.7164	0.5372	0.3977	0.4475	0.6885	0.9091	0.9741	0.9882	(86)
MIT	19.4356	19.6912	20.0676	20.5238	20.8240	20.9589	20.9906	20.9849	20.8891	20.4618	19.8699	19.3958	(87)
Th 2	19.9749	19.9770	19.9791	19.9890	19.9908	19.9994	19.9994	20.0010	19.9961	19.9908	19.9871	19.9832	(88)
util rest of house	0.9825	0.9660	0.9279	0.8271	0.6620	0.4617	0.3099	0.3548	0.6129	0.8816	0.9669	0.9854	(89)
MIT 2	18.1643	18.4882	18.9586	19.5115	19.8409	19.9737	19.9957	19.9945	19.9169	19.4555	18.7245	18.1194	(90)
Living area fraction									fLA = Living area / (4) =			0.2077	(91)
MIT	18.4283	18.7381	19.1889	19.7217	20.0450	20.1783	20.2023	20.2002	20.1188	19.6645	18.9624	18.3845	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4283	18.7381	19.1889	19.7217	20.0450	20.1783	20.2023	20.2002	20.1188	19.6645	18.9624	18.3845	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9753	0.9556	0.9148	0.8178	0.6652	0.4757	0.3280	0.3737	0.6229	0.8708	0.9571	0.9790	(94)
Useful gains	702.6099	810.0572	889.8837	922.1147	814.6752	579.6377	382.2112	400.7482	597.7911	706.1791	685.0241	672.4113	(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	1550.8376	1515.4544	1386.4379	1169.7211	900.1870	596.0401	384.9026	405.3292	645.4681	977.7931	1284.8739	1542.9742	(97)
Space heating kWh	631.0814	474.0269	369.4364	178.2766	63.6208	0.0000	0.0000	0.0000	0.0000	202.0808	431.8919	647.6988	(98a)
Space heating requirement - total per year (kWh/year)												2998.1135	
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	631.0814	474.0269	369.4364	178.2766	63.6208	0.0000	0.0000	0.0000	0.0000	202.0808	431.8919	647.6988	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2998.1135	
Space heating per m2											(98c) / (4) =	30.9148	(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	631.0814	474.0269	369.4364	178.2766	63.6208	0.0000	0.0000	0.0000	0.0000	202.0808	431.8919	647.6988	(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)	683.7285	513.5719	400.2561	193.1491	68.9283	0.0000	0.0000	0.0000	0.0000	218.9391	467.9219	701.7321	(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	244.9723	216.6193	230.3319	203.2954	197.5299	178.5169	176.6959	183.5043	185.2590	205.9190	218.0984	242.4273	(64)
Efficiency of water heater												79.8000	(216)
(217)m	86.0851	85.7661	85.1135	83.7666	81.8202	79.8000	79.8000	79.8000	79.8000	84.0176	85.5621	86.1537	(217)
Fuel for water heating, kWh/month													

	284.5699	252.5698	270.6172	242.6927	241.4194	223.7054	221.4235	229.9552	232.1541	245.0904	254.9008	281.3894 (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	26.4754	21.2395	19.1238	14.0110	10.8225	8.8420	9.8726	12.8328	16.6685	21.8700	24.7021	27.2112 (232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	-44.4766	-62.2552	-88.8501	-99.1551	-106.2747	-98.9307	-97.6590	-92.4746	-83.2794	-70.7827	-48.7173	-38.5014 (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	-26.5223	-55.6262	-110.2688	-165.2139	-218.0916	-219.0344	-216.5023	-183.5199	-134.7600	-79.4722	-35.3816	-20.9900 (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	3248.2270 (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	2980.4879 (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)	213.6715 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-2396.7397 (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	4131.6466 (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	3248.2270	0.2100	682.1277	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2980.4879	0.2100	625.9025	(264)
Space and water heating			1308.0301	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	213.6715	0.1443	30.8394	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-931.3566	0.1347	-125.4996	
PV Unit electricity exported	-1465.3831	0.1260	-184.5844	
Total			-310.0840	(269)
Total CO2, kg/year			1040.7148	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			10.7300	(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	3248.2270	1.1300	3670.4965	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2980.4879	1.1300	3367.9513	(278)
Space and water heating			7038.4478	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	213.6715	1.5338	327.7365	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-931.3566	1.4980	-1395.1903	
PV Unit electricity exported	-1465.3831	0.4624	-677.5557	
Total			-2072.7460	(283)
Total Primary energy kWh/year			5423.5390	(286)
Target Primary Energy Rate (TPER)			55.9200	(287)

Building Regulations England Part L (BREL) Compliance Report

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

Date: Fri 14 Mar 2025 09:30:51

Project Information			
Assessed By	Richard Millard	Building Type	House, Semi-detached
OCDEA Registration	EES/025661	Assessment Date	2025-03-14

Dwelling Details			
Assessment Type	As designed	Total Floor Area	97 m^2
Site Reference	KV1	Plot Reference	Proposed
Address	40		

Client Details	
Name	Ian White
Company	Cotswold Homes Ltd
Address	West House, Yate, Bristol, BS37 5NG

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

1a Target emission rate and dwelling emission rate		
Fuel for main heating system	Electricity	
Target carbon dioxide emission rate	*11.17 $kgCO_2/m^2$*	
Dwelling carbon dioxide emission rate	3.73 $kgCO_2/m^2$	OK
1b Target primary energy rate and dwelling primary energy		
Target primary energy	*58.31 kWh_{PE}/m^2*	
Dwelling primary energy	42.37 kWh_{PE}/m^2	OK
1c Target fabric energy efficiency and dwelling fabric energy efficiency		
Target fabric energy efficiency	*39.5 kWh/m^2*	
Dwelling fabric energy efficiency	37.7 kWh/m^2	OK

2a Fabric U-values				
Element	***Maximum permitted average U-Value [W/m^2K]***	**Dwelling average U-Value [W/m^2K]**	**Element with highest individual U-Value**	
External walls	*0.26*	0.18	Walls (1) (0.18)	OK
Party walls	*0.2*	0	Party Wall (1) (0)	**N/A**
Curtain walls	*1.6*	0	N/A	**N/A**
Floors	*0.18*	0.12	Ground Floor (0.12)	OK
Roofs	*0.16*	0.11	Roof (1) (0.11)	OK
Windows, doors, and roof windows	*1.6*	1.2	K-W01 (1.2)	OK
Rooflights	*2.2*	N/A	N/A	**N/A**

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))		
Name	**Net area [m^2]**	**U-Value [W/m^2K]**
Exposed wall: Walls (1)	94.08	0.18
Party wall: Party Wall (1)	28.76	0 **(!)**
Ground floor: Ground Floor , Ground Floor	48.49	0.12
Exposed roof: Roof (1)	48.49	0.11

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	**Area [m^2]**	**Orientation**	**Frame factor**	**U-Value [W/m^2K]**
K-W01, Windows/Glazed Doors	2.12	North West	0.7	1.2
K-ED01, Solid Doors	1.98	North West	N/A	1.2
K-W02, Windows/Glazed Doors	1.44	North West	0.7	1.2
K-W03, Windows/Glazed Doors	2.12	South West	0.7	1.2
K-ED02, Windows/Glazed Doors	3.78	North East	0.7	1.2
K-W04, Windows/Glazed Doors	2.12	North West	0.7	1.2
K-W05, Windows/Glazed Doors	1.26	North West	0.7	1.2
K-W06, Windows/Glazed Doors	1.26	North West	0.7	1.2
K-W07, Windows/Glazed Doors	1.44	North East	0.7	1.2
K-W09, Windows/Glazed Doors	1.44	South West	0.7	1.2

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))
Building part **1**: Thermal bridging calculated from linear thermal transmittances for each junction

Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E1: Steel lintel with perforated steel base plate	Calculated by person with suitable expertise	0.241	EMPF125E101
External wall	E3: Sill	Calculated by person with suitable expertise	0.026 **(!)**	EMPF125E301
External wall	E4: Jamb	Calculated by person with suitable expertise	0.02 **(!)**	EMPF125E401
External wall	E5: Ground floor (normal)	Calculated by person with suitable expertise	0.045	EMPF125E504
External wall	E6: Intermediate floor within a dwelling	Calculated by person with suitable expertise	0.002 **(!)**	EMPF125E601
External wall	E10: Eaves (insulation at ceiling level)	Calculated by person with suitable expertise	0.05	EMPF125E1001
External wall	E12: Gable (insulation at ceiling level)	Calculated by person with suitable expertise	0.031 **(!)**	EMPF125E1201
External wall	E16: Corner (normal)	Calculated by person with suitable expertise	0.037 **(!)**	EMPF125E21601
Party wall	P1: Ground floor	Calculated by person with suitable expertise	0.051	MPWP104
Party wall	P2: Intermediate floor within a dwelling	SAP table default	0 **(!)**	
Party wall	P4: Roof (insulation at ceiling level)	Calculated by person with suitable expertise	0.04	MPWP101
External wall	E25: Staggered party wall between dwellings	Calculated by person with suitable expertise	0.036 **(!)**	MPF125E2502

3 Air permeability (better than typically expected values are flagged with a subsequent (!))		
Maximum permitted air permeability at 50Pa	*8 m^3/hm^2*	
Dwelling air permeability at 50Pa	5.01 m^3/hm^2, Design value	**OK**
Air permeability test certificate reference		

4 Space heating	
Main heating system 1: Heat pump with radiators or underfloor heating - Electricity	
Efficiency	239.6%
Emitter type	Radiators
Flow temperature	55°C
System type	Heat Pump
Manufacturer	Daikin Europe NV
Model	EDLA08EV3
Commissioning	
Secondary heating system: N/A	
Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water	
Cylinder/store - type: Cylinder	
Capacity	210 litres
Declared heat loss	1.7 kWh/day
Primary pipework insulated	Yes
Manufacturer	
Model	
Commissioning	
Waste water heat recovery system 1 - type: N/A	
Efficiency	
Manufacturer	
Model	

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

Water heating - type: Cylinder thermostat and HW separately timed	
Manufacturer	
Model	

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

8 Mechanical ventilation		
System type: Decentralised mechanical extract		
Maximum permitted specific fan power	*0.7 W/(l/s)*	
Specific fan power	0.32 W/(l/s)	**OK**
Minimum permitted heat recovery efficiency	*N/A*	
Heat recovery efficiency	N/A	**N/A**
Manufacturer/Model	Eco dMEV+	
Commissioning		

9 Local generation	
Technology type: **Photovoltaic system (1)**	
Peak power	1.34 kWp
Orientation	South
Pitch	30°
Overshading	None or very little
Manufacturer	
MCS certificate	

10 Heat networks
N/A

11 Supporting documentary evidence
N/A

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

Full SAP Calculation Printout

Property Reference	KV1	**Issued on Date**	14/03/2025
Assessment Reference	Proposed	**Prop Type Ref**	Proposed 40
Property	40		

SAP Rating	83 B	**DER**	3.73	**TER**	11.17
Environmental	97 A	**% DER < TER**			66.61
CO_2 Emissions (t/year)	0.32	**DFEE**	37.71	**TFEE**	39.53
Compliance Check	See BREL	**% DFEE < TFEE**			4.61
% DPER < TPER	27.33	**DPER**	42.37	**TPER**	58.31

Assessor Details	Mr. Richard Millard	**Assessor ID**	U367-0001
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)	
Main dwelling						
Ground floor	48.4900 (1b)	x	2.4000 (2b)	=	116.3760	(1b) - (3b)
First floor	48.4900 (1c)	x	2.6000 (2c)	=	126.0740	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	96.9800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	242.4500	(5)

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2. Ventilation rate

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			m3 per hour	
Number of open chimneys		0 * 80 =	0.0000	(6a)
Number of open flues		0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire		0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler		0 * 20 =	0.0000	(6d)
Number of flues attached to other heater		0 * 35 =	0.0000	(6e)
Number of blocked chimneys		0 * 20 =	0.0000	(6f)
Number of intermittent extract fans		4 * 10 =	40.0000	(7a)
Number of passive vents		0 * 10 =	0.0000	(7b)
Number of flueless gas fires		0 * 40 =	0.0000	(7c)
		Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =		40.0000 / (5) =	0.1650	(8)
Pressure test			Yes	
Pressure Test Method			Blower Door	
Measured/design AP50			5.0100	(17)
Infiltration rate			0.4155	(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) =	0.3843	(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	0.4900	0.4804	0.4708	0.4228	0.4131	0.3651	0.3651	0.3555	0.3843	0.4131	0.4324	0.4516	(22b)

Mechanical extract ventilation - decentralised

If mechanical ventilation	0.5000	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000	(23b)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.7400	0.7304	0.7208	0.6728	0.6631	0.6151	0.6151	0.6055	0.6343	0.6631	0.6824	0.7016	(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	
Main dwelling								
Windows/Glazed Doors			16.9800	1.1450	19.4427			(27)
Solid Doors			1.9800	1.2000	2.3760			(26)
Ground Floor			48.4900	0.1200	5.8188	75.0000	3636.7500	(28a)
Cavity Wall	113.0400	18.9600	94.0800	0.1800	16.9344	60.0000	5644.8001	(29a)
Flat Ceiling	48.4900		48.4900	0.1100	5.3339	9.0000	436.4100	(30)
Total net area of external elements Aum(A, m2)			210.0200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		49.9058			(33)
Main dwelling								
Party Wall 1			28.7600	0.0000	0.0000	45.0000	1294.2000	(32)
Internal Wall 2			190.2900			9.0000	1712.6099	(32c)
Internal Wall 2			55.2500			75.0000	4143.7500	(32c)
Internal Floor 1			48.4900			18.0000	872.8200	(32d)
Internal Ceiling 1			48.4900			9.0000	436.4100	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		18177.7500	(34)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 187.4381 (35)
List of Thermal Bridges

	K1 Element	Length	Psi-value	Total
E1	Steel lintel with perforated steel base plate	14.0600	0.2410	3.3885
E3	Sill	11.3100	0.0260	0.2941
E4	Jamb	27.0000	0.0200	0.5400
E5	Ground floor (normal)	22.6100	0.0450	1.0174
E6	Intermediate floor within a dwelling	22.6100	0.0020	0.0452
E10	Eaves (insulation at ceiling level)	11.1000	0.0500	0.5550
E12	Gable (insulation at ceiling level)	11.5100	0.0310	0.3568
E16	Corner (normal)	20.0000	0.0370	0.7400
P1	Party wall - Ground floor	5.7500	0.0510	0.2932
P2	Party wall - Intermediate floor within a dwelling	5.7500	0.0000	0.0000
P4	Party wall - Roof (insulation at ceiling level)	5.7500	0.0400	0.2300
E25	Staggered party wall between dwellings	10.0000	0.0360	0.3600

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 7.8202 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 57.7261 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	59.2071	58.4383	57.6696	53.8260	53.0573	49.2136	49.2136	48.4449	50.7511	53.0573	54.5947	56.1322	(38)
Heat transfer coeff	116.9332	116.1644	115.3957	111.5521	110.7834	106.9397	106.9397	106.1710	108.4772	110.7834	112.3208	113.8583	(39)
Average = Sum(39)m / 12 =												111.3599	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2057	1.1978	1.1899	1.1503	1.1423	1.1027	1.1027	1.0948	1.1186	1.1423	1.1582	1.1740	(40)
HLP (average)												1.1483	
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 2.7098 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	69.6535	68.6067	67.0814	64.1629	62.0092	59.6074	58.2422	59.7560	61.4153	63.9942	66.9753	69.3866	(42a)
Hot water usage for baths	30.0765	29.6298	29.0008	27.8410	26.9726	26.0096	25.4895	26.1141	26.7942	27.8246	29.0082	29.9748	(42b)
Hot water usage for other uses	42.3806	40.8395	39.2984	37.7573	36.2161	34.6750	34.6750	36.2161	37.7573	39.2984	40.8395	42.3806	(42c)
Average daily hot water use (litres/day)												130.6316	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	142.1105	139.0760	135.3805	129.7612	125.1979	120.2920	118.4067	122.0862	125.9668	131.1171	136.8230	141.7420	(44)
Energy conte	225.0684	198.0424	208.0748	177.6366	168.5404	147.9131	143.2026	151.1682	155.3296	177.9247	194.9295	221.9337	(45)
Energy content (annual)										Total = Sum(45)m =		2169.7640	
Distribution loss (46)m = 0.15 x (45)m	33.7603	29.7064	31.2112	26.6455	25.2811	22.1870	21.4804	22.6752	23.2994	26.6887	29.2394	33.2901	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9180	(55)
Total storage loss	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(56)
If cylinder contains dedicated solar storage	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	276.7888	244.7576	259.7952	227.6886	220.2608	197.9651	194.9230	202.8886	205.3816	229.6451	244.9815	273.6541	(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	276.7888	244.7576	259.7952	227.6886	220.2608	197.9651	194.9230	202.8886	205.3816	229.6451	244.9815	273.6541	(64)
										Total per year (kWh/year) = Sum(64)m =		2778.7300	(64)
12Total per year (kWh/year)												2779	(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	116.2116	103.2212	110.5612	99.1058	97.4160	89.2227	88.9912	91.6397	91.6887	100.5363	104.8557	115.1693	(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	135.4877	135.4877	135.4877	135.4877	135.4877	135.4877	135.4877	135.4877	135.4877	135.4877	135.4877	135.4877	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	130.0785	144.0154	130.0785	134.4144	130.0785	134.4144	130.0785	130.0785	134.4144	130.0785	134.4144	130.0785	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	251.3510	253.9593	247.3866	233.3941	215.7312	199.1305	188.0402	185.4320	192.0047	205.9971	223.6601	240.2608	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.5488	36.5488	36.5488	36.5488	36.5488	36.5488	36.5488	36.5488	36.5488	36.5488	36.5488	36.5488	(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)	-108.3902	-108.3902	-108.3902	-108.3902	-108.3902	-108.3902	-108.3902	-108.3902	-108.3902	-108.3902	-108.3902	-108.3902	(71)
Water heating gains (Table 5)	156.1983	153.6030	148.6038	137.6469	130.9355	123.9204	119.6118	123.1717	127.3454	135.1294	145.6329	154.7974	(72)
Total internal gains	601.2741	615.2241	589.7151	569.1018	540.3915	521.1117	501.3768	502.3285	517.4108	534.8513	567.3537	588.7830	(73)

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6. Solar gains

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

Northeast				5.2200		11.2829		0.6300		0.7000		0.7700	17.9997 (75)
Southwest				3.5600		36.7938		0.6300		0.7000		0.7700	40.0310 (79)
Northwest				8.2000		11.2829		0.6300		0.7000		0.7700	28.2754 (81)
Solar gains	86.3061	162.3818	263.0052	394.3091	504.1213	527.9508	497.5671	411.4418	307.8130	190.4746	106.1739	72.0487 (83)	
Total gains	687.5802	777.6059	852.7204	963.4108	1044.5128	1049.0625	998.9439	913.7703	825.2239	725.3259	673.5276	660.8317 (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	43.1817	43.4675	43.7570	45.2647	45.5788	47.2170	47.2170	47.5589	46.5478	45.5788	44.9549	44.3479	
alpha	3.8788	3.8978	3.9171	4.0176	4.0386	4.1478	4.1478	4.1706	4.1032	4.0386	3.9970	3.9565	
util living area	0.9886	0.9806	0.9637	0.9095	0.7960	0.6090	0.4598	0.5155	0.7630	0.9367	0.9800	0.9902	(86)
Living	19.2678	19.4900	19.8372	20.3475	20.7255	20.9366	20.9844	20.9758	20.8350	20.3474	19.7604	19.2753	
Non living	17.9106	18.1967	18.6387	19.2876	19.7239	19.9578	19.9924	19.9944	19.8627	19.3042	18.5635	17.9369	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	20.1139	19.4900	19.8372	20.3475	20.7255	20.9366	20.9844	20.9758	20.8350	20.3474	19.7604	19.5165	(87)
Th 2	19.9154	19.9217	19.9281	19.9600	19.9664	19.9986	19.9986	20.0051	19.9857	19.9664	19.9536	19.9408	(88)
util rest of house	0.9858	0.9758	0.9542	0.8859	0.7456	0.5285	0.3603	0.4123	0.6900	0.9152	0.9741	0.9877	(89)
MIT 2	19.1162	18.1967	18.6387	19.2876	19.7239	19.9578	19.9924	19.9944	19.8627	19.3042	18.5635	18.2980	(90)
Living area fraction										fLA = Living area / (4) =		0.2077	(91)
MIT	19.3234	18.4653	18.8876	19.5077	19.9319	20.1611	20.1984	20.1982	20.0646	19.5209	18.8121	18.5511	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.3234	18.4653	18.8876	19.5077	19.9319	20.1611	20.1984	20.1982	20.0646	19.5209	18.8121	18.5511	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9838	0.9667	0.9421	0.8736	0.7438	0.5422	0.3807	0.4331	0.6963	0.9034	0.9652	0.9832	(94)
Useful gains	676.4627	751.6871	803.3577	841.6182	776.8871	568.8465	380.2518	395.7183	574.6059	655.2516	650.0696	649.7553	(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	1756.7293	1575.8035	1429.4742	1183.3149	911.9543	594.6974	384.8098	403.2608	647.0264	988.2843	1315.5088	1633.9895	(97)
Space heating kWh	803.7183	553.8062	465.8307	246.0216	100.4900	0.0000	0.0000	0.0000	0.0000	247.7764	479.1162	732.2702	(98a)
Space heating requirement - total per year (kWh/year)												3629.0297	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	803.7183	553.8062	465.8307	246.0216	100.4900	0.0000	0.0000	0.0000	0.0000	247.7764	479.1162	732.2702	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3629.0297	
Space heating per m2											(98c) / (4) =	37.4204	(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 %)												239.5986	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement	803.7183	553.8062	465.8307	246.0216	100.4900	0.0000	0.0000	0.0000	0.0000	247.7764	479.1162	732.2702	(98)
Space heating efficiency (main heating system 1)	239.5986	239.5986	239.5986	239.5986	239.5986	0.0000	0.0000	0.0000	0.0000	239.5986	239.5986	239.5986	(210)
Space heating fuel (main heating system)	335.4436	231.1392	194.4213	102.6807	41.9410	0.0000	0.0000	0.0000	0.0000	103.4131	199.9662	305.6237	(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	276.7888	244.7576	259.7952	227.6886	220.2608	197.9651	194.9230	202.8886	205.3816	229.6451	244.9815	273.6541	(64)
Efficiency of water heater												169.8084	(216)
(217)m	169.8084	169.8084	169.8084	169.8084	169.8084	169.8084	169.8084	169.8084	169.8084	169.8084	169.8084	169.8084	(217)
Fuel for water heating, kWh/month	163.0006	144.1375	152.9931	134.0855	129.7114	116.5814	114.7899	119.4809	120.9490	135.2377	144.2693	161.1546	(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	8.1205	7.3346	8.1205	7.8585	8.1205	7.8585	8.1205	8.1205	7.8585	8.1205	7.8585	8.1205	(231)
Lighting	27.0277	21.6827	19.5228	14.3033	11.0482	9.0265	10.0786	13.1005	17.0163	22.3263	25.2175	27.7789	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-27.4949	-41.9950	-65.2263	-77.6886	-86.4447	-79.9515	-78.8764	-72.3358	-61.1253	-49.2319	-31.0181	-23.2933	(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	-6.0630	-14.0036	-30.1457	-50.1287	-71.4627	-75.2967	-74.3201	-61.5128	-43.7050	-22.3549	-8.7864	-4.7889	(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	1514.6288	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	169.8084	
Water heating fuel used	1636.3909	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
(MEVDecentralised, Database: total watage = 11.9600, total flow = 37.0000, SFP = 0.3232)		
mechanical ventilation fans (SFP = 0.3232)	95.6118	(230a)
Total electricity for the above, kWh/year	95.6118	(231)
Electricity for lighting (calculated in Appendix L)	218.1293	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-1157.2504	(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	2307.5104	(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	1514.6288	0.1556	235.7013	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1636.3909	0.1410	230.6495	(264)
Space and water heating			466.3508	(265)
Pumps, fans and electric keep-hot	95.6118	0.1387	13.2625	(267)
Energy for lighting	218.1293	0.1443	31.4828	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-694.6818	0.1336	-92.7851	
PV Unit electricity exported	-462.5686	0.1230	-56.8734	
Total			-149.6585	(269)
Total CO2, kg/year			361.4377	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			3.7300	(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	1514.6288	1.5761	2387.2068	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1636.3909	1.5212	2489.2531	(278)
Space and water heating			4876.4599	(279)
Pumps, fans and electric keep-hot	95.6118	1.5128	144.6415	(281)
Energy for lighting	218.1293	1.5338	334.5740	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-694.6818	1.4936	-1037.5669	
PV Unit electricity exported	-462.5686	0.4511	-208.6870	
Total			-1246.2539	(283)
Total Primary energy kWh/year			4109.4216	(286)
Dwelling Primary energy Rate (DPER)			42.3700	(287)

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Main dwelling						
Ground floor	48.4900	(1b)	x 2.4000	(2b) =	116.3760	(1b) - (3b)
First floor	48.4900	(1c)	x 2.6000	(2c) =	126.0740	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 96.9800						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		242.4500	(5)

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2. Ventilation rate

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	m3 per hour	
Number of open chimneys	0 * 80 = 0.0000	(6a)
Number of open flues	0 * 20 = 0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000	(6d)
Number of flues attached to other heater	0 * 35 = 0.0000	(6e)
Number of blocked chimneys	0 * 20 = 0.0000	(6f)
Number of intermittent extract fans	3 * 10 = 30.0000	(7a)
Number of passive vents	0 * 10 = 0.0000	(7b)
Number of flueless gas fires	0 * 40 = 0.0000	(7c)
	Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) = 0.1237	(8)
Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design AP50	5.0000	(17)

Infiltration rate												0.3737	(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) =				0.3457	(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	0.4408	0.4321	0.4235	0.3803	0.3716	0.3284	0.3284	0.3198	0.3457	0.3716	0.3889	0.4062	(22b)
Effective ac	0.5971	0.5934	0.5897	0.5723	0.5691	0.5539	0.5539	0.5511	0.5598	0.5691	0.5756	0.5825	(25)

3. Heat losses and heat loss parameter

Element	Gross	Openings	NetArea	U-value	A x U	K-value	A x K	
	m2	m2	m2	W/m2K	W/K	kJ/m2K	kJ/K	
Main dwelling								
TER Opaque door			1.9800	1.0000	1.9800			(26)
TER Opening Type			16.9800	1.1450	19.4427			(27)
Ground Floor			48.4900	0.1300	6.3037			(28a)
Cavity Wall	113.0400	18.9600	94.0800	0.1800	16.9344			(29a)
Flat Ceiling	48.4900		48.4900	0.1100	5.3339			(30)
Total net area of external elements Aum(A, m2)			210.0200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		49.9947			(33)
Main dwelling								
Party Wall 1			28.7600	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 187.4381 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	14.0600	0.0500	0.7030
E3 Sill	11.3100	0.0500	0.5655
E4 Jamb	27.0000	0.0500	1.3500
E5 Ground floor (normal)	22.6100	0.1600	3.6176
E6 Intermediate floor within a dwelling	22.6100	0.0000	0.0000
E10 Eaves (insulation at ceiling level)	11.1000	0.0600	0.6660
E12 Gable (insulation at ceiling level)	11.5100	0.0600	0.6906
E16 Corner (normal)	20.0000	0.0900	1.8000
P1 Party wall - Ground floor	5.7500	0.0800	0.4600
P2 Party wall - Intermediate floor within a dwelling	5.7500	0.0000	0.0000
P4 Party wall - Roof (insulation at ceiling level)	5.7500	0.1200	0.6900
E25 Staggered party wall between dwellings	10.0000	0.0600	0.6000

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		11.1427	(36)
Point Thermal bridges	(36a) =	0.0000	
Total fabric heat loss	(33) + (36) + (36a) =	61.1374	(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	47.7764	47.4746	47.1788	45.7893	45.5293	44.3191	44.3191	44.0950	44.7853	45.5293	46.0552	46.6051	(38)
Heat transfer coeff	108.9139	108.6121	108.3162	106.9267	106.6668	105.4566	105.4566	105.2325	105.9227	106.6668	107.1927	107.7425	(39)
Average = Sum(39)m / 12 =												106.9255	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1231	1.1199	1.1169	1.1026	1.0999	1.0874	1.0874	1.0851	1.0922	1.0999	1.1053	1.1110	(40)
HLP (average)												1.1026	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.7098	(42)
Hot water usage for mixer showers	69.6535	68.6067	67.0814	64.1629	62.0092	59.6074	58.2422	59.7560	61.4153	63.9942	66.9753	69.3866	(42a)
Hot water usage for baths	30.0765	29.6298	29.0008	27.8410	26.9726	26.0096	25.4895	26.1141	26.7942	27.8246	29.0082	29.9748	(42b)
Hot water usage for other uses	42.3806	40.8395	39.2984	37.7573	36.2161	34.6750	34.6750	36.2161	37.7573	39.2984	40.8395	42.3806	(42c)
Average daily hot water use (litres/day)												130.6316	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	142.1105	139.0760	135.3805	129.7612	125.1979	120.2920	118.4067	122.0862	125.9668	131.1171	136.8230	141.7420	(44)
Energy conte	225.0684	198.0424	208.0748	177.6366	168.5404	147.9131	143.2026	151.1682	155.3296	177.9247	194.9295	221.9337	(45)
Energy content (annual)										Total = Sum(45)m =		2169.7640	
Distribution loss (46)m = 0.15 x (45)m	33.7603	29.7064	31.2112	26.6455	25.2811	22.1870	21.4804	22.6752	23.2994	26.6887	29.2394	33.2901	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7016	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9188	(55)
Total storage loss	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(56)
If cylinder contains dedicated solar storage	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	276.8150	244.7812	259.8214	227.7139	220.2870	197.9904	194.9492	202.9148	205.4070	229.6713	245.0068	273.6803	(62)
WWHRS	-31.8427	-28.1619	-29.4895	-24.4185	-22.7572	-19.4735	-18.2533	-19.4105	-20.1480	-23.7523	-26.9084	-31.2530	(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	244.9723	216.6193	230.3319	203.2954	197.5299	178.5169	176.6959	183.5043	185.2590	205.9190	218.0984	242.4273	(64)
										Total per year (kWh/year) = Sum(64)m =		2483.1697	(64)
12Total per year (kWh/year)												2483	(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	116.2325	103.2402	110.5822	99.1260	97.4370	89.2430	89.0121	91.6607	91.7090	100.5572	104.8759	115.1902	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	135.4877	135.4877	135.4877	135.4877	135.4877	135.4877	135.4877	135.4877	135.4877	135.4877	135.4877	135.4877	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	130.0785	144.0154	130.0785	134.4144	130.0785	134.4144	130.0785	130.0785	134.4144	130.0785	134.4144	130.0785	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	251.3510	253.9593	247.3866	233.3941	215.7312	199.1305	188.0402	185.4320	192.0047	205.9971	223.6601	240.2608	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.5488	36.5488	36.5488	36.5488	36.5488	36.5488	36.5488	36.5488	36.5488	36.5488	36.5488	36.5488	(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)													
	-108.3902	-108.3902	-108.3902	-108.3902	-108.3902	-108.3902	-108.3902	-108.3902	-108.3902	-108.3902	-108.3902	-108.3902	(71)
Water heating gains (Table 5)													
	156.2265	153.6312	148.6319	137.6751	130.9637	123.9486	119.6400	123.1999	127.3736	135.1576	145.6610	154.8256	(72)
Total internal gains													
	604.3023	618.2522	592.7433	572.1299	543.4197	521.1398	501.4050	502.3567	517.4390	537.8795	570.3818	591.8111	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	5.2200	11.2829	0.6300	0.7000	0.7700	17.9997	(75)
Southwest	3.5600	36.7938	0.6300	0.7000	0.7700	40.0310	(79)
Northwest	8.2000	11.2829	0.6300	0.7000	0.7700	28.2754	(81)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	86.3061	162.3818	263.0052	394.3091	504.1213	527.9508	497.5671	411.4418	307.8130	190.4746	106.1739	72.0487	(83)
Total gains	690.6084	780.6341	855.7486	966.4390	1047.5410	1049.0907	998.9721	913.7984	825.2520	728.3541	676.5557	663.8599	(84)

7. Mean internal temperature (heating season)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
tau	46.3612	46.4900	46.6170	47.2228	47.3378	47.8811	47.8811	47.9831	47.6704	47.3378	47.1056	46.8652	
alpha	4.0907	4.0993	4.1078	4.1482	4.1559	4.1921	4.1921	4.1989	4.1780	4.1559	4.1404	4.1243	
util living area	0.9881	0.9794	0.9607	0.9029	0.7835	0.6032	0.4543	0.5118	0.7550	0.9325	0.9789	0.9898	(86)
MIT	19.4244	19.6346	19.9608	20.4133	20.7613	20.9411	20.9858	20.9771	20.8495	20.4005	19.8477	19.3971	(87)
Th 2	19.9820	19.9846	19.9871	19.9987	20.0009	20.0111	20.0111	20.0130	20.0072	20.0009	19.9965	19.9919	(88)
util rest of house	0.9852	0.9743	0.9508	0.8786	0.7331	0.5238	0.3569	0.4099	0.6825	0.9103	0.9728	0.9873	(89)
MIT 2	18.1539	18.4219	18.8339	19.3953	19.7907	19.9732	20.0054	20.0029	19.8952	19.3933	18.7028	18.1258	(90)
Living area fraction										fLA = Living area / (4) =		0.2077	(91)
MIT	18.4177	18.6737	19.0679	19.6067	19.9923	20.1742	20.2090	20.2052	20.0934	19.6024	18.9406	18.3898	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4177	18.6737	19.0679	19.6067	19.9923	20.1742	20.2090	20.2052	20.0934	19.6024	18.9406	18.3898	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9788	0.9655	0.9392	0.8674	0.7326	0.5375	0.3768	0.4304	0.6894	0.8992	0.9641	0.9816	(94)
Useful gains	675.9627	753.7127	803.6825	838.2719	767.4051	563.8541	376.4409	393.2927	568.9393	654.9323	652.2481	651.6529	(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	1537.6147	1495.9937	1361.3121	1144.8340	884.5115	587.8338	380.5924	400.4303	634.8360	960.2598	1269.2210	1528.8469	(97)
Space heating kWh	641.0691	498.8129	414.8764	220.7247	87.1272	0.0000	0.0000	0.0000	0.0000	227.1637	444.2205	652.6324	(98a)
Space heating requirement - total per year (kWh/year)												3186.6268	
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	641.0691	498.8129	414.8764	220.7247	87.1272	0.0000	0.0000	0.0000	0.0000	227.1637	444.2205	652.6324	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3186.6268	
Space heating per m2											(98c) / (4) =	32.8586	(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	641.0691	498.8129	414.8764	220.7247	87.1272	0.0000	0.0000	0.0000	0.0000	227.1637	444.2205	652.6324	(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)	694.5494	540.4256	449.4869	239.1384	94.3956	0.0000	0.0000	0.0000	0.0000	246.1145	481.2790	707.0773	(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

	244.9723	216.6193	230.3319	203.2954	197.5299	178.5169	176.6959	183.5043	185.2590	205.9190	218.0984	242.4273 (64)
Efficiency of water heater												79.8000 (216)
(217)m	86.1148	85.8678	85.3631	84.2446	82.3548	79.8000	79.8000	79.8000	79.8000	84.2805	85.6202	86.1678 (217)
Fuel for water heating, kWh/month												
	284.4719	252.2708	269.8260	241.3156	239.8524	223.7054	221.4235	229.9552	232.1541	244.3259	254.7278	281.3432 (219)
Space cooling fuel requirement												
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041 (231)
Lighting	27.0277	21.6827	19.5228	14.3033	11.0482	9.0265	10.0786	13.1005	17.0163	22.3263	25.2175	27.7789 (232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	-44.4943	-62.2853	-88.8958	-99.2052	-106.3243	-98.9746	-97.7082	-92.5312	-83.3369	-70.8276	-48.7415	-38.5166 (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	-26.5046	-55.5961	-110.2231	-165.1637	-218.0420	-218.9904	-216.4531	-183.4633	-134.7025	-79.4272	-35.3575	-20.9748 (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	3452.4667 (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	2975.3718 (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)	218.1293 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-2396.7398 (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	4335.2280 (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	3452.4667	0.2100	725.0180	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2975.3718	0.2100	624.8281	(264)
Space and water heating			1349.8461	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	218.1293	0.1443	31.4828	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-931.8414	0.1347	-125.5643	
PV Unit electricity exported	-1464.8984	0.1260	-184.5191	
Total			-310.0834	(269)
Total CO2, kg/year			1083.1747	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			11.1700	(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	3452.4667	1.1300	3901.2874	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2975.3718	1.1300	3362.1701	(278)
Space and water heating			7263.4576	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	218.1293	1.5338	334.5740	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-931.8414	1.4980	-1395.9144	
PV Unit electricity exported	-1464.8984	0.4624	-677.3158	
Total			-2073.2302	(283)
Total Primary energy kWh/year			5654.9022	(286)
Target Primary Energy Rate (TPER)			58.3100	(287)

Building Regulations England Part L (BREL) Compliance Report

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

Date: Fri 14 Mar 2025 09:30:56

Project Information			
Assessed By	Richard Millard	Building Type	House, Semi-detached
OCDEA Registration	EES/025661	Assessment Date	2025-03-14

Dwelling Details			
Assessment Type	As designed	Total Floor Area	97 m^2
Site Reference	KV1	Plot Reference	Regulated (Baseline)
Address	40		

Client Details	
Name	Ian White
Company	Cotswold Homes Ltd
Address	West House, Yate, Bristol, BS37 5NG

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

1a Target emission rate and dwelling emission rate		
Fuel for main heating system	Mains gas	
Target carbon dioxide emission rate	*11.17 $kgCO_2/m^2$*	
Dwelling carbon dioxide emission rate	16.41 $kgCO_2/m^2$	**FAIL**
1b Target primary energy rate and dwelling primary energy		
Target primary energy	*58.31 kWh_{PE}/m^2*	
Dwelling primary energy	91.46 kWh_{PE}/m^2	**FAIL**
1c Target fabric energy efficiency and dwelling fabric energy efficiency		
Target fabric energy efficiency	*39.5 kWh/m^2*	
Dwelling fabric energy efficiency	38.9 kWh/m^2	**OK**

2a Fabric U-values				
Element	***Maximum permitted average U-Value [W/m^2K]***	**Dwelling average U-Value [W/m^2K]**	**Element with highest individual U-Value**	
External walls	*0.26*	0.18	Walls (1) (0.18)	**OK**
Party walls	*0.2*	0	Party Wall (1) (0)	**N/A**
Curtain walls	*1.6*	0	N/A	**N/A**
Floors	*0.18*	0.13	Ground Floor (0.13)	**OK**
Roofs	*0.16*	0.11	Roof (1) (0.11)	**OK**
Windows, doors, and roof windows	*1.6*	1.2	K-W01 (1.2)	**OK**
Rooflights	*2.2*	N/A	N/A	**N/A**

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))		
Name	**Net area [m^2]**	**U-Value [W/m^2K]**
Exposed wall: Walls (1)	94.08	0.18
Party wall: Party Wall (1)	28.76	0 **(!)**
Ground floor: Ground Floor , Ground Floor	48.49	0.13
Exposed roof: Roof (1)	48.49	0.11

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	**Area [m^2]**	**Orientation**	**Frame factor**	**U-Value [W/m^2K]**
K-W01, Windows/Glazed Doors	2.12	North West	0.7	1.2
K-ED01, Solid Doors	1.98	North West	N/A	1.2
K-W02, Windows/Glazed Doors	1.44	North West	0.7	1.2
K-W03, Windows/Glazed Doors	2.12	South West	0.7	1.2
K-ED02, Windows/Glazed Doors	3.78	North East	0.7	1.2
K-W04, Windows/Glazed Doors	2.12	North West	0.7	1.2
K-W05, Windows/Glazed Doors	1.26	North West	0.7	1.2
K-W06, Windows/Glazed Doors	1.26	North West	0.7	1.2
K-W07, Windows/Glazed Doors	1.44	North East	0.7	1.2
K-W09, Windows/Glazed Doors	1.44	South West	0.7	1.2

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))
Building part **1**: Thermal bridging calculated from linear thermal transmittances for each junction

Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E2: Other lintels (including other steel lintels)	Calculated by person with suitable expertise	0.05	CATNIC BROKEN LINTELS
External wall	E3: Sill	Calculated by person with suitable expertise	0.05	MPF125E301
External wall	E4: Jamb	Calculated by person with suitable expertise	0.022 **(!)**	MPF125E401
External wall	E5: Ground floor (normal)	Calculated by person with suitable expertise	0.16	MPF125E504
External wall	E6: Intermediate floor within a dwelling	Calculated by person with suitable expertise	0.003 **(!)**	MPF125E601
External wall	E10: Eaves (insulation at ceiling level)	Calculated by person with suitable expertise	0.06	MPF125E1001
External wall	E12: Gable (insulation at ceiling level)	Calculated by person with suitable expertise	0.06	MPF125E1201
External wall	E16: Corner (normal)	Calculated by person with suitable expertise	0.09	MPF125E1601
Party wall	P1: Ground floor	Calculated by person with suitable expertise	0.051	MPWP104
Party wall	P2: Intermediate floor within a dwelling	SAP table default	0 **(!)**	
Party wall	P4: Roof (insulation at ceiling level)	Calculated by person with suitable expertise	0.04	MPWP101
External wall	E25: Staggered party wall between dwellings	Calculated by person with suitable expertise	0.036 **(!)**	MPF125E2502

3 Air permeability (better than typically expected values are flagged with a subsequent (!))		
Maximum permitted air permeability at 50Pa	*8 m^3/hm^2*	
Dwelling air permeability at 50Pa	5.01 m^3/hm^2, Design value	OK
Air permeability test certificate reference		

4 Space heating	
Main heating system 1: Boiler with radiators or underfloor heating - Mains gas	
Efficiency	88.6%
Emitter type	Radiators
Flow temperature	45°C
System type	Regular boiler
Manufacturer	Bosch Thermotechnology
Model	Greenstar 8000 Life
Commissioning	
Secondary heating system: N/A	
Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water	
Cylinder/store - type: Cylinder	
Capacity	210 litres
Declared heat loss	1.7 kWh/day
Primary pipework insulated	Yes
Manufacturer	
Model	
Commissioning	
Waste water heat recovery system 1 - type: N/A	
Efficiency	
Manufacturer	
Model	

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

Water heating - type: Cylinder thermostat and HW separately timed	
Manufacturer	
Model	

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

8 Mechanical ventilation		
System type: Decentralised mechanical extract		
Maximum permitted specific fan power	*0.7 W/(l/s)*	
Specific fan power	0.32 W/(l/s)	**OK**
Minimum permitted heat recovery efficiency	*N/A*	
Heat recovery efficiency	N/A	**N/A**
Manufacturer/Model	Eco dMEV+	
Commissioning		

9 Local generation
N/A

10 Heat networks
N/A

11 Supporting documentary evidence
N/A

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

Full SAP Calculation Printout

Property Reference	KV1	**Issued on Date**	14/03/2025
Assessment Reference	Regulated (Baseline)	**Prop Type Ref**	Proposed 40
Property	40		

SAP Rating	83 B	**DER**	16.41	**TER**	11.17
Environmental	85 B	**% DER < TER**			-46.91
CO_2 Emissions (t/year)	1.47	**DFEE**	38.91	**TFEE**	39.53
Compliance Check	See BREL	**% DFEE < TFEE**			1.55
% DPER < TPER	-56.85	**DPER**	91.46	**TPER**	58.31

Assessor Details	Mr. Richard Millard	**Assessor ID**	U367-0001
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)	
Main dwelling						
Ground floor	48.4900 (1b)	x	2.4000 (2b)	=	116.3760	(1b) - (3b)
First floor	48.4900 (1c)	x	2.6000 (2c)	=	126.0740	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	96.9800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	242.4500	(5)

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2. Ventilation rate

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				m3 per hour	
Number of open chimneys			0 * 80 =	0.0000	(6a)
Number of open flues			0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire			0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler			0 * 20 =	0.0000	(6d)
Number of flues attached to other heater			0 * 35 =	0.0000	(6e)
Number of blocked chimneys			0 * 20 =	0.0000	(6f)
Number of intermittent extract fans			4 * 10 =	40.0000	(7a)
Number of passive vents			0 * 10 =	0.0000	(7b)
Number of flueless gas fires			0 * 40 =	0.0000	(7c)
				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =			40.0000 / (5) =	0.1650	(8)
Pressure test				Yes	
Pressure Test Method				Blower Door	
Measured/design AP50				5.0100	(17)
Infiltration rate				0.4155	(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) =	0.3843	(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	0.4900	0.4804	0.4708	0.4228	0.4131	0.3651	0.3651	0.3555	0.3843	0.4131	0.4324	0.4516	(22b)

Mechanical extract ventilation - decentralised

If mechanical ventilation	0.5000	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000	(23b)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.7400	0.7304	0.7208	0.6728	0.6631	0.6151	0.6151	0.6055	0.6343	0.6631	0.6824	0.7016	(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	
Main dwelling								
Windows/Glazed Doors			16.9800	1.1450	19.4427			(27)
Solid Doors			1.9800	1.2000	2.3760			(26)
Ground Floor			48.4900	0.1300	6.3037	75.0000	3636.7500	(28a)
Cavity Wall	113.0400	18.9600	94.0800	0.1800	16.9344	60.0000	5644.8000	(29a)
Flat Ceiling	48.4900		48.4900	0.1100	5.3339	9.0000	436.4100	(30)
Total net area of external elements Aum(A, m2)			210.0200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		50.3907			(33)
Main dwelling								
Party Wall 1			28.7600	0.0000	0.0000	45.0000	1294.2000	(32)
Internal Wall 2			190.2900			9.0000	1712.6100	(32c)
Internal Wall 2			55.2500			75.0000	4143.7500	(32c)
Internal Floor 1			48.4900			18.0000	872.8200	(32d)
Internal Ceiling 1			48.4900			9.0000	436.4100	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		18177.7500	(34)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 187.4381 (35)
List of Thermal Bridges

	K1 Element	Length	Psi-value	Total
E2	Other lintels (including other steel lintels)	14.0600	0.0500	0.7030
E3	Sill	11.3100	0.0500	0.5655
E4	Jamb	27.0000	0.0220	0.5940
E5	Ground floor (normal)	22.6100	0.1600	3.6176
E6	Intermediate floor within a dwelling	22.6100	0.0030	0.0678
E10	Eaves (insulation at ceiling level)	11.1000	0.0600	0.6660
E12	Gable (insulation at ceiling level)	11.5100	0.0600	0.6906
E16	Corner (normal)	20.0000	0.0900	1.8000
P1	Party wall - Ground floor	5.7500	0.0510	0.2932
P2	Party wall - Intermediate floor within a dwelling	5.7500	0.0000	0.0000
P4	Party wall - Roof (insulation at ceiling level)	5.7500	0.0400	0.2300
E25	Staggered party wall between dwellings	10.0000	0.0360	0.3600

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 9.5878 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 59.9785 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	59.2071	58.4383	57.6696	53.8260	53.0573	49.2136	49.2136	48.4449	50.7511	53.0573	54.5947	56.1322	(38)
Heat transfer coeff	119.1856	118.4169	117.6481	113.8045	113.0358	109.1922	109.1922	108.4234	110.7296	113.0358	114.5732	116.1107	(39)

Average = Sum(39)m / 12 = 113.6123

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2290	1.2210	1.2131	1.1735	1.1656	1.1259	1.1259	1.1180	1.1418	1.1656	1.1814	1.1973	(40)
HLP (average)												1.1715	
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 2.7098 (42)
Hot water usage for mixer showers

69.6535	68.6067	67.0814	64.1629	62.0092	59.6074	58.2422	59.7560	61.4153	63.9942	66.9753	69.3866	(42a)

Hot water usage for baths

30.0765	29.6298	29.0008	27.8410	26.9726	26.0096	25.4895	26.1141	26.7942	27.8246	29.0082	29.9748	(42b)

Hot water usage for other uses

42.3806	40.8395	39.2984	37.7573	36.2161	34.6750	34.6750	36.2161	37.7573	39.2984	40.8395	42.3806	(42c)

Average daily hot water use (litres/day) 130.6316 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	142.1105	139.0760	135.3805	129.7612	125.1979	120.2920	118.4067	122.0862	125.9668	131.1171	136.8230	141.7420	(44)
Energy conte	225.0684	198.0424	208.0748	177.6366	168.5404	147.9131	143.2026	151.1682	155.3296	177.9247	194.9295	221.9337	(45)

Energy content (annual) Total = Sum(45)m = 2169.7640

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

33.7603	29.7064	31.2112	26.6455	25.2811	22.1870	21.4804	22.6752	23.2994	26.6887	29.2394	33.2901	(46)

Water storage loss:
Store volume 210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.7000 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 0.9180 (55)
Total storage loss

28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(56)

If cylinder contains dedicated solar storage

28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(57)
Primary loss 23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)

Total heat required for water heating calculated for each month

276.7888	244.7576	259.7952	227.6886	220.2608	197.9651	194.9230	202.8886	205.3816	229.6451	244.9815	273.6541	(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

276.7888	244.7576	259.7952	227.6886	220.2608	197.9651	194.9230	202.8886	205.3816	229.6451	244.9815	273.6541	(64)

Total per year (kWh/year) = Sum(64)m = 2778.7300 (64)
12Total per year (kWh/year) 2779 (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

116.2116	103.2212	110.5612	99.1058	97.4160	89.2227	88.9912	91.6397	91.6887	100.5363	104.8557	115.1693	(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	135.4877	135.4877	135.4877	135.4877	135.4877	135.4877	135.4877	135.4877	135.4877	135.4877	135.4877	135.4877	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	130.0785	144.0154	130.0785	134.4144	130.0785	134.4144	130.0785	130.0785	134.4144	130.0785	134.4144	130.0785	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	251.3510	253.9593	247.3866	233.3941	215.7312	199.1305	188.0402	185.4320	192.0047	205.9971	223.6601	240.2607	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.5488	36.5488	36.5488	36.5488	36.5488	36.5488	36.5488	36.5488	36.5488	36.5488	36.5488	36.5488	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-108.3902	-108.3902	-108.3902	-108.3902	-108.3902	-108.3902	-108.3902	-108.3902	-108.3902	-108.3902	-108.3902	-108.3902	(71)
Water heating gains (Table 5)	156.1983	153.6030	148.6038	137.6469	130.9355	123.9204	119.6118	123.1717	127.3454	135.1294	145.6329	154.7974	(72)
Total internal gains	604.2741	618.2241	592.7151	572.1018	543.3915	521.1116	501.3768	502.3285	517.4108	537.8513	570.3537	591.7829	(73)

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6. Solar gains

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

Northeast				5.2200		11.2829		0.6300		0.7000		0.7700	17.9997 (75)
Southwest				3.5600		36.7938		0.6300		0.7000		0.7700	40.0310 (79)
Northwest				8.2000		11.2829		0.6300		0.7000		0.7700	28.2754 (81)
Solar gains	86.3061	162.3818	263.0052	394.3091	504.1213	527.9508	497.5671	411.4418	307.8130	190.4746	106.1739	72.0487	(83)
Total gains	690.5802	780.6059	855.7204	966.4108	1047.5128	1049.0625	998.9439	913.7702	825.2238	728.3259	676.5276	663.8317	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	42.3657	42.6407	42.9193	44.3688	44.6706	46.2430	46.2430	46.5709	45.6009	44.6706	44.0712	43.4876	
alpha	3.8244	3.8427	3.8613	3.9579	3.9780	4.0829	4.0829	4.1047	4.0401	3.9780	3.9381	3.8992	
util living area	0.9885	0.9806	0.9640	0.9112	0.8005	0.6177	0.4681	0.5242	0.7696	0.9376	0.9800	0.9901	(86)
MIT	19.2297	19.4527	19.8032	20.3196	20.7080	20.9295	20.9822	20.9726	20.8220	20.3235	19.7281	19.2367	(87)
Th 2	19.8969	19.9032	19.9095	19.9413	19.9477	19.9797	19.9797	19.9862	19.9669	19.9477	19.9349	19.9222	(88)
util rest of house	0.9856	0.9758	0.9546	0.8878	0.7501	0.5356	0.3654	0.4181	0.6963	0.9161	0.9741	0.9876	(89)
MIT 2	17.8502	18.1371	18.5834	19.2402	19.6894	19.9343	19.9726	19.9741	19.8339	19.2616	18.5101	17.8755	(90)
Living area fraction										fLA = Living area / (4) =		0.2077	(91)
MIT	18.1367	18.4103	18.8367	19.4644	19.9010	20.1410	20.1822	20.1814	20.0391	19.4821	18.7630	18.1582	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9867	18.2603	18.6867	19.3144	19.7510	19.9910	20.0322	20.0314	19.8891	19.3321	18.6130	18.0082	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9781	0.9653	0.9402	0.8707	0.7394	0.5365	0.3709	0.4230	0.6900	0.8997	0.9635	0.9809	(94)
Useful gains	675.4661	753.5298	804.5294	841.4292	774.5264	562.8696	370.4671	386.5630	569.3999	655.2624	651.8503	651.1685	(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	1631.2582	1582.0866	1433.7412	1185.2049	910.0468	588.6502	374.7738	393.7329	641.0240	987.0408	1319.0865	1603.2801	(97)
Space heating kWh	711.1093	556.7901	468.1336	247.5185	100.8272	0.0000	0.0000	0.0000	0.0000	246.8431	480.4101	708.3710	(98a)
Space heating requirement - total per year (kWh/year)												3520.0030	
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	711.1093	556.7901	468.1336	247.5185	100.8272	0.0000	0.0000	0.0000	0.0000	246.8431	480.4101	708.3710	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3520.0030	
Space heating per m2											(98c) / (4) =	36.2962	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												88.6000	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement	711.1093	556.7901	468.1336	247.5185	100.8272	0.0000	0.0000	0.0000	0.0000	246.8431	480.4101	708.3710	(98)
Space heating efficiency (main heating system 1)	88.6000	88.6000	88.6000	88.6000	88.6000	0.0000	0.0000	0.0000	0.0000	88.6000	88.6000	88.6000	(210)
Space heating fuel (main heating system)	802.6065	628.4313	528.3675	279.3663	113.8004	0.0000	0.0000	0.0000	0.0000	278.6039	542.2236	799.5158	(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	276.7888	244.7576	259.7952	227.6886	220.2608	197.9651	194.9230	202.8886	205.3816	229.6451	244.9815	273.6541	(64)
Efficiency of water heater												79.6000	(216)
(217)m	85.8795	85.6432	85.1634	84.0469	82.2227	79.6000	79.6000	79.6000	79.6000	84.0215	85.3413	85.8937	(217)
Fuel for water heating, kWh/month	322.2991	285.7877	305.0549	270.9067	267.8831	248.6998	244.8781	254.8852	258.0171	273.3171	287.0610	318.5961	(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	15.4246	13.9319	15.4246	14.9270	15.4246	14.9270	15.4246	15.4246	14.9270	15.4246	14.9270	15.4246	(231)
Lighting	27.0277	21.6827	19.5228	14.3033	11.0482	9.0265	10.0786	13.1005	17.0163	22.3263	25.2175	27.7789	(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												3972.9154	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												79.6000	
Water heating fuel used												3337.3860	(219)

Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
(MEVDecentralised, Database: total watage = 11.9600, total flow = 37.0000, SFP = 0.3232)		
mechanical ventilation fans (SFP = 0.3232)	95.6118	(230a)
central heating pump	41.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	181.6118	(231)
Electricity for lighting (calculated in Appendix L)	218.1293	(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	7710.0425	(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	3972.9154	0.2100	834.3122	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3337.3860	0.2100	700.8511	(264)
Space and water heating			1535.1633	(265)
Pumps, fans and electric keep-hot	181.6118	0.1387	25.1918	(267)
Energy for lighting	218.1293	0.1443	31.4828	(268)
Total CO2, kg/year			1591.8379	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			16.4100	(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	3972.9154	1.1300	4489.3943	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3337.3860	1.1300	3771.2462	(278)
Space and water heating			8260.6405	(279)
Pumps, fans and electric keep-hot	181.6118	1.5128	274.7423	(281)
Energy for lighting	218.1293	1.5338	334.5740	(282)
Total Primary energy kWh/year			8869.9569	(286)
Dwelling Primary energy Rate (DPER)			91.4600	(287)

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Main dwelling						
Ground floor	48.4900 (1b)	x	2.4000 (2b)	=	116.3760	(1b) - (3b)
First floor	48.4900 (1c)	x	2.6000 (2c)	=	126.0740	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	96.9800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	242.4500	(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) =	0.1237 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.3737 (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) =	0.3457 (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	0.4408	0.4321	0.4235	0.3803	0.3716	0.3284	0.3284	0.3198	0.3457	0.3716	0.3889	0.4062	(22b)
Effective ac	0.5971	0.5934	0.5897	0.5723	0.5691	0.5539	0.5539	0.5511	0.5598	0.5691	0.5756	0.5825	(25)

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3. Heat losses and heat loss parameter

Element	Gross	Openings	NetArea	U-value	A x U	K-value	A x K	
Main dwelling	m2	m2	m2	W/m2K	W/K	kJ/m2K	kJ/K	
TER Opaque door			1.9800	1.0000	1.9800			(26)
TER Opening Type			16.9800	1.1450	19.4427			(27)
Ground Floor			48.4900	0.1300	6.3037			(28a)
Cavity Wall	113.0400	18.9600	94.0800	0.1800	16.9344			(29a)
Flat Ceiling	48.4900		48.4900	0.1100	5.3339			(30)
Total net area of external elements Aum(A, m2)			210.0200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		49.9947			(33)
Main dwelling								
Party Wall 1			28.7600	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 187.4381 (35)

List of Thermal Bridges

	Length	Psi-value	Total	
K1 Element				
E2 Other lintels (including other steel lintels)	14.0600	0.0500	0.7030	
E3 Sill	11.3100	0.0500	0.5655	
E4 Jamb	27.0000	0.0500	1.3500	
E5 Ground floor (normal)	22.6100	0.1600	3.6176	
E6 Intermediate floor within a dwelling	22.6100	0.0000	0.0000	
E10 Eaves (insulation at ceiling level)	11.1000	0.0600	0.6660	
E12 Gable (insulation at ceiling level)	11.5100	0.0600	0.6906	
E16 Corner (normal)	20.0000	0.0900	1.8000	
P1 Party wall - Ground floor	5.7500	0.0800	0.4600	
P2 Party wall - Intermediate floor within a dwelling	5.7500	0.0000	0.0000	
P4 Party wall - Roof (insulation at ceiling level)	5.7500	0.1200	0.6900	
E25 Staggered party wall between dwellings	10.0000	0.0600	0.6000	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 11.1427 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 61.1374 (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	47.7764	47.4746	47.1788	45.7893	45.5293	44.3191	44.3191	44.0950	44.7853	45.5293	46.0552	46.6051	(38)
Heat transfer coeff	108.9139	108.6121	108.3162	106.9267	106.6668	105.4566	105.4566	105.2325	105.9227	106.6668	107.1927	107.7425	(39)

Average = Sum(39)m / 12 = 106.9255

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1231	1.1199	1.1169	1.1026	1.0999	1.0874	1.0874	1.0851	1.0922	1.0999	1.1053	1.1110	(40)
HLP (average)												1.1026	
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 2.7098 (42)

Hot water usage for mixer showers

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
69.6535	68.6067	67.0814	64.1629	62.0092	59.6074	58.2422	59.7560	61.4153	63.9942	66.9753	69.3866	(42a)

Hot water usage for baths

30.0765	29.6298	29.0008	27.8410	26.9726	26.0096	25.4895	26.1141	26.7942	27.8246	29.0082	29.9748	(42b)

Hot water usage for other uses

42.3806	40.8395	39.2984	37.7573	36.2161	34.6750	34.6750	36.2161	37.7573	39.2984	40.8395	42.3806	(42c)

Average daily hot water use (litres/day) 130.6316 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	142.1105	139.0760	135.3805	129.7612	125.1979	120.2920	118.4067	122.0862	125.9668	131.1171	136.8230	141.7420	(44)
Energy conte	225.0684	198.0424	208.0748	177.6366	168.5404	147.9131	143.2026	151.1682	155.3296	177.9247	194.9295	221.9337	(45)
Energy content (annual)										Total = Sum(45)m =		2169.7640	
Distribution loss (46)m = 0.15 x (45)m	33.7603	29.7064	31.2112	26.6455	25.2811	22.1870	21.4804	22.6752	23.2994	26.6887	29.2394	33.2901	(46)

Water storage loss:

Store volume 210.0000 (47)

a) If manufacturer declared loss factor is known (kWh/day): 1.7016 (48)

Temperature factor from Table 2b 0.5400 (49)

Enter (49) or (54) in (55) 0.9188 (55)

Total storage loss

28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(56)

If cylinder contains dedicated solar storage

28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(57)
Primary loss 23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)

Total heat required for water heating calculated for each month

276.8150	244.7812	259.8214	227.7139	220.2870	197.9904	194.9492	202.9148	205.4070	229.6713	245.0068	273.6803	(62)
WWHRS -31.8427	-28.1619	-29.4895	-24.4185	-22.7572	-19.4735	-18.2533	-19.4105	-20.1480	-23.7523	-26.9084	-31.2530	(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

244.9723	216.6193	230.3319	203.2954	197.5299	178.5169	176.6959	183.5043	185.2590	205.9190	218.0984	242.4273	(64)
								Total per year (kWh/year) = Sum(64)m =			2483.1697	(64)
12Total per year (kWh/year)											2483	(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

116.2325	103.2402	110.5822	99.1260	97.4370	89.2430	89.0121	91.6607	91.7090	100.5572	104.8759	115.1902	(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	135.4877	135.4877	135.4877	135.4877	135.4877	135.4877	135.4877	135.4877	135.4877	135.4877	135.4877	135.4877	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	130.0785	144.0154	130.0785	134.4144	130.0785	134.4144	130.0785	130.0785	134.4144	130.0785	134.4144	130.0785	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	251.3510	253.9593	247.3866	233.3941	215.7312	199.1305	188.0402	185.4320	192.0047	205.9971	223.6601	240.2607	(68)

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

	36.5488	36.5488	36.5488	36.5488	36.5488	36.5488	36.5488	36.5488	36.5488	36.5488	36.5488	36.5488	(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)													
	-108.3902	-108.3902	-108.3902	-108.3902	-108.3902	-108.3902	-108.3902	-108.3902	-108.3902	-108.3902	-108.3902	-108.3902	(71)
Water heating gains (Table 5)													
	156.2265	153.6312	148.6319	137.6751	130.9637	123.9486	119.6400	123.1999	127.3736	135.1576	145.6610	154.8256	(72)
Total internal gains													
	604.3023	618.2522	592.7433	572.1299	543.4196	521.1398	501.4050	502.3566	517.4390	537.8795	570.3818	591.8111	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	5.2200	11.2829	0.6300	0.7000	0.7700	17.9997	(75)
Southwest	3.5600	36.7938	0.6300	0.7000	0.7700	40.0310	(79)
Northwest	8.2000	11.2829	0.6300	0.7000	0.7700	28.2754	(81)

Solar gains	86.3061	162.3818	263.0052	394.3091	504.1213	527.9508	497.5671	411.4418	307.8130	190.4746	106.1739	72.0487	(83)
Total gains	690.6083	780.6340	855.7485	966.4390	1047.5410	1049.0907	998.9721	913.7984	825.2520	728.3541	676.5557	663.8598	(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	46.3612	46.4900	46.6170	47.2228	47.3378	47.8811	47.8811	47.9831	47.6704	47.3378	47.1056	46.8652	
alpha	4.0907	4.0993	4.1078	4.1482	4.1559	4.1921	4.1921	4.1989	4.1780	4.1559	4.1404	4.1243	
util living area	0.9881	0.9794	0.9607	0.9029	0.7835	0.6032	0.4543	0.5118	0.7550	0.9325	0.9789	0.9898	(86)
MIT	19.4244	19.6346	19.9608	20.4133	20.7613	20.9411	20.9858	20.9771	20.8495	20.4005	19.8477	19.3971	(87)
Th 2	19.9820	19.9846	19.9871	19.9987	20.0009	20.0111	20.0111	20.0130	20.0072	20.0009	19.9965	19.9919	(88)
util rest of house	0.9852	0.9743	0.9508	0.8786	0.7331	0.5238	0.3569	0.4099	0.6825	0.9103	0.9728	0.9873	(89)
MIT 2	18.1539	18.4219	18.8339	19.3953	19.7907	19.9732	20.0054	20.0029	19.8952	19.3933	18.7028	18.1258	(90)
Living area fraction										fLA = Living area / (4) =		0.2077	(91)
MIT	18.4177	18.6737	19.0679	19.6067	19.9923	20.1742	20.2090	20.2052	20.0934	19.6024	18.9406	18.3898	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4177	18.6737	19.0679	19.6067	19.9923	20.1742	20.2090	20.2052	20.0934	19.6024	18.9406	18.3898	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9788	0.9655	0.9392	0.8674	0.7326	0.5375	0.3768	0.4304	0.6894	0.8992	0.9641	0.9816	(94)
Useful gains	675.9627	753.7127	803.6825	838.2719	767.4051	563.8541	376.4409	393.2927	568.9393	654.9323	652.2481	651.6529	(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	1537.6147	1495.9937	1361.3121	1144.8340	884.5115	587.8338	380.5924	400.4303	634.8360	960.2598	1269.2210	1528.8469	(97)
Space heating kWh	641.0691	498.8128	414.8764	220.7247	87.1272	0.0000	0.0000	0.0000	0.0000	227.1637	444.2205	652.6323	(98a)
Space heating requirement - total per year (kWh/year)												3186.6268	
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	641.0691	498.8128	414.8764	220.7247	87.1272	0.0000	0.0000	0.0000	0.0000	227.1637	444.2205	652.6323	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3186.6268	
Space heating per m2											(98c) / (4) =	32.8586	(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	641.0691	498.8128	414.8764	220.7247	87.1272	0.0000	0.0000	0.0000	0.0000	227.1637	444.2205	652.6323	(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)	694.5494	540.4256	449.4869	239.1384	94.3956	0.0000	0.0000	0.0000	0.0000	246.1145	481.2790	707.0773	(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	244.9723	216.6193	230.3319	203.2954	197.5299	178.5169	176.6959	183.5043	185.2590	205.9190	218.0984	242.4273	(64)
Efficiency of water heater												79.8000	(216)
(217)m	86.1148	85.8678	85.3631	84.2446	82.3548	79.8000	79.8000	79.8000	79.8000	84.2805	85.6202	86.1678	(217)
Fuel for water heating, kWh/month	284.4719	252.2708	269.8260	241.3156	239.8524	223.7054	221.4235	229.9552	232.1541	244.3259	254.7278	281.3432	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	27.0277	21.6827	19.5228	14.3033	11.0482	9.0265	10.0786	13.1005	17.0163	22.3263	25.2175	27.7789	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-44.4943	-62.2853	-88.8958	-99.2052	-106.3243	-98.9746	-97.7082	-92.5312	-83.3369	-70.8276	-48.7415	-38.5166	(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	-26.5046	-55.5961	-110.2231	-165.1637	-218.0420	-218.9904	-216.4531	-183.4633	-134.7025	-79.4272	-35.3575	-20.9748	(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	3452.4667	(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	2975.3718	(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)	218.1293	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-2396.7397	(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	4335.2280	(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	3452.4667	0.2100	725.0180	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2975.3718	0.2100	624.8281	(264)
Space and water heating			1349.8461	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	218.1293	0.1443	31.4828	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-931.8414	0.1347	-125.5643	
PV Unit electricity exported	-1464.8983	0.1260	-184.5191	
Total			-310.0834	(269)
Total CO2, kg/year			1083.1747	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			11.1700	(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	3452.4667	1.1300	3901.2874	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2975.3718	1.1300	3362.1701	(278)
Space and water heating			7263.4575	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	218.1293	1.5338	334.5740	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-931.8414	1.4980	-1395.9143	
PV Unit electricity exported	-1464.8983	0.4624	-677.3158	
Total			-2073.2302	(283)
Total Primary energy kWh/year			5654.9021	(286)
Target Primary Energy Rate (TPER)			58.3100	(287)

Building Regulations England Part L (BREL) Compliance Report

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

Date: Fri 14 Mar 2025 09:30:50

Project Information			
Assessed By	Richard Millard	Building Type	House, Semi-detached
OCDEA Registration	EES/025661	Assessment Date	2025-03-14

Dwelling Details			
Assessment Type	As designed	Total Floor Area	97 m^2
Site Reference	M	Plot Reference	Proposed
Address	9		

Client Details	
Name	Ian White
Company	Cotswold Homes Ltd
Address	West House, Yate, Bristol, BS37 5NG

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

1a Target emission rate and dwelling emission rate		
Fuel for main heating system	Electricity	
Target carbon dioxide emission rate	*10.29 $kgCO_2/m^2$*	
Dwelling carbon dioxide emission rate	3.08 $kgCO_2/m^2$	OK
1b Target primary energy rate and dwelling primary energy		
Target primary energy	*53.55 kWh_{PE}/m^2*	
Dwelling primary energy	35.54 kWh_{PE}/m^2	OK
1c Target fabric energy efficiency and dwelling fabric energy efficiency		
Target fabric energy efficiency	*35.5 kWh/m^2*	
Dwelling fabric energy efficiency	33.9 kWh/m^2	OK

2a Fabric U-values				
Element	***Maximum permitted average U-Value [W/m^2K]***	**Dwelling average U-Value [W/m^2K]**	**Element with highest individual U-Value**	
External walls	*0.26*	0.18	Walls (1) (0.18)	OK
Party walls	*0.2*	0	Party Wall (1) (0)	**N/A**
Curtain walls	*1.6*	0	N/A	**N/A**
Floors	*0.18*	0.12	Heatloss Floor 1 (0.12)	OK
Roofs	*0.16*	0.11	Roof (1) (0.11)	OK
Windows, doors, and roof windows	*1.6*	1.2	WG01 (1.2)	OK
Rooflights	*2.2*	N/A	N/A	**N/A**

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))		
Name	**Net area [m^2]**	**U-Value [W/m^2K]**
Exposed wall: Walls (1)	81.93	0.18
Party wall: Party Wall (1)	43.82	0 **(!)**
Ground floor: Heatloss Floor 1, Heatloss Floor 1	48.37	0.12
Exposed roof: Roof (1)	48.37	0.11

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	**Area [m^2]**	**Orientation**	**Frame factor**	**U-Value [W/m^2K]**
WG01, Windows	2.19	North East	0.7	1.2
WG02, Windows	0.59	North East	0.7	1.2
WG03, Windows	1.46	North West	0.7	1.2
FG01, Windows	2.16	North East	0.7	1.2
FG02, Windows	1.08	North East	0.7	1.2
FG03, Windows	0.74	North West	0.7	1.2
FG04, Windows	1.43	South West	0.7	1.2
FG05, Windows	1.43	South West	0.7	1.2
ED01, Doors	2.04	North East	N/A	1.2
ED02, Glazed Doors	5.08	South West	0.7	1.2
WG04, Windows	1.44	South West	0.7	1.2

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))				
Building part **1**: Thermal bridging calculated from linear thermal transmittances for each junction				
Main element	**Junction detail**	**Source**	**Psi value [W/mK]**	**Drawing / reference**
External wall	E1: Steel lintel with perforated steel base plate	Calculated by person with suitable expertise	0.241	EMPF125E101
External wall	E3: Sill	Calculated by person with suitable expertise	0.026 **(!)**	EMPF125E301
External wall	E4: Jamb	Calculated by person with suitable expertise	0.02 **(!)**	EMPF125E401
External wall	E5: Ground floor (normal)	Calculated by person with suitable expertise	0.045	EMPF125E504
External wall	E6: Intermediate floor within a dwelling	Calculated by person with suitable expertise	0.002 **(!)**	EMPF125E601
External wall	E10: Eaves (insulation at ceiling level)	Calculated by person with suitable expertise	0.05	EMPF125E1001
External wall	E12: Gable (insulation at ceiling level)	Calculated by person with suitable expertise	0.031 **(!)**	EMPF125E1201
External wall	E16: Corner (normal)	Calculated by person with suitable expertise	0.037 **(!)**	EMPF125E21601
External wall	E17: Corner (inverted - internal area greater than external area)	Calculated by person with suitable expertise	-0.09	EMPF125E21701
External wall	E18: Party wall between dwellings	Calculated by person with suitable expertise	0.06	EMPF125E21802

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

4 Space heating	
Main heating system 1: Heat pump with radiators or underfloor heating - Electricity	
Efficiency	239.2%
Emitter type	Radiators
Flow temperature	55°C
System type	Heat Pump
Manufacturer	Daikin Europe NV
Model	EDLA08EV3
Commissioning	
Secondary heating system: N/A	
Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water	
Cylinder/store - type: Cylinder	
Capacity	210 litres
Declared heat loss	1.7 kWh/day
Primary pipework insulated	Yes
Manufacturer	
Model	
Commissioning	
Waste water heat recovery system 1 - type: N/A	
Efficiency	
Manufacturer	
Model	

6 Controls	
Main heating 1 - type: Time and temperature zone control by arrangement of plumbing and electrical services	
Function	
Ecodesign class	
Manufacturer	
Model	
Water heating - type: Cylinder thermostat and HW separately timed	
Manufacturer	
Model	

7 Lighting		
Minimum permitted light source efficacy	*75 lm/W*	
Lowest light source efficacy	85 lm/W	OK
External lights control	N/A	

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

9 Local generation	
Technology type: **Photovoltaic system (1)**	
Peak power	1.34 kWp
Orientation	South West
Pitch	30°
Overshading	None or very little
Manufacturer	
MCS certificate	

10 Heat networks
N/A

11 Supporting documentary evidence
N/A

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

Full SAP Calculation Printout

Property Reference	M	**Issued on Date**	14/03/2025
Assessment Reference	Proposed	**Prop Type Ref**	Proposed 9
Property	9		

SAP Rating	86 B	**DER**	3.08	**TER**	10.29
Environmental	97 A	**% DER < TER**			70.07
CO_2 Emissions (t/year)	0.27	**DFEE**	33.89	**TFEE**	35.50
Compliance Check	See BREL	**% DFEE < TFEE**			4.52
% DPER < TPER	33.63	**DPER**	35.54	**TPER**	53.55

Assessor Details	Mr. Richard Millard	**Assessor ID**	U367-0001
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)	
Main dwelling						
Ground floor	48.3000 (1b)	x	2.4000 (2b)	=	115.9200	(1b) - (3b)
First floor	48.3700 (1c)	x	2.6000 (2c)	=	125.7620	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	96.6700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	241.6820	(5)

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2. Ventilation rate

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			m3 per hour	
Number of open chimneys		0 * 80 =	0.0000	(6a)
Number of open flues		0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire		0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler		0 * 20 =	0.0000	(6d)
Number of flues attached to other heater		0 * 35 =	0.0000	(6e)
Number of blocked chimneys		0 * 20 =	0.0000	(6f)
Number of intermittent extract fans		3 * 10 =	30.0000	(7a)
Number of passive vents		0 * 10 =	0.0000	(7b)
Number of flueless gas fires		0 * 40 =	0.0000	(7c)
		Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =		30.0000 / (5) =	0.1241	(8)
Pressure test			Yes	
Pressure Test Method			Blower Door	
Measured/design AP50			5.0000	(17)
Infiltration rate			0.3741	(18)
Number of sides sheltered			2	(19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor		(21) = (18) x (20) =	0.3180	(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	0.4055	0.3975	0.3896	0.3498	0.3419	0.3021	0.3021	0.2942	0.3180	0.3419	0.3578	0.3737	(22b)
Effective ac	0.5822	0.5790	0.5759	0.5612	0.5584	0.5456	0.5456	0.5433	0.5506	0.5584	0.5640	0.5698	(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	
Main dwelling								
Windows			12.5200	1.1450	14.3359			(27)
Glazed Doors			5.0800	1.1450	5.8168			(27)
Doors			2.0400	1.2000	2.4480			(26)
Heatloss Floor 1			48.3700	0.1200	5.8044	75.0000	3627.7500	(28a)
Cavity Wall	101.5700	19.6400	81.9300	0.1800	14.7474	60.0000	4915.8000	(29a)
External Roof 1	48.3700		48.3700	0.1100	5.3207	9.0000	435.3300	(30)
Total net area of external elements Aum(A, m2)			198.3100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		48.4732			(33)
Main dwelling								
Party Wall 1			43.8200	0.0000	0.0000	45.0000	1971.9000	(32)
Internal Wall 2 - Stud			77.0000			9.0000	693.0000	(32c)
Internal Wall 3 - Up			135.3000			9.0000	1217.7000	(32c)
Internal Floor 1			48.3700			18.0000	870.6600	(32d)
Internal Ceiling 1			48.3700			9.0000	435.3300	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	14167.4700 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		146.5550 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total

E1 Steel lintel with perforated steel base plate	13.8000	0.2410	3.3258
E3 Sill	10.4200	0.0260	0.2709
E4 Jamb	30.0200	0.0200	0.6004
E5 Ground floor (normal)	29.0800	0.0450	1.3086
E6 Intermediate floor within a dwelling	29.0800	0.0020	0.0582
E10 Eaves (insulation at ceiling level)	14.5400	0.0500	0.7270
E12 Gable (insulation at ceiling level)	2.8200	0.0310	0.0874
E16 Corner (normal)	20.0000	0.0370	0.7400
E17 Corner (inverted - internal area greater than external area)	5.0000	-0.0900	-0.4500
E18 Party wall between dwellings	8.7600	0.0600	0.5256

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 7.1939 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 55.6671 (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	46.4334	46.1788	45.9293	44.7573	44.5380	43.5172	43.5172	43.3281	43.9104	44.5380	44.9816	45.4454	(38)
Heat transfer coeff	102.1005	101.8459	101.5964	100.4243	100.2051	99.1842	99.1842	98.9952	99.5774	100.2051	100.6487	101.1124	(39)
Average = Sum(39)m / 12 =												100.4233	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0562	1.0535	1.0510	1.0388	1.0366	1.0260	1.0260	1.0241	1.0301	1.0366	1.0412	1.0460	(40)
HLP (average)												1.0388	
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 2.7065 (42)
Hot water usage for mixer showers

69.5987	68.5527	67.0286	64.1125	61.9604	59.5605	58.1963	59.7089	61.3670	63.9438	66.9226	69.3320	(42a)

Hot water usage for baths

30.0529	29.6066	28.9781	27.8192	26.9514	25.9892	25.4695	26.0936	26.7732	27.8028	28.9855	29.9513	(42b)

Hot water usage for other uses

42.3471	40.8072	39.2673	37.7274	36.1875	34.6477	34.6477	36.1875	37.7274	39.2673	40.8072	42.3471	(42c)

Average daily hot water use (litres/day) 130.5288 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	141.9987	138.9666	135.2740	129.6591	125.0994	120.1973	118.3135	121.9901	125.8676	131.0139	136.7154	141.6305	(44)
Energy conte	224.8913	197.8865	207.9111	177.4968	168.4078	147.7967	143.0899	151.0492	155.2074	177.7847	194.7761	221.7591	(45)
Energy content (annual)											Total = Sum(45)m =	2168.0566	
Distribution loss (46)m = 0.15 x (45)m	33.7337	29.6830	31.1867	26.6245	25.2612	22.1695	21.4635	22.6574	23.2811	26.6677	29.2164	33.2639	(46)

Water storage loss:
Store volume 210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.7000 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 0.9180 (55)
Total storage loss

28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(56)

If cylinder contains dedicated solar storage

28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(57)
Primary loss 23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)

Total heat required for water heating calculated for each month

276.6117	244.6017	259.6315	227.5488	220.1282	197.8487	194.8103	202.7696	205.2594	229.5051	244.8281	273.4795	(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

276.6117	244.6017	259.6315	227.5488	220.1282	197.8487	194.8103	202.7696	205.2594	229.5051	244.8281	273.4795	(64)
										Total per year (kWh/year) = Sum(64)m =	2777.0226	(64)
12Total per year (kWh/year)											2777	(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

116.1527	103.1694	110.5068	99.0593	97.3719	89.1840	88.9537	91.6002	91.6481	100.4897	104.8047	115.1112	(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	135.3243	135.3243	135.3243	135.3243	135.3243	135.3243	135.3243	135.3243	135.3243	135.3243	135.3243	135.3243	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	128.9851	142.8049	128.9851	133.2846	128.9851	133.2846	128.9851	128.9851	133.2846	128.9851	133.2846	128.9851	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	250.8292	253.4320	246.8730	232.9096	215.2833	198.7171	187.6499	185.0470	191.6061	205.5695	223.1957	239.7620	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.5324	36.5324	36.5324	36.5324	36.5324	36.5324	36.5324	36.5324	36.5324	36.5324	36.5324	36.5324	(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)	-108.2595	-108.2595	-108.2595	-108.2595	-108.2595	-108.2595	-108.2595	-108.2595	-108.2595	-108.2595	-108.2595	-108.2595	(71)
Water heating gains (Table 5)	156.1192	153.5259	148.5306	137.5823	130.8762	123.8667	119.5614	123.1185	127.2890	135.0668	145.5620	154.7194	(72)
Total internal gains	599.5308	613.3602	587.9860	567.3738	538.7420	519.4657	499.7937	500.7480	515.7769	533.2187	565.6397	587.0637	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.0200	11.2829	0.6300	0.7000	0.7700	20.7582	(75)
Southwest	4.3000	36.7938	0.6300	0.7000	0.7700	48.3521	(79)
Northwest	2.2000	11.2829	0.6300	0.7000	0.7700	7.5861	(81)
Southwest	5.0800	36.7938	0.6300	0.7000	0.7700	57.1229	(79)

Solar gains	133.8194	237.3587	349.7720	475.3009	570.6359	583.3384	555.3970	481.6999	392.8379	269.0746	161.9993	113.4120	(83)
Total gains	733.3501	850.7189	937.7580	1042.6747	1109.3779	1102.8040	1055.1907	982.4479	908.6148	802.2933	727.6389	700.4758	(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	38.5445	38.6408	38.7357	39.1878	39.2736	39.6778	39.6778	39.7535	39.5211	39.2736	39.1005	38.9211	
alpha	3.5696	3.5761	3.5824	3.6125	3.6182	3.6452	3.6452	3.6502	3.6347	3.6182	3.6067	3.5947	
util living area	0.9714	0.9515	0.9175	0.8388	0.7107	0.5403	0.4037	0.4481	0.6643	0.8726	0.9522	0.9752	(86)
Living	19.3214	19.5952	19.9624	20.4214	20.7560	20.9335	20.9822	20.9741	20.8577	20.4185	19.8010	19.2779	
Non living	18.0877	18.4326	18.8908	19.4515	19.8307	20.0148	20.0532	20.0500	19.9474	19.4626	18.7030	18.0384	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	20.1413	19.5952	19.9624	20.4214	20.7560	20.9335	20.9822	20.9741	20.8577	20.4185	19.8010	19.5188	(87)
Th 2	20.0368	20.0390	20.0411	20.0511	20.0530	20.0617	20.0617	20.0633	20.0583	20.0530	20.0492	20.0452	(88)
util rest of house	0.9660	0.9428	0.9025	0.8102	0.6626	0.4718	0.3217	0.3629	0.5971	0.8433	0.9421	0.9706	(89)
MIT 2	19.2597	18.4326	18.8908	19.4515	19.8307	20.0148	20.0532	20.0500	19.9474	19.4626	18.7030	18.4000	(90)
Living area fraction									fLA = Living area / (4) =			0.1766	(91)
MIT	19.4154	18.6379	19.0800	19.6228	19.9941	20.1770	20.2173	20.2132	20.1081	19.6314	18.8969	18.5976	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.4154	18.6379	19.0800	19.6228	19.9941	20.1770	20.2173	20.2132	20.1081	19.6314	18.8969	18.5976	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9619	0.9263	0.8841	0.7956	0.6594	0.4805	0.3356	0.3769	0.6009	0.8280	0.9260	0.9612	(94)
Useful gains	705.3873	788.0055	829.1054	829.5919	731.5541	529.9199	354.1033	370.3256	545.9916	664.2864	673.8252	673.3302	(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	1543.2896	1399.1477	1278.0823	1076.8253	831.1091	553.1540	358.7748	377.4887	598.2719	904.9876	1187.3442	1455.7757	(97)
Space heating kWh	623.3993	410.6875	334.0388	178.0081	74.0690	0.0000	0.0000	0.0000	0.0000	179.0817	369.7337	582.1395	(98a)
Space heating requirement - total per year (kWh/year)												2751.1575	
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	623.3993	410.6875	334.0388	178.0081	74.0690	0.0000	0.0000	0.0000	0.0000	179.0817	369.7337	582.1395	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2751.1575	
Space heating per m2										(98c) / (4) =		28.4593	(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 %) 239.1751 (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	623.3993	410.6875	334.0388	178.0081	74.0690	0.0000	0.0000	0.0000	0.0000	179.0817	369.7337	582.1395	(98)
Space heating efficiency (main heating system 1)	239.1751	239.1751	239.1751	239.1751	239.1751	0.0000	0.0000	0.0000	0.0000	239.1751	239.1751	239.1751	(210)
Space heating fuel (main heating system)	260.6456	171.7100	139.6629	74.4258	30.9685	0.0000	0.0000	0.0000	0.0000	74.8747	154.5870	243.3947	(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	276.6117	244.6017	259.6315	227.5488	220.1282	197.8487	194.8103	202.7696	205.2594	229.5051	244.8281	273.4795	(64)
Efficiency of water heater												170.4424	(216)
(217)m	170.4424	170.4424	170.4424	170.4424	170.4424	170.4424	170.4424	170.4424	170.4424	170.4424	170.4424	170.4424	(217)
Fuel for water heating, kWh/month	162.2904	143.5099	152.3280	133.5048	129.1511	116.0795	114.2969	118.9667	120.4275	134.6526	143.6428	160.4528	(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	26.2528	21.0609	18.9630	13.8931	10.7315	8.7677	9.7896	12.7249	16.5284	21.6861	24.4944	26.9824	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-24.2471	-37.9348	-60.6023	-74.0681	-83.8055	-78.2803	-77.0952	-70.2083	-58.3608	-45.1992	-27.6183	-20.4135	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-5.2875	-12.6964	-28.6222	-48.9054	-70.3640	-74.0388	-72.9086	-59.4887	-40.9474	-20.3967	-7.6934	-4.1057	(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												1150.2692	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												170.4424	

Water heating fuel used	1629.3031	(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)	211.8748	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-1103.2882	(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	1888.1590	(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	1150.2692	0.1558	179.2569	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1629.3031	0.1409	229.6498	(264)
Space and water heating			408.9067	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	211.8748	0.1443	30.5801	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-657.8334	0.1331	-87.5275	
PV Unit electricity exported	-445.4547	0.1224	-54.5331	
Total			-142.0606	(269)
Total CO2, kg/year			297.4262	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			3.0800	(273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	1150.2692	1.5769	1813.8645	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1629.3031	1.5212	2478.4688	(278)
Space and water heating			4292.3334	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	211.8748	1.5338	324.9807	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-657.8334	1.4917	-981.2689	
PV Unit electricity exported	-445.4547	0.4492	-200.0918	
Total			-1181.3607	(283)
Total Primary energy kWh/year			3435.9534	(286)
Dwelling Primary energy Rate (DPER)			35.5400	(287)

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Main dwelling						
Ground floor	48.3000 (1b)	x	2.4000 (2b)	=	115.9200	(1b) - (3b)
First floor	48.3700 (1c)	x	2.6000 (2c)	=	125.7620	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 96.6700						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	241.6820	(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) =	0.1241	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3741	(18)
Number of sides sheltered		2	(19)
Shelter factor (20) = 1 - [0.075 x (19)] =		0.8500	(20)
Infiltration rate adjusted to include shelter factor (21) = (18) x (20) =		0.3180	(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													
	0.4055	0.3975	0.3896	0.3498	0.3419	0.3021	0.3021	0.2942	0.3180	0.3419	0.3578	0.3737	(22b)
Effective ac	0.5822	0.5790	0.5759	0.5612	0.5584	0.5456	0.5456	0.5433	0.5506	0.5584	0.5640	0.5698	(25)

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3. Heat losses and heat loss parameter

Element	Gross	Openings	NetArea	U-value	A x U	K-value	A x K	
Main dwelling	m2	m2	m2	W/m2K	W/K	kJ/m2K	kJ/K	
TER Opaque door			2.0400	1.0000	2.0400			(26)
TER Opening Type			17.6000	1.1450	20.1527			(27)
Heatloss Floor 1			48.3700	0.1300	6.2881			(28a)
Cavity Wall	101.5700	19.6400	81.9300	0.1800	14.7474			(29a)
External Roof 1	48.3700		48.3700	0.1100	5.3207			(30)
Total net area of external elements Aum(A, m2)			198.3100					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	48.5489			(33)
Main dwelling								
Party Wall 1			43.8200	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 146.5550 (35)

List of Thermal Bridges

	Length	Psi-value	Total	
K1 Element				
E1 Steel lintel with perforated steel base plate	13.8000	0.0500	0.6900	
E3 Sill	10.4200	0.0500	0.5210	
E4 Jamb	30.0200	0.0500	1.5010	
E5 Ground floor (normal)	29.0800	0.1600	4.6528	
E6 Intermediate floor within a dwelling	29.0800	0.0000	0.0000	
E10 Eaves (insulation at ceiling level)	14.5400	0.0600	0.8724	
E12 Gable (insulation at ceiling level)	2.8200	0.0600	0.1692	
E16 Corner (normal)	20.0000	0.0900	1.8000	
E17 Corner (inverted - internal area greater than external area)	5.0000	-0.0900	-0.4500	
E18 Party wall between dwellings	8.7600	0.0600	0.5256	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 10.2820 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 58.8309 (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	46.4334	46.1788	45.9293	44.7573	44.5380	43.5172	43.5172	43.3281	43.9104	44.5380	44.9816	45.4454	(38)
Heat transfer coeff	105.2643	105.0097	104.7602	103.5881	103.3689	102.3480	102.3480	102.1590	102.7412	103.3689	103.8125	104.2762	(39)
Average = Sum(39)m / 12 =												103.5871	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0889	1.0863	1.0837	1.0716	1.0693	1.0587	1.0587	1.0568	1.0628	1.0693	1.0739	1.0787	(40)
HLP (average)												1.0716	
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 2.7065 (42)

Hot water usage for mixer showers

69.5987	68.5527	67.0286	64.1125	61.9604	59.5605	58.1963	59.7089	61.3670	63.9438	66.9226	69.3320	(42a)

Hot water usage for baths

30.0529	29.6066	28.9781	27.8192	26.9514	25.9892	25.4695	26.0936	26.7732	27.8028	28.9855	29.9513	(42b)

Hot water usage for other uses

42.3471	40.8072	39.2673	37.7274	36.1875	34.6477	34.6477	36.1875	37.7274	39.2673	40.8072	42.3471	(42c)

Average daily hot water use (litres/day) 130.5288 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	141.9987	138.9666	135.2740	129.6591	125.0994	120.1973	118.3135	121.9901	125.8676	131.0139	136.7154	141.6305	(44)
Energy conte	224.8913	197.8865	207.9111	177.4968	168.4078	147.7967	143.0899	151.0492	155.2074	177.7847	194.7761	221.7591	(45)
Energy content (annual)										Total = Sum(45)m =		2168.0566	
Distribution loss (46)m = 0.15 x (45)m													
	33.7337	29.6830	31.1867	26.6245	25.2612	22.1695	21.4635	22.6574	23.2811	26.6677	29.2164	33.2639	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7016	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9188	(55)
Total storage loss													
	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(56)
If cylinder contains dedicated solar storage													
	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month													
	276.6378	244.6254	259.6577	227.5742	220.1544	197.8740	194.8365	202.7958	205.2847	229.5313	244.8534	273.5057	(62)
WWHRS	-31.8176	-28.1397	-29.4663	-24.3993	-22.7393	-19.4581	-18.2389	-19.3952	-20.1321	-23.7336	-26.8873	-31.2284	(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													
	244.8202	216.4856	230.1914	203.1749	197.4152	178.4159	176.5976	183.4006	185.1526	205.7977	217.9662	242.2773	(64)
										Total per year (kWh/year) = Sum(64)m =		2481.6951	(64)
12Total per year (kWh/year)												2482	(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)
Heat gains from water heating, kWh/month													
	116.1736	103.1884	110.5277	99.0796	97.3929	89.2043	88.9747	91.6211	91.6683	100.5107	104.8249	115.1322	(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	135.3243	135.3243	135.3243	135.3243	135.3243	135.3243	135.3243	135.3243	135.3243	135.3243	135.3243	135.3243	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
128.9851 142.8049 128.9851 133.2846 128.9851 133.2846 128.9851 128.9851 133.2846 128.9851 133.2846 128.9851 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
250.8292 253.4320 246.8730 232.9096 215.2833 198.7171 187.6499 185.0470 191.6061 205.5695 223.1957 239.7620 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
36.5324 36.5324 36.5324 36.5324 36.5324 36.5324 36.5324 36.5324 36.5324 36.5324 36.5324 36.5324 (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)
-108.2595 -108.2595 -108.2595 -108.2595 -108.2595 -108.2595 -108.2595 -108.2595 -108.2595 -108.2595 -108.2595 -108.2595 (71)
Water heating gains (Table 5)
156.1473 153.5541 148.5588 137.6105 130.9044 123.8948 119.5896 123.1467 127.3171 135.0950 145.5902 154.7475 (72)
Total internal gains
602.5589 616.3884 591.0142 570.4020 541.7701 519.4938 499.8219 500.7761 515.8051 536.2469 568.6678 590.0919 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.0200	11.2829	0.6300	0.7000	0.7700	20.7582	(75)
Southwest	9.3800	36.7938	0.6300	0.7000	0.7700	105.4750	(79)
Northwest	2.2000	11.2829	0.6300	0.7000	0.7700	7.5861	(81)

Solar gains 133.8194 237.3587 349.7720 475.3009 570.6359 583.3384 555.3970 481.6999 392.8379 269.0746 161.9993 113.4120 (83)
Total gains 736.3783 853.7470 940.7862 1045.7029 1112.4060 1102.8322 1055.2188 982.4760 908.6430 805.3214 730.6671 703.5039 (84)

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7. Mean internal temperature (heating season)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	37.3860	37.4766	37.5659	37.9909	38.0715	38.4512	38.4512	38.5224	38.3041	38.0715	37.9088	37.7402	
alpha	3.4924	3.4984	3.5044	3.5327	3.5381	3.5634	3.5634	3.5682	3.5536	3.5381	3.5273	3.5160	
util living area	0.9716	0.9525	0.9197	0.8440	0.7196	0.5524	0.4148	0.4597	0.6753	0.8764	0.9531	0.9754	(86)
MIT	19.2532	19.5285	19.9029	20.3756	20.7291	20.9226	20.9786	20.9691	20.8392	20.3779	19.7437	19.2093	(87)
Th 2	20.0099	20.0121	20.0142	20.0241	20.0260	20.0347	20.0347	20.0363	20.0313	20.0260	20.0222	20.0183	(88)
util rest of house	0.9662	0.9437	0.9048	0.8156	0.6710	0.4815	0.3287	0.3707	0.6069	0.8473	0.9429	0.9707	(89)
MIT 2	17.9840	18.3311	18.7986	19.3771	19.7791	19.9801	20.0245	20.0205	19.9059	19.3946	18.6134	17.9341	(90)
Living area fraction										fLA = Living area / (4) =		0.1766	(91)
MIT	18.2081	18.5425	18.9936	19.5534	19.9468	20.1465	20.1930	20.1880	20.0707	19.5683	18.8130	18.1593	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2081	18.5425	18.9936	19.5534	19.9468	20.1465	20.1930	20.1880	20.0707	19.5683	18.8130	18.1593	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9528	0.9268	0.8858	0.7999	0.6667	0.4901	0.3431	0.3852	0.6099	0.8310	0.9265	0.9584	(94)
Useful gains	701.5882	791.2489	833.3221	836.4327	741.6691	540.5229	362.0881	378.4162	554.1989	669.1910	676.9414	674.2081	(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	1464.0296	1432.5974	1308.8289	1103.5670	852.4636	567.6780	367.7327	386.9796	613.4359	927.0392	1215.9528	1455.6204	(97)
Space heating kWh	567.2564	430.9862	353.7770	192.3367	82.4311	0.0000	0.0000	0.0000	0.0000	191.8391	388.0882	581.3708	(98a)
Space heating requirement - total per year (kWh/year)												2788.0855	
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	567.2564	430.9862	353.7770	192.3367	82.4311	0.0000	0.0000	0.0000	0.0000	191.8391	388.0882	581.3708	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2788.0855	
Space heating per m2											(98c) / (4) =	28.8413	(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	567.2564	430.9862	353.7770	192.3367	82.4311	0.0000	0.0000	0.0000	0.0000	191.8391	388.0882	581.3708	(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)	614.5789	466.9407	383.2904	208.3821	89.3078	0.0000	0.0000	0.0000	0.0000	207.8430	420.4639	629.8708	(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	244.8202	216.4856	230.1914	203.1749	197.4152	178.4159	176.5976	183.4006	185.1526	205.7977	217.9662	242.2773	(64)
Efficiency of water heater												79.8000	(216)
(217)m	85.8800	85.5731	85.0203	83.9370	82.2557	79.8000	79.8000	79.8000	79.8000	83.9026	85.3385	85.9487	(217)
Fuel for water heating, kWh/month	285.0725	252.9833	270.7489	242.0564	240.0019	223.5788	221.3002	229.8253	232.0208	245.2818	255.4136	281.8860	(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	26.8006	21.5004	19.3587	14.1830	10.9554	8.9506	9.9939	12.9904	16.8733	22.1386	25.0055	27.5454	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-44.3355	-62.0720	-88.6059	-98.8999	-106.0138	-98.6923	-97.4282	-92.2558	-83.0751	-70.5907	-48.5701	-38.3779	(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	-26.3852	-55.3474	-109.7327	-164.4331	-217.0816	-218.0269	-215.5021	-182.6572	-134.1099	-79.0753	-35.1993	-20.8804	(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	3020.6776	(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	2980.1694	(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)	216.2958	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-2387.3485	(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	3915.7944	(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	3020.6776	0.2100	634.3423	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2980.1694	0.2100	625.8356	(264)
Space and water heating			1260.1779	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	216.2958	0.1443	31.2182	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-928.9173	0.1347	-125.1669	
PV Unit electricity exported	-1458.4312	0.1260	-183.7033	
Total			-308.8702	(269)
Total CO2, kg/year			994.4552	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			10.2900	(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	3020.6776	1.1300	3413.3657	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2980.1694	1.1300	3367.5915	(278)
Space and water heating			6780.9572	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	216.2958	1.5338	331.7617	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-928.9173	1.4980	-1391.5211	
PV Unit electricity exported	-1458.4312	0.4624	-674.3212	
Total			-2065.8423	(283)
Total Primary energy kWh/year			5176.9774	(286)
Target Primary Energy Rate (TPER)			53.5500	(287)

Building Regulations England Part L (BREL) Compliance Report

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

Date: Fri 14 Mar 2025 09:30:56

Project Information			
Assessed By	Richard Millard	Building Type	House, Semi-detached
OCDEA Registration	EES/025661	Assessment Date	2025-03-14

Dwelling Details			
Assessment Type	As designed	Total Floor Area	97 m^2
Site Reference	M	Plot Reference	Regulated (Baseline)
Address	9		

Client Details	
Name	Ian White
Company	Cotswold Homes Ltd
Address	West House, Yate, Bristol, BS37 5NG

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

1a Target emission rate and dwelling emission rate		
Fuel for main heating system	Mains gas	
Target carbon dioxide emission rate	*10.28 $kgCO_2/m^2$*	
Dwelling carbon dioxide emission rate	14.37 $kgCO_2/m^2$	**FAIL**
1b Target primary energy rate and dwelling primary energy		
Target primary energy	*53.51 kWh_{PE}/m^2*	
Dwelling primary energy	79.65 kWh_{PE}/m^2	**FAIL**
1c Target fabric energy efficiency and dwelling fabric energy efficiency		
Target fabric energy efficiency	*35.5 kWh/m^2*	
Dwelling fabric energy efficiency	35.5 kWh/m^2	**OK**

2a Fabric U-values				
Element	***Maximum permitted average U-Value [W/m^2K]***	**Dwelling average U-Value [W/m^2K]**	**Element with highest individual U-Value**	
External walls	*0.26*	0.18	Walls (1) (0.18)	**OK**
Party walls	*0.2*	0	Party Wall (1) (0)	**N/A**
Curtain walls	*1.6*	0	N/A	**N/A**
Floors	*0.18*	0.13	Heatloss Floor 1 (0.13)	**OK**
Roofs	*0.16*	0.11	Roof (1) (0.11)	**OK**
Windows, doors, and roof windows	*1.6*	1.2	WG01 (1.2)	**OK**
Rooflights	*2.2*	N/A	N/A	**N/A**

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))		
Name	**Net area [m^2]**	**U-Value [W/m^2K]**
Exposed wall: Walls (1)	81.93	0.18
Party wall: Party Wall (1)	43.82	0 **(!)**
Ground floor: Heatloss Floor 1, Heatloss Floor 1	48.37	0.13
Exposed roof: Roof (1)	48.37	0.11

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	**Area [m^2]**	**Orientation**	**Frame factor**	**U-Value [W/m^2K]**
WG01, Windows	2.19	North East	0.7	1.2
WG02, Windows	0.59	North East	0.7	1.2
WG03, Windows	1.46	North West	0.7	1.2
FG01, Windows	2.16	North East	0.7	1.2
FG02, Windows	1.08	North East	0.7	1.2
FG03, Windows	0.74	North West	0.7	1.2
FG04, Windows	1.43	South West	0.7	1.2
FG05, Windows	1.43	South West	0.7	1.2
ED01, Doors	2.04	North East	N/A	1.2
ED02, Glazed Doors	5.08	South West	0.7	1.2
WG04, Windows	1.44	South West	0.7	1.2

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))				
Building part **1**: Thermal bridging calculated from linear thermal transmittances for each junction				
Main element	**Junction detail**	**Source**	**Psi value [W/mK]**	**Drawing / reference**
External wall	E2: Other lintels (including other steel lintels)	Calculated by person with suitable expertise	0.05	mpf125e2-04
External wall	E3: Sill	Calculated by person with suitable expertise	0.05	mpf125e3-01
External wall	E4: Jamb	Calculated by person with suitable expertise	0.022 **(!)**	mpf125e4-01
External wall	E5: Ground floor (normal)	Calculated by person with suitable expertise	0.16	mpf125e5-04
External wall	E6: Intermediate floor within a dwelling	Calculated by person with suitable expertise	0.003 **(!)**	mpf125e6-01
External wall	E10: Eaves (insulation at ceiling level)	Calculated by person with suitable expertise	0.06	mpf125e10-01
External wall	E12: Gable (insulation at ceiling level)	Calculated by person with suitable expertise	0.06	mpf125e12-01
External wall	E16: Corner (normal)	Calculated by person with suitable expertise	0.09	mpf125e16-01
External wall	E17: Corner (inverted - internal area greater than external area)	Calculated by person with suitable expertise	-0.085	mpf125e17-01
External wall	E18: Party wall between dwellings	Calculated by person with suitable expertise	0.09	mpf125e18-02

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

4 Space heating	
Main heating system 1: Boiler with radiators or underfloor heating - Mains gas	
Efficiency	88.6%
Emitter type	Radiators
Flow temperature	45°C
System type	Regular boiler
Manufacturer	Bosch Thermotechnology
Model	Greenstar 8000 Life
Commissioning	
Secondary heating system: N/A	
Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water	
Cylinder/store - type: Cylinder	
Capacity	210 litres
Declared heat loss	1.7 kWh/day
Primary pipework insulated	Yes
Manufacturer	
Model	
Commissioning	
Waste water heat recovery system 1 - type: N/A	
Efficiency	
Manufacturer	
Model	

6 Controls	
Main heating 1 - type: Time and temperature zone control by arrangement of plumbing and electrical services	
Function	
Ecodesign class	
Manufacturer	
Model	
Water heating - type: Cylinder thermostat and HW separately timed	
Manufacturer	
Model	

7 Lighting		
Minimum permitted light source efficacy	*75 lm/W*	
Lowest light source efficacy	85 lm/W	OK
External lights control	N/A	

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

9 Local generation
N/A

10 Heat networks
N/A

11 Supporting documentary evidence
N/A

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

Full SAP Calculation Printout

Property Reference	M	**Issued on Date**	14/03/2025
Assessment Reference	Regulated (Baseline)	**Prop Type Ref**	Proposed 9
Property	9		

SAP Rating	85 B	**DER**	14.37	**TER**	10.28
Environmental	87 B	**% DER < TER**			-39.79
CO_2 Emissions (t/year)	1.31	**DFEE**	35.45	**TFEE**	35.48
Compliance Check	See BREL	**% DFEE < TFEE**			0.08
% DPER < TPER	-48.85	**DPER**	79.65	**TPER**	53.51

Assessor Details	Mr. Richard Millard	**Assessor ID**	U367-0001
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)	
Main dwelling						
Ground floor	48.3700 (1b)	x	2.4000 (2b)	=	116.0880	(1b) - (3b)
First floor	48.3700 (1c)	x	2.6000 (2c)	=	125.7620	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	96.7400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	241.8500	(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) =	0.1240	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3740	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3179	(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	0.4054	0.3974	0.3895	0.3497	0.3418	0.3020	0.3020	0.2941	0.3179	0.3418	0.3577	0.3736	(22b)
Effective ac	0.5822	0.5790	0.5758	0.5612	0.5584	0.5456	0.5456	0.5432	0.5505	0.5584	0.5640	0.5698	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Main dwelling								
Windows			12.5200	1.1450	14.3359			(27)
Glazed Doors			5.0800	1.1450	5.8168			(27)
Doors			2.0400	1.2000	2.4480			(26)
Heatloss Floor 1			48.3700	0.1300	6.2881	75.0000	3627.7500	(28a)
Cavity Wall	101.5700	19.6400	81.9300	0.1800	14.7474	60.0000	4915.8000	(29a)
External Roof 1	48.3700		48.3700	0.1100	5.3207	9.0000	435.3300	(30)
Total net area of external elements Aum(A, m2)			198.3100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		48.9569			(33)
Main dwelling								
Party Wall 1			43.8200	0.0000	0.0000	45.0000	1971.9000	(32)
Internal Wall 2 - Stud			77.0000			9.0000	693.0000	(32c)
Internal Wall 3 - Up			135.3000			9.0000	1217.7000	(32c)
Internal Floor 1			48.3700			18.0000	870.6600	(32d)
Internal Ceiling 1			48.3700			9.0000	435.3300	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	14167.4700 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		146.4489 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total

E2 Other lintels (including other steel lintels)	13.8000	0.0500	0.6900		
E3 Sill	10.4200	0.0500	0.5210		
E4 Jamb	30.0200	0.0220	0.6604		
E5 Ground floor (normal)	29.0800	0.1600	4.6528		
E6 Intermediate floor within a dwelling	29.0800	0.0030	0.0872		
E10 Eaves (insulation at ceiling level)	14.5400	0.0600	0.8724		
E12 Gable (insulation at ceiling level)	2.8200	0.0600	0.1692		
E16 Corner (normal)	20.0000	0.0900	1.8000		
E17 Corner (inverted - internal area greater than external area)	5.0000	-0.0850	-0.4250		
E18 Party wall between dwellings	8.7600	0.0900	0.7884		
Thermal bridges (Sum(L x Psi) calculated using Appendix K)				9.8165	(36)
Point Thermal bridges			(36a) =	0.0000	
Total fabric heat loss			(33) + (36) + (36a) =	58.7734	(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	46.4627	46.2080	45.9585	44.7861	44.5668	43.5457	43.5457	43.3567	43.9390	44.5668	45.0105	45.4744	(38)
Heat transfer coeff	105.2360	104.9814	104.7318	103.5595	103.3401	102.3191	102.3191	102.1300	102.7124	103.3401	103.7839	104.2477	(39)
Average = Sum(39)m / 12 =												103.5584	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0878	1.0852	1.0826	1.0705	1.0682	1.0577	1.0577	1.0557	1.0617	1.0682	1.0728	1.0776	(40)
HLP (average)												1.0705	
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											2.7072	(42)
Hot water usage for mixer showers												
69.6111	68.5650	67.0406	64.1239	61.9715	59.5711	58.2067	59.7196	61.3780	63.9553	66.9346	69.3444	(42a)
Hot water usage for baths												
30.0583	29.6119	28.9832	27.8241	26.9562	25.9938	25.4740	26.0983	26.7779	27.8077	28.9907	29.9567	(42b)
Hot water usage for other uses												
42.3547	40.8146	39.2744	37.7342	36.1940	34.6539	34.6539	36.1940	37.7342	39.2744	40.8146	42.3547	(42c)
Average daily hot water use (litres/day)											130.5521	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	142.0241	138.9914	135.2982	129.6823	125.1217	120.2188	118.3346	122.0119	125.8901	131.0373	136.7398	141.6558	(44)
Energy conte	224.9314	197.9219	207.9483	177.5285	168.4379	147.8231	143.1155	151.0762	155.2351	177.8164	194.8109	221.7987	(45)
Energy content (annual)										Total = Sum(45)m =		2168.4440	
Distribution loss (46)m = 0.15 x (45)m													
	33.7397	29.6883	31.1922	26.6293	25.2657	22.1735	21.4673	22.6614	23.2853	26.6725	29.2216	33.2698	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9180	(55)
Total storage loss													
	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(56)
If cylinder contains dedicated solar storage													
	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month													
	276.6518	244.6371	259.6687	227.5805	220.1583	197.8751	194.8359	202.7966	205.2871	229.5368	244.8629	273.5191	(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													
	276.6518	244.6371	259.6687	227.5805	220.1583	197.8751	194.8359	202.7966	205.2871	229.5368	244.8629	273.5191	(64)
										Total per year (kWh/year) = Sum(64)m =		2777.4100	(64)
12Total per year (kWh/year)												2777	(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													
	116.1660	103.1812	110.5191	99.0698	97.3819	89.1928	88.9622	91.6092	91.6573	100.5003	104.8162	115.1244	(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	135.3614	135.3614	135.3614	135.3614	135.3614	135.3614	135.3614	135.3614	135.3614	135.3614	135.3614	135.3614	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	129.0602	142.8881	129.0602	133.3623	129.0602	133.3623	129.0602	129.0602	133.3623	129.0602	133.3623	129.0602	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	250.9472	253.5513	246.9892	233.0192	215.3846	198.8106	187.7382	185.1341	191.6962	205.6662	223.3008	239.8748	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.5361	36.5361	36.5361	36.5361	36.5361	36.5361	36.5361	36.5361	36.5361	36.5361	36.5361	36.5361	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-108.2891	-108.2891	-108.2891	-108.2891	-108.2891	-108.2891	-108.2891	-108.2891	-108.2891	-108.2891	-108.2891	-108.2891	(71)
Water heating gains (Table 5)	156.1371	153.5434	148.5472	137.5970	130.8897	123.8788	119.5729	123.1306	127.3018	135.0810	145.5781	154.7371	(72)
Total internal gains	602.7530	616.5913	591.2050	570.5869	541.9430	519.6601	499.9797	500.9334	515.9687	536.4159	568.8495	590.2805	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.0200	11.2829	0.6300	0.7000	0.7700	20.7582	(75)
Southwest	4.3000	36.7938	0.6300	0.7000	0.7700	48.3521	(79)
Northwest	2.2000	11.2829	0.6300	0.7000	0.7700	7.5861	(81)
Southwest	5.0800	36.7938	0.6300	0.7000	0.7700	57.1229	(79)

Solar gains	133.8194	237.3587	349.7720	475.3009	570.6359	583.3384	555.3970	481.6999	392.8379	269.0746	161.9993	113.4120	(83)
Total gains	736.5724	853.9499	940.9770	1045.8877	1112.5789	1102.9985	1055.3767	982.6333	908.8065	805.4905	730.8488	703.6926	(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	37.3960	37.4867	37.5761	38.0014	38.0821	38.4621	38.4621	38.5333	38.3148	38.0821	37.9193	37.7505	
alpha	3.4931	3.4991	3.5051	3.5334	3.5388	3.5641	3.5641	3.5689	3.5543	3.5388	3.5280	3.5167	
util living area	0.9716	0.9524	0.9196	0.8439	0.7195	0.5522	0.4146	0.4595	0.6752	0.8763	0.9530	0.9754	(86)
MIT	19.2541	19.5294	19.9037	20.3762	20.7294	20.9227	20.9786	20.9692	20.8394	20.3785	19.7445	19.2102	(87)
Th 2	20.0108	20.0129	20.0151	20.0250	20.0269	20.0356	20.0356	20.0372	20.0322	20.0269	20.0231	20.0192	(88)
util rest of house	0.9662	0.9437	0.9047	0.8155	0.6709	0.4814	0.3286	0.3706	0.6068	0.8472	0.9429	0.9707	(89)
MIT 2	17.9859	18.3329	18.8002	19.3785	19.7802	19.9811	20.0254	20.0214	19.9069	19.3960	18.6150	17.9359	(90)
Living area fraction									fLA = Living area / (4) =			0.1765	(91)
MIT	18.2096	18.5440	18.9949	19.5546	19.9477	20.1472	20.1936	20.1886	20.0715	19.5694	18.8143	18.1608	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.0596	18.3940	18.8449	19.4046	19.7977	19.9972	20.0436	20.0386	19.9215	19.4194	18.6643	18.0108	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9513	0.9247	0.8826	0.7945	0.6584	0.4785	0.3294	0.3708	0.5982	0.8251	0.9240	0.9571	(94)
Useful gains	700.7197	789.6441	830.4648	830.9411	732.4777	527.7742	347.6089	364.3407	543.6877	664.6264	675.3044	673.4845	(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	1448.0106	1416.6207	1292.9076	1087.8470	836.8168	552.2397	352.3442	371.6145	597.9352	911.3947	1200.1925	1439.7442	(97)
Space heating kWh	555.9844	421.3283	344.0574	184.9723	77.6283	0.0000	0.0000	0.0000	0.0000	183.5956	377.9194	570.0972	(98a)
Space heating requirement - total per year (kWh/year)												2715.5829	
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	555.9844	421.3283	344.0574	184.9723	77.6283	0.0000	0.0000	0.0000	0.0000	183.5956	377.9194	570.0972	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2715.5829	
Space heating per m2											(98c) / (4) =	28.0709	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												88.6000	(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													
	555.9844	421.3283	344.0574	184.9723	77.6283	0.0000	0.0000	0.0000	0.0000	183.5956	377.9194	570.0972	(98)
Space heating efficiency (main heating system 1)													
	88.6000	88.6000	88.6000	88.6000	88.6000	0.0000	0.0000	0.0000	0.0000	88.6000	88.6000	88.6000	(210)
Space heating fuel (main heating system)													
	627.5219	475.5398	388.3267	208.7723	87.6166	0.0000	0.0000	0.0000	0.0000	207.2185	426.5456	643.4506	(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													
	276.6518	244.6371	259.6687	227.5805	220.1583	197.8751	194.8359	202.7966	205.2871	229.5368	244.8629	273.5191	(64)
Efficiency of water heater												79.6000	(216)
(217)m	85.3921	85.0669	84.4912	83.3983	81.7652	79.6000	79.6000	79.6000	79.6000	83.3632	84.8290	85.4669	(217)
Fuel for water heating, kWh/month	323.9784	287.5821	307.3324	272.8838	269.2568	248.5868	244.7687	254.7696	257.8984	275.3456	288.6548	320.0292	(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	26.2681	21.0732	18.9741	13.9012	10.7377	8.7728	9.7953	12.7323	16.5380	21.6988	24.5087	26.9981	(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	3064.9919	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	79.6000	
Water heating fuel used	3351.0865	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
central heating pump	41.0000	(230c)

main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	86.0000	(231)
Electricity for lighting (calculated in Appendix L)	211.9983	(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	6714.0768	(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	3064.9919	0.2100	643.6483	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3351.0865	0.2100	703.7282	(264)
Space and water heating			1347.3765	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	211.9983	0.1443	30.5979	(268)
Total CO2, kg/year			1389.9036	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			14.3700	(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	3064.9919	1.1300	3463.4409	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3351.0865	1.1300	3786.7278	(278)
Space and water heating			7250.1687	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	211.9983	1.5338	325.1701	(282)
Total Primary energy kWh/year			7705.4395	(286)
Dwelling Primary energy Rate (DPER)			79.6500	(287)

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

1. Overall dwelling characteristics

		Area (m2)		Storey height (m)		Volume (m3)	
Main dwelling							
Ground floor		48.3700 (1b)	x	2.4000 (2b)	=	116.0880	(1b) - (3b)
First floor		48.3700 (1c)	x	2.6000 (2c)	=	125.7620	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	96.7400						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	241.8500	(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) =	0.1240	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3740	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3179	(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	0.4054	0.3974	0.3895	0.3497	0.3418	0.3020	0.3020	0.2941	0.3179	0.3418	0.3577	0.3736	(22b)
Effective ac	0.5822	0.5790	0.5758	0.5612	0.5584	0.5456	0.5456	0.5432	0.5505	0.5584	0.5640	0.5698	(25)

3. Heat losses and heat loss parameter

Element	Gross	Openings	NetArea	U-value	A x U	K-value	A x K	
Main dwelling	m2	m2	m2	W/m2K	W/K	kJ/m2K	kJ/K	
TER Opaque door			2.0400	1.0000	2.0400			(26)
TER Opening Type			17.6000	1.1450	20.1527			(27)
Heatloss Floor 1			48.3700	0.1300	6.2881			(28a)
Cavity Wall	101.5700	19.6400	81.9300	0.1800	14.7474			(29a)
External Roof 1	48.3700		48.3700	0.1100	5.3207			(30)
Total net area of external elements Aum(A, m2)			198.3100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		48.5489			(33)
Main dwelling								
Party Wall 1			43.8200	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 146.4489 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	13.8000	0.0500	0.6900
E3 Sill	10.4200	0.0500	0.5210
E4 Jamb	30.0200	0.0500	1.5010
E5 Ground floor (normal)	29.0800	0.1600	4.6528
E6 Intermediate floor within a dwelling	29.0800	0.0000	0.0000
E10 Eaves (insulation at ceiling level)	14.5400	0.0600	0.8724
E12 Gable (insulation at ceiling level)	2.8200	0.0600	0.1692
E16 Corner (normal)	20.0000	0.0900	1.8000
E17 Corner (inverted - internal area greater than external area)	5.0000	-0.0900	-0.4500
E18 Party wall between dwellings	8.7600	0.0600	0.5256

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 10.2820 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 58.8309 (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	46.4627	46.2080	45.9585	44.7861	44.5668	43.5457	43.5457	43.3567	43.9390	44.5668	45.0105	45.4744	(38)
Heat transfer coeff	105.2935	105.0389	104.7893	103.6170	103.3977	102.3766	102.3766	102.1875	102.7699	103.3977	103.8414	104.3053	(39)

Average = Sum(39)m / 12 = 103.6160

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0884	1.0858	1.0832	1.0711	1.0688	1.0583	1.0583	1.0563	1.0623	1.0688	1.0734	1.0782	(40)
HLP (average)												1.0711	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.7072 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	69.6111	68.5650	67.0406	64.1239	61.9715	59.5711	58.2067	59.7196	61.3780	63.9553	66.9346	69.3444	(42a)
Hot water usage for baths	30.0583	29.6119	28.9832	27.8241	26.9562	25.9938	25.4740	26.0983	26.7779	27.8077	28.9907	29.9567	(42b)
Hot water usage for other uses	42.3547	40.8146	39.2744	37.7342	36.1940	34.6539	34.6539	36.1940	37.7342	39.2744	40.8146	42.3547	(42c)

Average daily hot water use (litres/day) 130.5521 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	142.0241	138.9914	135.2982	129.6823	125.1217	120.2188	118.3346	122.0119	125.8901	131.0373	136.7398	141.6558	(44)
Energy conte	224.9314	197.9219	207.9483	177.5285	168.4379	147.8231	143.1155	151.0762	155.2351	177.8164	194.8109	221.7987	(45)
Energy content (annual)										Total = Sum(45)m =		2168.4440	
Distribution loss (46)m = 0.15 x (45)m	33.7397	29.6883	31.1922	26.6293	25.2657	22.1735	21.4673	22.6614	23.2853	26.6725	29.2216	33.2698	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7016	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9188	(55)
Total storage loss	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(56)
If cylinder contains dedicated solar storage	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	276.6780	244.6607	259.6949	227.6059	220.1845	197.9004	194.8621	202.8228	205.3125	229.5630	244.8883	273.5453	(62)
WWHRS	-31.8233	-28.1448	-29.4716	-24.4036	-22.7433	-19.4616	-18.2422	-19.3987	-20.1357	-23.7378	-26.8921	-31.2340	(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	244.8547	216.5160	230.2233	203.2022	197.4412	178.4388	176.6199	183.4241	185.1767	205.8252	217.9962	242.3113	(64)
										Total per year (kWh/year) = Sum(64)m =		2482.0297	(64)
12Total per year (kWh/year)												2482	(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	116.1870	103.2001	110.5401	99.0901	97.4029	89.2130	88.9832	91.6301	91.6776	100.5212	104.8365	115.1453	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	135.3614	135.3614	135.3614	135.3614	135.3614	135.3614	135.3614	135.3614	135.3614	135.3614	135.3614	135.3614	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	129.0602	142.8881	129.0602	133.3623	129.0602	133.3623	129.0602	129.0602	133.3623	129.0602	133.3623	129.0602	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	250.9472	253.5513	246.9892	233.0192	215.3846	198.8106	187.7382	185.1341	191.6962	205.6662	223.3008	239.8748	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.5361	36.5361	36.5361	36.5361	36.5361	36.5361	36.5361	36.5361	36.5361	36.5361	36.5361	36.5361	(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)	-108.2891	-108.2891	-108.2891	-108.2891	-108.2891	-108.2891	-108.2891	-108.2891	-108.2891	-108.2891	-108.2891	-108.2891	(71)
Water heating gains (Table 5)	156.1653	153.5716	148.5754	137.6252	130.9178	123.9070	119.6010	123.1588	127.3299	135.1092	145.6063	154.7652	(72)
Total internal gains	602.7812	616.6194	591.2332	570.6150	541.9711	519.6883	500.0079	500.9615	515.9968	536.4440	568.8777	590.3087	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.0200	11.2829	0.6300	0.7000	0.7700	20.7582	(75)
Southwest	9.3800	36.7938	0.6300	0.7000	0.7700	105.4750	(79)
Northwest	2.2000	11.2829	0.6300	0.7000	0.7700	7.5861	(81)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	133.8194	237.3587	349.7720	475.3009	570.6359	583.3384	555.3970	481.6999	392.8379	269.0746	161.9993	113.4120	(83)
Total gains	736.6005	853.9781	941.0052	1045.9159	1112.6070	1103.0267	1055.4048	982.6614	908.8347	805.5186	730.8770	703.7207	(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	37.3756	37.4662	37.5554	37.9803	38.0609	38.4405	38.4405	38.5116	38.2934	38.0609	37.8983	37.7297	
alpha	3.4917	3.4977	3.5037	3.5320	3.5374	3.5627	3.5627	3.5674	3.5529	3.5374	3.5266	3.5153	
util living area	0.9716	0.9524	0.9197	0.8440	0.7196	0.5524	0.4148	0.4597	0.6753	0.8764	0.9531	0.9754	(86)
MIT	19.2529	19.5282	19.9026	20.3754	20.7289	20.9225	20.9786	20.9691	20.8391	20.3777	19.7435	19.2090	(87)
Th 2	20.0103	20.0125	20.0146	20.0245	20.0264	20.0351	20.0351	20.0367	20.0317	20.0264	20.0226	20.0187	(88)
util rest of house	0.9662	0.9437	0.9048	0.8156	0.6710	0.4816	0.3288	0.3708	0.6070	0.8472	0.9429	0.9707	(89)
MIT 2	17.9839	18.3310	18.7985	19.3771	19.7792	19.9804	20.0249	20.0209	19.9062	19.3948	18.6134	17.9340	(90)
Living area fraction									fLA = Living area / (4) =			0.1765	(91)
MIT	18.2078	18.5423	18.9933	19.5533	19.9468	20.1467	20.1931	20.1882	20.0708	19.5682	18.8128	18.1590	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2078	18.5423	18.9933	19.5533	19.9468	20.1467	20.1931	20.1882	20.0708	19.5682	18.8128	18.1590	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9527	0.9268	0.8857	0.7999	0.6667	0.4902	0.3432	0.3852	0.6099	0.8309	0.9264	0.9583	(94)
Useful gains	701.7784	791.4362	833.4907	836.5906	741.8225	540.6635	362.2002	378.5297	554.3301	669.3332	677.1111	674.3963	(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	1464.4061	1432.9674	1309.1685	1103.8606	852.7016	567.8499	367.8536	387.1052	613.6162	927.2904	1216.2721	1455.9950	(97)
Space heating kWh	567.3950	431.1090	353.9043	192.4344	82.4941	0.0000	0.0000	0.0000	0.0000	191.9201	388.1959	581.5095	(98a)
Space heating requirement - total per year (kWh/year)												2788.9623	
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	567.3950	431.1090	353.9043	192.4344	82.4941	0.0000	0.0000	0.0000	0.0000	191.9201	388.1959	581.5095	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2788.9623	
Space heating per m2											(98c) / (4) =	28.8295	(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	567.3950	431.1090	353.9043	192.4344	82.4941	0.0000	0.0000	0.0000	0.0000	191.9201	388.1959	581.5095	(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)	614.7292	467.0736	383.4282	208.4880	89.3760	0.0000	0.0000	0.0000	0.0000	207.9308	420.5806	630.0211	(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	244.8547	216.5160	230.2233	203.2022	197.4412	178.4388	176.6199	183.4241	185.1767	205.8252	217.9962	242.3113	(64)
Efficiency of water heater												79.8000	(216)
(217)m	85.8802	85.5734	85.0207	83.9378	82.2568	79.8000	79.8000	79.8000	79.8000	83.9032	85.3388	85.9488	(217)
Fuel for water heating, kWh/month	285.1120	253.0178	270.7848	242.0866	240.0303	223.6075	221.3282	229.8548	232.0510	245.3127	255.4479	281.9250	(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	26.8162	21.5129	19.3700	14.1913	10.9618	8.9559	9.9997	12.9980	16.8831	22.1515	25.0201	27.5615	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-44.3892	-62.1417	-88.6977	-98.9934	-106.1063	-98.7756	-97.5103	-92.3372	-83.1543	-70.6657	-48.6269	-38.4250	(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	-26.4340	-55.4479	-109.9284	-164.7213	-217.4573	-218.4026	-215.8735	-182.9742	-134.3455	-79.2173	-35.2639	-20.9192	(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	3021.6276	(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	2980.5586	(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)	216.4219	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-2390.8084	(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	3913.7996	(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	3021.6276	0.2100	634.5418	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2980.5586	0.2100	625.9173	(264)
Space and water heating			1260.4591	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	216.4219	0.1443	31.2364	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-929.8233	0.1347	-125.2907	
PV Unit electricity exported	-1460.9851	0.1260	-184.0263	
Total			-309.3170	(269)
Total CO2, kg/year			994.3077	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			10.2800	(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	3021.6276	1.1300	3414.4392	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2980.5586	1.1300	3368.0312	(278)
Space and water heating			6782.4704	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	216.4219	1.5338	331.9551	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-929.8233	1.4980	-1392.8851	
PV Unit electricity exported	-1460.9851	0.4624	-675.5069	
Total			-2068.3920	(283)
Total Primary energy kWh/year			5176.1343	(286)
Target Primary Energy Rate (TPER)			53.5100	(287)

Building Regulations England Part L (BREL) Compliance Report

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

Date: Fri 14 Mar 2025 09:30:51

Project Information			
Assessed By	Richard Millard	Building Type	House, Semi-detached
OCDEA Registration	EES/025661	Assessment Date	2025-03-14

Dwelling Details			
Assessment Type	As designed	Total Floor Area	98 m^2
Site Reference	M+	Plot Reference	Proposed
Address	49		

Client Details	
Name	Ian White
Company	Cotswold Homes Ltd
Address	West House, Yate, Bristol, BS37 5NG

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

1a Target emission rate and dwelling emission rate		
Fuel for main heating system	Electricity	
Target carbon dioxide emission rate	*10.38 $kgCO_2/m^2$*	
Dwelling carbon dioxide emission rate	3.07 $kgCO_2/m^2$	OK
1b Target primary energy rate and dwelling primary energy		
Target primary energy	*54.04 kWh_{PE}/m^2*	
Dwelling primary energy	35.55 kWh_{PE}/m^2	OK
1c Target fabric energy efficiency and dwelling fabric energy efficiency		
Target fabric energy efficiency	*37.1 kWh/m^2*	
Dwelling fabric energy efficiency	35.5 kWh/m^2	OK

2a Fabric U-values				
Element	***Maximum permitted average U-Value [W/m^2K]***	**Dwelling average U-Value [W/m^2K]**	**Element with highest individual U-Value**	
External walls	*0.26*	0.18	Walls (1) (0.18)	OK
Party walls	*0.2*	0	Party Wall (1) (0)	**N/A**
Curtain walls	*1.6*	0	N/A	**N/A**
Floors	*0.18*	0.12	Heatloss Floor 1 (0.12)	OK
Roofs	*0.16*	0.11	Roof (2) (0.13)	OK
Windows, doors, and roof windows	*1.6*	1.2	WG01 (1.2)	OK
Rooflights	*2.2*	N/A	N/A	**N/A**

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))		
Name	**Net area [m^2]**	**U-Value [W/m^2K]**
Exposed wall: Walls (1)	82.45	0.18
Party wall: Party Wall (1)	43.82	0 **(!)**
Ground floor: Heatloss Floor 1, Heatloss Floor 1	49.99	0.12
Exposed roof: Roof (1)	48.37	0.11
Exposed roof: Roof (2)	1.62	0.13

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	**Area [m^2]**	**Orientation**	**Frame factor**	**U-Value [W/m^2K]**
WG01, Windows	2.19	East	0.7	1.2
WG02, Windows	0.59	East	0.7	1.2
WG03, Windows	1.33	East	0.7	1.2
FG01, Windows	2.16	East	0.7	1.2
FG02, Windows	1.08	East	0.7	1.2
FG03, Windows	0.74	North	0.7	1.2
FG04, Windows	1.43	West	0.7	1.2
FG05, Windows	1.43	West	0.7	1.2
ED01, Doors	2.04	East	N/A	1.2
ED02, Glazed Doors	5.08	West	0.7	1.2
WG04, Windows	2.62	South	0.7	1.2
WG06, Windows	1.44	West	0.7	1.2

Name	Area [m^2]	Orientation	Frame factor	U-Value [W/m^2K]
WG05, Windows	1.33	West	0.7	1.2

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))				
Building part **1**: Thermal bridging calculated from linear thermal transmittances for each junction				
Main element	**Junction detail**	**Source**	**Psi value [W/mK]**	**Drawing / reference**
External wall	E1: Steel lintel with perforated steel base plate	Calculated by person with suitable expertise	0.241	EMPF125E101
External wall	E3: Sill	Calculated by person with suitable expertise	0.026 **(!)**	EMPF125E301
External wall	E4: Jamb	Calculated by person with suitable expertise	0.02 **(!)**	EMPF125E401
External wall	E5: Ground floor (normal)	Calculated by person with suitable expertise	0.045	EMPF125E504
External wall	E6: Intermediate floor within a dwelling	Calculated by person with suitable expertise	0.002 **(!)**	EMPF125E601
External wall	E10: Eaves (insulation at ceiling level)	Calculated by person with suitable expertise	0.05	EMPF125E1001
External wall	E12: Gable (insulation at ceiling level)	Calculated by person with suitable expertise	0.031 **(!)**	EMPF125E1201
External wall	E16: Corner (normal)	Calculated by person with suitable expertise	0.037 **(!)**	EMPF125E21601
External wall	E17: Corner (inverted - internal area greater than external area)	Calculated by person with suitable expertise	-0.09	EMPF125E21701
External wall	E18: Party wall between dwellings	Calculated by person with suitable expertise	0.06	EMPF125E21802

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

4 Space heating	
Main heating system 1: Heat pump with radiators or underfloor heating - Electricity	
Efficiency	239.4%
Emitter type	Radiators
Flow temperature	55°C
System type	Heat Pump
Manufacturer	Daikin Europe NV
Model	EDLA08EV3
Commissioning	
Secondary heating system: N/A	
Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water	
Cylinder/store - type: Cylinder	
Capacity	210 litres
Declared heat loss	1.7 kWh/day
Primary pipework insulated	Yes
Manufacturer	
Model	
Commissioning	
Waste water heat recovery system 1 - type: N/A	
Efficiency	
Manufacturer	
Model	

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

Water heating - type: Cylinder thermostat and HW separately timed	
Manufacturer	
Model	

7 Lighting		
Minimum permitted light source efficacy	*75 lm/W*	
Lowest light source efficacy	85 lm/W	**OK**
External lights control	N/A	

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

9 Local generation	
Technology type: **Photovoltaic system (1)**	
Peak power	1.34 kWp
Orientation	South
Pitch	30°
Overshading	None or very little
Manufacturer	
MCS certificate	

10 Heat networks
N/A

11 Supporting documentary evidence
N/A

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

Full SAP Calculation Printout

Property Reference	M+	**Issued on Date**	14/03/2025
Assessment Reference	Proposed	**Prop Type Ref**	Proposed 49
Property	49		

SAP Rating	86 B	**DER**	3.07	**TER**	10.38
Environmental	97 A	**% DER < TER**			70.42
CO_2 Emissions (t/year)	0.27	**DFEE**	35.52	**TFEE**	37.14
Compliance Check	See BREL	**% DFEE < TFEE**			4.36
% DPER < TPER	34.22	**DPER**	35.55	**TPER**	54.04

Assessor Details	Mr. Richard Millard	**Assessor ID**	U367-0001
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)	
Main dwelling						
Ground floor	49.9900 (1b)	x	2.4000 (2b)	=	119.9760	(1b) - (3b)
First floor	48.3700 (1c)	x	2.6000 (2c)	=	125.7620	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	98.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	245.7380	(5)

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2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1221	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3721	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3163	(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	0.4032	0.3953	0.3874	0.3479	0.3400	0.3005	0.3005	0.2925	0.3163	0.3400	0.3558	0.3716	(22b)
Effective ac	0.5813	0.5781	0.5751	0.5605	0.5578	0.5451	0.5451	0.5428	0.5500	0.5578	0.5633	0.5690	(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	
Main dwelling								
Windows			16.3400	1.1450	18.7099			(27)
Glazed Doors			5.0800	1.1450	5.8168			(27)
Doors			2.0400	1.2000	2.4480			(26)
Heatloss Floor 1			49.9900	0.1200	5.9988	75.0000	3749.2500	(28a)
Cavity Wall	105.9100	23.4600	82.4500	0.1800	14.8410	60.0000	4947.0002	(29a)
External Roof 1	48.3700		48.3700	0.1100	5.3207	9.0000	435.3300	(30)
External Roof 2	1.6200		1.6200	0.1300	0.2106	9.0000	14.5800	(30)
Total net area of external elements Aum(A, m2)			205.8900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		53.3458			(33)
Main dwelling								
Party Wall 1			43.8200	0.0000	0.0000	45.0000	1971.9000	(32)
Internal Wall 2 - Stud			77.0000			9.0000	693.0000	(32c)
Internal Wall 3 - Up			135.3000			9.0000	1217.7000	(32c)
Internal Floor 1			48.3700			18.0000	870.6600	(32d)
Internal Ceiling 1			49.9900			9.0000	449.9100	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		14349.3302	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							145.8858	(35)
List of Thermal Bridges								

	Length	Psi-value	Total	
K1 Element				
E1 Steel lintel with perforated steel base plate	16.1900	0.2410	3.9018	
E3 Sill	12.8100	0.0260	0.3331	
E4 Jamb	33.3400	0.0200	0.6668	
E5 Ground floor (normal)	30.8900	0.0450	1.3901	
E6 Intermediate floor within a dwelling	29.0800	0.0020	0.0582	
E10 Eaves (insulation at ceiling level)	12.3200	0.0500	0.6160	
E12 Gable (insulation at ceiling level)	4.6300	0.0310	0.1435	
E16 Corner (normal)	24.8000	0.0370	0.9176	
E17 Corner (inverted - internal area greater than external area)	9.8000	-0.0900	-0.8820	
E18 Party wall between dwellings	8.7600	0.0600	0.5256	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			7.6706	(36)
Point Thermal bridges		(36a) =	0.0000	
Total fabric heat loss		(33) + (36) + (36a) =	61.0164	(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	47.1399	46.8839	46.6329	45.4542	45.2337	44.2071	44.2071	44.0170	44.6025	45.2337	45.6798	46.1462	(38)
Heat transfer coeff	108.1563	107.9003	107.6493	106.4706	106.2501	105.2235	105.2235	105.0334	105.6189	106.2501	106.6962	107.1626	(39)
Average = Sum(39)m / 12 =												106.4696	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0996	1.0970	1.0944	1.0825	1.0802	1.0698	1.0698	1.0678	1.0738	1.0802	1.0848	1.0895	(40)
HLP (average)												1.0824	
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												2.7238	(42)
Hot water usage for mixer showers	69.8892	68.8389	67.3084	64.3801	62.2191	59.8091	58.4393	59.9582	61.6232	64.2108	67.2020	69.6215	(42a)
Hot water usage for baths	30.1779	29.7297	29.0986	27.9349	27.0635	26.0973	25.5754	26.2021	26.8845	27.9184	29.1060	30.0759	(42b)
Hot water usage for other uses	42.5246	40.9783	39.4319	37.8856	36.3392	34.7929	34.7929	36.3392	37.8856	39.4319	40.9783	42.5246	(42c)
Average daily hot water use (litres/day)												131.0739	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	142.5917	139.5469	135.8389	130.2005	125.6218	120.6993	118.8076	122.4995	126.3933	131.5611	137.2863	142.2219	(44)
Energy conte	225.8304	198.7129	208.7793	178.2380	169.1111	148.4138	143.6874	151.6800	155.8555	178.5271	195.5895	222.6851	(45)
Energy content (annual)										Total = Sum(45)m =		2177.1103	
Distribution loss (46)m = 0.15 x (45)m	33.8746	29.8069	31.3169	26.7357	25.3667	22.2621	21.5531	22.7520	23.3783	26.7791	29.3384	33.4028	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9180	(55)
Total storage loss	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(56)
If cylinder contains dedicated solar storage	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(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	277.5508	245.4281	260.4997	228.2900	220.8315	198.4658	195.4078	203.4004	205.9075	230.2475	245.6415	274.4055	(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	277.5508	245.4281	260.4997	228.2900	220.8315	198.4658	195.4078	203.4004	205.9075	230.2475	245.6415	274.4055	(64)
										Total per year (kWh/year) = Sum(64)m =		2786.0763	(64)
12Total per year (kWh/year)												2786	(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	116.4649	103.4442	110.7954	99.3057	97.6058	89.3892	89.1524	91.8099	91.8636	100.7366	105.0751	115.4191	(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	136.1908	136.1908	136.1908	136.1908	136.1908	136.1908	136.1908	136.1908	136.1908	136.1908	136.1908	136.1908	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	128.0281	141.7454	128.0281	132.2957	128.0281	132.2957	128.0281	128.0281	132.2957	128.0281	132.2957	128.0281	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	253.6489	256.2810	249.6482	235.5278	217.7034	200.9510	189.7593	187.1272	193.7600	207.8804	225.7048	242.4572	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.6191	36.6191	36.6191	36.6191	36.6191	36.6191	36.6191	36.6191	36.6191	36.6191	36.6191	36.6191	(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)	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	(71)
Water heating gains (Table 5)	156.5389	153.9348	148.9186	137.9246	131.1905	124.1517	119.8285	123.4004	127.5883	135.3986	145.9377	155.1332	(72)
Total internal gains	602.0731	615.8184	590.4522	569.6054	540.7793	521.2556	501.4731	502.4130	517.5012	535.1643	567.7954	589.4758	(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	0.7400	10.6334	0.6300	0.7000	0.7700	2.4048	(74)
East	7.3500	19.6403	0.6300	0.7000	0.7700	44.1171	(76)
South	2.6200	46.7521	0.6300	0.7000	0.7700	37.4347	(78)
West	5.6300	19.6403	0.6300	0.7000	0.7700	33.7931	(80)

West			5.0800		19.6403		0.6300		0.7000		0.7700		30.4918 (80)
Solar gains	148.2413	277.9611	435.1329	610.1369	733.0758	745.5856	711.7095	619.9395	497.1360	323.2209	182.5039	123.4962	(83)
Total gains	750.3145	893.7795	1025.5851	1179.7423	1273.8551	1266.8412	1213.1827	1122.3526	1014.6372	858.3853	750.2992	712.9720	(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	36.8534	36.9408	37.0269	37.4369	37.5146	37.8806	37.8806	37.9491	37.7387	37.5146	37.3577	37.1951	
alpha	3.4569	3.4627	3.4685	3.4958	3.5010	3.5254	3.5254	3.5299	3.5159	3.5010	3.4905	3.4797	
util living area	0.9714	0.9487	0.9057	0.8105	0.6707	0.5031	0.3736	0.4177	0.6368	0.8643	0.9519	0.9756	(86)
Living	19.2252	19.5341	19.9573	20.4503	20.7785	20.9401	20.9839	20.9761	20.8628	20.3986	19.7283	19.1750	
Non living	17.9436	18.3322	18.8574	19.4531	19.8190	19.9842	20.0181	20.0152	19.9172	19.4107	18.5885	17.8856	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	20.0921	19.5341	19.9573	20.4503	20.7785	20.9401	20.9839	20.9761	20.8628	20.3986	19.7283	19.4303	(87)
Th 2	20.0012	20.0033	20.0054	20.0152	20.0170	20.0256	20.0256	20.0272	20.0223	20.0170	20.0133	20.0094	(88)
util rest of house	0.9660	0.9394	0.8888	0.7788	0.6205	0.4353	0.2942	0.3345	0.5678	0.8333	0.9416	0.9709	(89)
MIT 2	19.1809	18.3322	18.8574	19.4531	19.8190	19.9842	20.0181	20.0152	19.9172	19.4107	18.5885	18.2683	(90)
Living area fraction									fLA = Living area / (4) =			0.1919	(91)
MIT	19.3558	18.5629	19.0685	19.6445	20.0031	20.1677	20.2035	20.1997	20.0987	19.6003	18.8072	18.4913	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.3558	18.5629	19.0685	19.6445	20.0031	20.1677	20.2035	20.1997	20.0987	19.6003	18.8072	18.4913	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9618	0.9220	0.8696	0.7654	0.6198	0.4455	0.3090	0.3496	0.5736	0.8178	0.9250	0.9614	(94)
Useful gains	721.6271	824.1018	891.8820	903.0323	789.5222	564.4293	374.8260	392.3468	581.9871	701.9948	694.0257	685.4325	(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	1628.3778	1474.2304	1352.9957	1143.9706	882.2102	585.8530	379.1680	399.0943	633.5799	956.2877	1249.1188	1531.4981	(97)
Space heating kWh	674.6226	436.8864	343.0686	173.4756	68.9598	0.0000	0.0000	0.0000	0.0000	189.1939	399.6671	629.4728	(98a)
Space heating requirement - total per year (kWh/year)												2915.3468	
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	674.6226	436.8864	343.0686	173.4756	68.9598	0.0000	0.0000	0.0000	0.0000	189.1939	399.6671	629.4728	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2915.3468	
Space heating per m2											(98c) / (4) =	29.6396	(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 %)												239.4198	(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	674.6226	436.8864	343.0686	173.4756	68.9598	0.0000	0.0000	0.0000	0.0000	189.1939	399.6671	629.4728	(98)
Space heating efficiency (main heating system 1)	239.4198	239.4198	239.4198	239.4198	239.4198	0.0000	0.0000	0.0000	0.0000	239.4198	239.4198	239.4198	(210)
Space heating fuel (main heating system)	281.7739	182.4771	143.2916	72.4567	28.8029	0.0000	0.0000	0.0000	0.0000	79.0218	166.9315	262.9159	(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	277.5508	245.4281	260.4997	228.2900	220.8315	198.4658	195.4078	203.4004	205.9075	230.2475	245.6415	274.4055	(64)
Efficiency of water heater												170.0752	(216)
(217)m	170.0752	170.0752	170.0752	170.0752	170.0752	170.0752	170.0752	170.0752	170.0752	170.0752	170.0752	170.0752	(217)
Fuel for water heating, kWh/month	163.1930	144.3056	153.1674	134.2288	129.8434	116.6930	114.8949	119.5944	121.0685	135.3798	144.4311	161.3436	(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	26.0580	20.9047	18.8223	13.7901	10.6518	8.7026	9.7170	12.6305	16.4057	21.5252	24.3127	26.7822	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-27.2819	-41.4700	-64.0759	-76.2731	-85.2690	-79.4953	-78.3930	-71.9222	-60.8290	-48.6417	-30.7619	-23.1480	(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	-6.2761	-14.5286	-31.2961	-51.5442	-72.6384	-75.7529	-74.8035	-61.9264	-44.0012	-22.9451	-9.0427	-4.9343	(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												1217.6715	(211)
Space heating fuel - main system 2												0.0000	(213)

Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	170.0752	
Water heating fuel used	1638.1435	(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)	210.3029	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-1157.2504	(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	1908.8675	(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	1217.6715	0.1561	190.0213	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1638.1435	0.1410	230.8992	(264)
Space and water heating			420.9205	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	210.3029	0.1443	30.3532	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-687.5609	0.1335	-91.7992	
PV Unit electricity exported	-469.6895	0.1233	-57.9017	
Total			-149.7009	(269)
Total CO2, kg/year			301.5728	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			3.0700	(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	1217.6715	1.5777	1921.1030	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1638.1435	1.5212	2491.9293	(278)
Space and water heating			4413.0323	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	210.3029	1.5338	322.5695	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-687.5609	1.4934	-1026.7987	
PV Unit electricity exported	-469.6895	0.4524	-212.4746	
Total			-1239.2733	(283)
Total Primary energy kWh/year			3496.3285	(286)
Dwelling Primary energy Rate (DPER)			35.5500	(287)

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Main dwelling						
Ground floor	49.9900	(1b) x	2.4000	(2b) =	119.9760	(1b) - (3b)
First floor	48.3700	(1c) x	2.6000	(2c) =	125.7620	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	98.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		245.7380	(5)

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2. Ventilation rate

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		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	3 * 10 =	30.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1221	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3721	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)

Infiltration rate adjusted to include shelter factor (21) = (18) x (20) = 0.3163 (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	0.4032	0.3953	0.3874	0.3479	0.3400	0.3005	0.3005	0.2925	0.3163	0.3400	0.3558	0.3716	(22b)
Effective ac	0.5813	0.5781	0.5751	0.5605	0.5578	0.5451	0.5451	0.5428	0.5500	0.5578	0.5633	0.5690	(25)

3. Heat losses and heat loss parameter

Element	Gross	Openings	NetArea	U-value	A x U	K-value	A x K	
Main dwelling	m2	m2	m2	W/m2K	W/K	kJ/m2K	kJ/K	
TER Opaque door			2.0400	1.0000	2.0400			(26)
TER Opening Type			21.4200	1.1450	24.5267			(27)
Heatloss Floor 1			49.9900	0.1300	6.4987			(28a)
Cavity Wall	105.9100	23.4600	82.4500	0.1800	14.8410			(29a)
External Roof 1	48.3700		48.3700	0.1100	5.3207			(30)
External Roof 2	1.6200		1.6200	0.1100	0.1782			(30)
Total net area of external elements Aum(A, m2)			205.8900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		53.4053			(33)
Main dwelling								
Party Wall 1			43.8200	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 145.8858 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	16.1900	0.0500	0.8095
E3 Sill	12.8100	0.0500	0.6405
E4 Jamb	33.3400	0.0500	1.6670
E5 Ground floor (normal)	30.8900	0.1600	4.9424
E6 Intermediate floor within a dwelling	29.0800	0.0000	0.0000
E10 Eaves (insulation at ceiling level)	12.3200	0.0600	0.7392
E12 Gable (insulation at ceiling level)	4.6300	0.0600	0.2778
E16 Corner (normal)	24.8000	0.0900	2.2320
E17 Corner (inverted - internal area greater than external area)	9.8000	-0.0900	-0.8820
E18 Party wall between dwellings	8.7600	0.0600	0.5256

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 10.9520 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 64.3573 (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	47.1399	46.8839	46.6329	45.4542	45.2337	44.2071	44.2071	44.0170	44.6025	45.2337	45.6798	46.1462	(38)
Heat transfer coeff	111.4972	111.2412	110.9902	109.8115	109.5910	108.5644	108.5644	108.3743	108.9598	109.5910	110.0371	110.5035	(39)
Average = Sum(39)m / 12 =												109.8105	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1336	1.1310	1.1284	1.1164	1.1142	1.1037	1.1037	1.1018	1.1078	1.1142	1.1187	1.1235	(40)
HLP (average)												1.1164	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.7238 (42)

Hot water usage for mixer showers

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
69.8892	68.8389	67.3084	64.3801	62.2191	59.8091	58.4393	59.9582	61.6232	64.2108	67.2020	69.6215	(42a)

Hot water usage for baths

30.1779	29.7297	29.0986	27.9349	27.0635	26.0973	25.5754	26.2021	26.8845	27.9184	29.1060	30.0759	(42b)

Hot water usage for other uses

42.5246	40.9783	39.4319	37.8856	36.3392	34.7929	34.7929	36.3392	37.8856	39.4319	40.9783	42.5246	(42c)

Average daily hot water use (litres/day) 131.0739 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	142.5917	139.5469	135.8389	130.2005	125.6218	120.6993	118.8076	122.4995	126.3933	131.5611	137.2863	142.2219	(44)
Energy conte	225.8304	198.7129	208.7793	178.2380	169.1111	148.4138	143.6874	151.6800	155.8555	178.5271	195.5895	222.6851	(45)
Energy content (annual)										Total = Sum(45)m =		2177.1103	
Distribution loss (46)m = 0.15 x (45)m	33.8746	29.8069	31.3169	26.7357	25.3667	22.2621	21.5531	22.7520	23.3783	26.7791	29.3384	33.4028	(46)

Water storage loss:

Store volume 210.0000 (47)

a) If manufacturer declared loss factor is known (kWh/day): 1.7016 (48)

Temperature factor from Table 2b 0.5400 (49)

Enter (49) or (54) in (55) 0.9188 (55)

Total storage loss

28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(56)

If cylinder contains dedicated solar storage

28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(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)

Total heat required for water heating calculated for each month

277.5770	245.4518	260.5259	228.3154	220.8577	198.4912	195.4340	203.4266	205.9329	230.2737	245.6668	274.4317	(62)
-31.9504	-28.2572	-29.5893	-24.5011	-22.8342	-19.5394	-18.3150	-19.4762	-20.2162	-23.8327	-26.9995	-31.3588	(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)

Output from w/h

245.6266	217.1945	230.9366	203.8142	198.0235	178.9518	177.1190	183.9504	185.7167	206.4411	218.6673	243.0730	(64)
								Total per year (kWh/year) = Sum(64)m =			2489.5146	(64)

12Total per year (kWh/year) 2490 (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

116.4859	103.4631	110.8164	99.3260	97.6267	89.4095	89.1733	91.8309	91.8838	100.7575	105.0954	115.4401	(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	136.1908	136.1908	136.1908	136.1908	136.1908	136.1908	136.1908	136.1908	136.1908	136.1908	136.1908	136.1908	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	128.0281	141.7454	128.0281	132.2957	128.0281	132.2957	128.0281	128.0281	132.2957	128.0281	132.2957	128.0281	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	253.6489	256.2810	249.6482	235.5278	217.7034	200.9510	189.7593	187.1272	193.7600	207.8804	225.7048	242.4572	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.6191	36.6191	36.6191	36.6191	36.6191	36.6191	36.6191	36.6191	36.6191	36.6191	36.6191	36.6191	(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)													
	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	(71)
Water heating gains (Table 5)													
	156.5671	153.9630	148.9468	137.9528	131.2187	124.1798	119.8566	123.4286	127.6165	135.4268	145.9658	155.1614	(72)
Total internal gains													
	605.1013	618.8466	593.4803	572.6336	543.8074	521.2837	501.5013	502.4412	517.5294	538.1925	570.8235	592.5040	(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	0.7400	10.6334	0.6300	0.7000	0.7700	2.4048	(74)
East	7.3500	19.6403	0.6300	0.7000	0.7700	44.1171	(76)
South	2.6200	46.7521	0.6300	0.7000	0.7700	37.4347	(78)
West	10.7100	19.6403	0.6300	0.7000	0.7700	64.2848	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	148.2413	277.9611	435.1329	610.1369	733.0758	745.5856	711.7095	619.9395	497.1360	323.2209	182.5039	123.4962	(83)
Total gains	753.3426	896.8077	1028.6133	1182.7704	1276.8832	1266.8694	1213.2108	1122.3807	1014.6654	861.4134	753.3274	716.0002	(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	35.7491	35.8314	35.9124	36.2979	36.3709	36.7148	36.7148	36.7793	36.5816	36.3709	36.2235	36.0706	
alpha	3.3833	3.3888	3.3942	3.4199	3.4247	3.4477	3.4477	3.4520	3.4388	3.4247	3.4149	3.4047	
util living area													
	0.9716	0.9497	0.9082	0.8165	0.6803	0.5149	0.3840	0.4288	0.6479	0.8682	0.9527	0.9757	(86)
MIT	19.1557	19.4659	19.8965	20.4048	20.7529	20.9301	20.9805	20.9715	20.8448	20.3571	19.6697	19.1051	(87)
Th 2	19.9735	19.9756	19.9777	19.9874	19.9893	19.9978	19.9978	19.9994	19.9945	19.9893	19.9856	19.9817	(88)
util rest of house													
	0.9661	0.9404	0.8914	0.7848	0.6292	0.4446	0.3005	0.3416	0.5775	0.8373	0.9424	0.9710	(89)
MIT 2	17.8380	18.2285	18.7636	19.3788	19.7683	19.9496	19.9888	19.9852	19.8757	19.3414	18.4969	17.7794	(90)
Living area fraction									fLA = Living area / (4) =			0.1919	(91)
MIT	18.0909	18.4660	18.9810	19.5757	19.9573	20.1378	20.1792	20.1745	20.0618	19.5364	18.7221	18.0339	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.0909	18.4660	18.9810	19.5757	19.9573	20.1378	20.1792	20.1745	20.0618	19.5364	18.7221	18.0339	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9523	0.9226	0.8715	0.7703	0.6275	0.4548	0.3160	0.3573	0.5825	0.8209	0.9253	0.9583	(94)
Useful gains	717.3902	827.3566	896.4706	911.0914	801.2717	576.1138	383.3228	400.9977	591.0820	707.1070	697.0884	686.1710	(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													
	1537.6511	1509.1006	1385.2712	1172.3201	904.9259	601.2090	388.5684	409.0637	649.5915	979.3472	1278.8575	1528.6917	(97)
Space heating kWh													
	610.2741	458.1320	363.6676	188.0847	77.1187	0.0000	0.0000	0.0000	0.0000	202.5468	418.8737	626.8354	(98a)
Space heating requirement - total per year (kWh/year)												2945.5330	
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													
	610.2741	458.1320	363.6676	188.0847	77.1187	0.0000	0.0000	0.0000	0.0000	202.5468	418.8737	626.8354	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2945.5330	
Space heating per m2											(98c) / (4) =	29.9465	(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													
	610.2741	458.1320	363.6676	188.0847	77.1187	0.0000	0.0000	0.0000	0.0000	202.5468	418.8737	626.8354	(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)													
	661.1854	496.3510	394.0061	203.7754	83.5522	0.0000	0.0000	0.0000	0.0000	219.4440	453.8177	679.1283	(211)
Space heating efficiency (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	245.6266	217.1945	230.9366	203.8142	198.0235	178.9518	177.1190	183.9504	185.7167	206.4411	218.6673	243.0730	(64)
Efficiency of water heater												79.8000	(216)
(217)m	86.0160	85.6918	85.0735	83.8801	82.1332	79.8000	79.8000	79.8000	79.8000	84.0171	85.4929	86.0871	(217)

Fuel for water heating, kWh/month													
	285.5592	253.4602	271.4553	242.9829	241.1004	224.2504	221.9536	230.5143	232.7277	245.7132	255.7725	282.3572	(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	26.6017	21.3409	19.2151	14.0778	10.8741	8.8842	9.9197	12.8940	16.7481	21.9744	24.8200	27.3411	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-45.6073	-63.7137	-90.7575	-101.0832	-108.1731	-100.6359	-99.3378	-94.1425	-84.9083	-72.3420	-49.9097	-39.4945	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-27.5880	-57.8142	-114.5210	-171.4638	-226.2273	-227.1652	-224.5418	-190.3896	-139.8760	-82.5609	-36.7907	-21.8372	(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	3191.2600	(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	2987.8468	(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)	214.6910	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-2470.8811	(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	4008.9167	(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	3191.2600	0.2100	670.1646	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2987.8468	0.2100	627.4478	(264)
Space and water heating			1297.6124	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	214.6910	0.1443	30.9866	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-950.1055	0.1348	-128.0659	
PV Unit electricity exported	-1520.7755	0.1260	-191.5933	
Total			-319.6592	(269)
Total CO2, kg/year			1020.8691	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			10.3800	(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	3191.2600	1.1300	3606.1238	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2987.8468	1.1300	3376.2669	(278)
Space and water heating			6982.3907	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	214.6910	1.5338	329.3003	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-950.1055	1.4982	-1423.4263	
PV Unit electricity exported	-1520.7755	0.4625	-703.2847	
Total			-2126.7110	(283)
Total Primary energy kWh/year			5315.0807	(286)
Target Primary Energy Rate (TPER)			54.0400	(287)

Building Regulations England Part L (BREL) Compliance Report

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

Date: Fri 14 Mar 2025 09:30:56

Project Information			
Assessed By	Richard Millard	Building Type	House, Semi-detached
OCDEA Registration	EES/025661	Assessment Date	2025-03-14

Dwelling Details			
Assessment Type	As designed	Total Floor Area	98 m^2
Site Reference	M+	Plot Reference	Regulated (Baseline)
Address	49		

Client Details	
Name	Ian White
Company	Cotswold Homes Ltd
Address	West House, Yate, Bristol, BS37 5NG

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

1a Target emission rate and dwelling emission rate		
Fuel for main heating system	Mains gas	
Target carbon dioxide emission rate	*10.36 $kgCO_2/m^2$*	
Dwelling carbon dioxide emission rate	14.67 $kgCO_2/m^2$	**FAIL**
1b Target primary energy rate and dwelling primary energy		
Target primary energy	*53.93 kWh_{PE}/m^2*	
Dwelling primary energy	81.2 kWh_{PE}/m^2	**FAIL**
1c Target fabric energy efficiency and dwelling fabric energy efficiency		
Target fabric energy efficiency	*37.1 kWh/m^2*	
Dwelling fabric energy efficiency	37.1 kWh/m^2	**OK**

2a Fabric U-values				
Element	***Maximum permitted average U-Value [W/m^2K]***	**Dwelling average U-Value [W/m^2K]**	**Element with highest individual U-Value**	
External walls	*0.26*	0.18	Walls (1) (0.18)	**OK**
Party walls	*0.2*	0	Party Wall (1) (0)	**N/A**
Curtain walls	*1.6*	0	N/A	**N/A**
Floors	*0.18*	0.13	Heatloss Floor 1 (0.13)	**OK**
Roofs	*0.16*	0.11	Roof (1) (0.11)	**OK**
Windows, doors, and roof windows	*1.6*	1.2	WG01 (1.2)	**OK**
Rooflights	*2.2*	N/A	N/A	**N/A**

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))		
Name	**Net area [m^2]**	**U-Value [W/m^2K]**
Exposed wall: Walls (1)	82.45	0.18
Party wall: Party Wall (1)	43.82	0 **(!)**
Ground floor: Heatloss Floor 1, Heatloss Floor 1	49.99	0.13
Exposed roof: Roof (1)	48.37	0.11
Exposed roof: Roof (2)	1.62	0.11

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	**Area [m^2]**	**Orientation**	**Frame factor**	**U-Value [W/m^2K]**
WG01, Windows	2.19	East	0.7	1.2
WG02, Windows	0.59	East	0.7	1.2
WG03, Windows	1.33	East	0.7	1.2
FG01, Windows	2.16	East	0.7	1.2
FG02, Windows	1.08	East	0.7	1.2
FG03, Windows	0.74	North	0.7	1.2
FG04, Windows	1.43	West	0.7	1.2
FG05, Windows	1.43	West	0.7	1.2
ED01, Doors	2.04	East	N/A	1.2
ED02, Glazed Doors	5.08	West	0.7	1.2
WG04, Windows	2.62	South	0.7	1.2
WG06, Windows	1.44	West	0.7	1.2

Name	Area [m^2]	Orientation	Frame factor	U-Value [W/m^2K]
WG05, Windows	1.33	West	0.7	1.2

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))				
Building part **1**: Thermal bridging calculated from linear thermal transmittances for each junction				
Main element	**Junction detail**	**Source**	**Psi value [W/mK]**	**Drawing / reference**
External wall	E2: Other lintels (including other steel lintels)	Calculated by person with suitable expertise	0.05	mpf125e2-04
External wall	E3: Sill	Calculated by person with suitable expertise	0.05	mpf125e3-01
External wall	E4: Jamb	Calculated by person with suitable expertise	0.022 **(!)**	mpf125e4-01
External wall	E5: Ground floor (normal)	Calculated by person with suitable expertise	0.16	mpf125e5-04
External wall	E6: Intermediate floor within a dwelling	Calculated by person with suitable expertise	0.003 **(!)**	mpf125e6-01
External wall	E10: Eaves (insulation at ceiling level)	Calculated by person with suitable expertise	0.06	mpf125e10-01
External wall	E12: Gable (insulation at ceiling level)	Calculated by person with suitable expertise	0.06	mpf125e12-01
External wall	E16: Corner (normal)	Calculated by person with suitable expertise	0.09	mpf125e16-01
External wall	E17: Corner (inverted - internal area greater than external area)	Calculated by person with suitable expertise	-0.085	mpf125e17-01
External wall	E18: Party wall between dwellings	Calculated by person with suitable expertise	0.09	mpf125e18-02

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

4 Space heating	
Main heating system 1: Boiler with radiators or underfloor heating - Mains gas	
Efficiency	88.6%
Emitter type	Radiators
Flow temperature	45°C
System type	Regular boiler
Manufacturer	Bosch Thermotechnology
Model	Greenstar 8000 Life
Commissioning	
Secondary heating system: N/A	
Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water	
Cylinder/store - type: Cylinder	
Capacity	200 litres
Declared heat loss	2.09 kWh/day
Primary pipework insulated	Yes
Manufacturer	
Model	
Commissioning	
Waste water heat recovery system 1 - type: N/A	
Efficiency	
Manufacturer	
Model	

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

Water heating - type: Cylinder thermostat and HW separately timed	
Manufacturer	
Model	

7 Lighting		
Minimum permitted light source efficacy	*75 lm/W*	
Lowest light source efficacy	85 lm/W	**OK**
External lights control	N/A	

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

9 Local generation
N/A

10 Heat networks
N/A

11 Supporting documentary evidence
N/A

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

Full SAP Calculation Printout

Property Reference	M+	**Issued on Date**	14/03/2025
Assessment Reference	Regulated (Baseline)	**Prop Type Ref**	Proposed 49
Property	49		

SAP Rating	85 B	**DER**	14.67	**TER**	10.36
Environmental	87 B	**% DER < TER**			-41.60
CO_2 Emissions (t/year)	1.36	**DFEE**	37.08	**TFEE**	37.14
Compliance Check	See BREL	**% DFEE < TFEE**			0.16
% DPER < TPER	-50.57	**DPER**	81.20	**TPER**	53.93

Assessor Details	Mr. Richard Millard	**Assessor ID**	U367-0001
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)	
Main dwelling						
Ground floor	49.9900 (1b)	x	2.4000 (2b)	=	119.9760	(1b) - (3b)
First floor	48.3700 (1c)	x	2.6000 (2c)	=	125.7620	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	98.3600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	245.7380	(5)

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2. Ventilation rate

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			m3 per hour	
Number of open chimneys		0 * 80 =	0.0000	(6a)
Number of open flues		0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire		0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler		0 * 20 =	0.0000	(6d)
Number of flues attached to other heater		0 * 35 =	0.0000	(6e)
Number of blocked chimneys		0 * 20 =	0.0000	(6f)
Number of intermittent extract fans		3 * 10 =	30.0000	(7a)
Number of passive vents		0 * 10 =	0.0000	(7b)
Number of flueless gas fires		0 * 40 =	0.0000	(7c)
			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =		30.0000 / (5) =	0.1221	(8)
Pressure test			Yes	
Pressure Test Method			Blower Door	
Measured/design AP50			5.0000	(17)
Infiltration rate			0.3721	(18)
Number of sides sheltered			2	(19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor		(21) = (18) x (20) =	0.3163	(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	0.4032	0.3953	0.3874	0.3479	0.3400	0.3005	0.3005	0.2925	0.3163	0.3400	0.3558	0.3716	(22b)
Effective ac	0.5813	0.5781	0.5751	0.5605	0.5578	0.5451	0.5451	0.5428	0.5500	0.5578	0.5633	0.5690	(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	
Main dwelling								
Windows			16.3400	1.1450	18.7099			(27)
Glazed Doors			5.0800	1.1450	5.8168			(27)
Doors			2.0400	1.2000	2.4480			(26)
Heatloss Floor 1			49.9900	0.1300	6.4987	75.0000	3749.2500	(28a)
Cavity Wall	105.9100	23.4600	82.4500	0.1800	14.8410	60.0000	4947.0000	(29a)
External Roof 1	48.3700		48.3700	0.1100	5.3207	9.0000	435.3300	(30)
External Roof 2	1.6200		1.6200	0.1100	0.1782	9.0000	14.5800	(30)
Total net area of external elements Aum(A, m2)			205.8900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		53.8133			(33)
Main dwelling								
Party Wall 1			43.8200	0.0000	0.0000	45.0000	1971.9000	(32)
Internal Wall 2 - Stud			77.0000			9.0000	693.0000	(32c)
Internal Wall 3 - Up			135.3000			9.0000	1217.7000	(32c)
Internal Floor 1			48.3700			18.0000	870.6600	(32d)
Internal Ceiling 1			49.9900			9.0000	449.9100	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		14349.3300	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							145.8858	(35)
List of Thermal Bridges								

	Length	Psi-value	Total	
K1 Element				
E2 Other lintels (including other steel lintels)	16.1900	0.0500	0.8095	
E3 Sill	12.8100	0.0500	0.6405	
E4 Jamb	33.3400	0.0220	0.7335	
E5 Ground floor (normal)	30.8900	0.1600	4.9424	
E6 Intermediate floor within a dwelling	29.0800	0.0030	0.0872	
E10 Eaves (insulation at ceiling level)	12.3200	0.0600	0.7392	
E12 Gable (insulation at ceiling level)	4.6300	0.0600	0.2778	
E16 Corner (normal)	24.8000	0.0900	2.2320	
E17 Corner (inverted - internal area greater than external area)	9.8000	-0.0850	-0.8330	
E18 Party wall between dwellings	8.7600	0.0900	0.7884	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			10.4175	(36)
Point Thermal bridges		(36a) =	0.0000	
Total fabric heat loss		(33) + (36) + (36a) =	64.2308	(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	47.1399	46.8839	46.6329	45.4542	45.2337	44.2071	44.2071	44.0170	44.6025	45.2337	45.6798	46.1462	(38)
Heat transfer coeff	111.3707	111.1147	110.8637	109.6850	109.4645	108.4379	108.4379	108.2478	108.8333	109.4645	109.9106	110.3771	(39)
Average = Sum(39)m / 12 =												109.6840	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1323	1.1297	1.1271	1.1151	1.1129	1.1025	1.1025	1.1005	1.1065	1.1129	1.1174	1.1222	(40)
HLP (average)												1.1151	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.7238	(42)
Hot water usage for mixer showers	69.8892	68.8389	67.3084	64.3801	62.2191	59.8091	58.4393	59.9582	61.6232	64.2108	67.2020	69.6215	(42a)
Hot water usage for baths	30.1779	29.7297	29.0986	27.9349	27.0635	26.0973	25.5754	26.2021	26.8845	27.9184	29.1060	30.0759	(42b)
Hot water usage for other uses	42.5246	40.9783	39.4319	37.8856	36.3392	34.7929	34.7929	36.3392	37.8856	39.4319	40.9783	42.5246	(42c)
Average daily hot water use (litres/day)												131.0739	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	142.5917	139.5469	135.8389	130.2005	125.6218	120.6993	118.8076	122.4995	126.3933	131.5611	137.2863	142.2219	(44)
Energy conte	225.8304	198.7129	208.7793	178.2380	169.1111	148.4138	143.6874	151.6800	155.8555	178.5271	195.5895	222.6851	(45)
Energy content (annual)										Total = Sum(45)m =		2177.1103	
Distribution loss (46)m = 0.15 x (45)m	33.8746	29.8069	31.3169	26.7357	25.3667	22.2621	21.5531	22.7520	23.3783	26.7791	29.3384	33.4028	(46)
Water storage loss:													
Store volume												200.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												2.0900	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.1286	(55)
Total storage loss	34.9866	31.6008	34.9866	33.8580	34.9866	33.8580	34.9866	34.9866	33.8580	34.9866	33.8580	34.9866	(56)
If cylinder contains dedicated solar storage	34.9866	31.6008	34.9866	33.8580	34.9866	33.8580	34.9866	34.9866	33.8580	34.9866	33.8580	34.9866	(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	284.0794	251.3249	267.0283	234.6080	227.3601	204.7838	201.9364	209.9290	212.2255	236.7761	251.9595	280.9341	(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	284.0794	251.3249	267.0283	234.6080	227.3601	204.7838	201.9364	209.9290	212.2255	236.7761	251.9595	280.9341	(64)
										Total per year (kWh/year) = Sum(64)m =		2862.9453	(64)
12Total per year (kWh/year)												2863	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000	(64a)
Heat gains from water heating, kWh/month	121.6878	108.1616	116.0183	104.3601	102.8286	94.4436	94.3753	97.0328	96.9180	105.9595	110.1295	120.6420	(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	136.1908	136.1908	136.1908	136.1908	136.1908	136.1908	136.1908	136.1908	136.1908	136.1908	136.1908	136.1908	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	128.0281	141.7454	128.0281	132.2957	128.0281	132.2957	128.0281	128.0281	132.2957	128.0281	132.2957	128.0281	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	253.6489	256.2810	249.6482	235.5278	217.7034	200.9510	189.7593	187.1272	193.7600	207.8804	225.7048	242.4572	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.6191	36.6191	36.6191	36.6191	36.6191	36.6191	36.6191	36.6191	36.6191	36.6191	36.6191	36.6191	(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)	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	(71)
Water heating gains (Table 5)	163.5589	160.9548	155.9386	144.9446	138.2105	131.1717	126.8485	130.4204	134.6083	142.4186	152.9577	162.1532	(72)
Total internal gains	612.0931	625.8384	600.4722	579.6254	550.7993	528.2756	508.4931	509.4330	524.5212	545.1843	577.8154	599.4958	(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	0.7400	10.6334	0.6300	0.7000	0.7700	2.4048	(74)
East	7.3500	19.6403	0.6300	0.7000	0.7700	44.1171	(76)
South	2.6200	46.7521	0.6300	0.7000	0.7700	37.4347	(78)
West	5.6300	19.6403	0.6300	0.7000	0.7700	33.7931	(80)

West			5.0800		19.6403		0.6300		0.7000		0.7700		30.4918 (80)
Solar gains	148.2413	277.9611	435.1329	610.1369	733.0758	745.5856	711.7095	619.9395	497.1360	323.2209	182.5039	123.4962	(83)
Total gains	760.3344	903.7995	1035.6051	1189.7623	1283.8751	1273.8612	1220.2027	1129.3726	1021.6572	868.4053	760.3192	722.9920	(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	35.7897	35.8722	35.9534	36.3397	36.4129	36.7577	36.7577	36.8222	36.6241	36.4129	36.2651	36.1119	
alpha	3.3860	3.3915	3.3969	3.4226	3.4275	3.4505	3.4505	3.4548	3.4416	3.4275	3.4177	3.4075	
util living area	0.9708	0.9486	0.9066	0.8142	0.6775	0.5121	0.3816	0.4260	0.6444	0.8657	0.9515	0.9750	(86)
MIT	19.1686	19.4780	19.9068	20.4120	20.7567	20.9315	20.9810	20.9722	20.8478	20.3654	19.6815	19.1182	(87)
Th 2	19.9746	19.9767	19.9787	19.9885	19.9903	19.9988	19.9988	20.0004	19.9955	19.9903	19.9866	19.9828	(88)
util rest of house	0.9653	0.9392	0.8897	0.7823	0.6264	0.4420	0.2986	0.3393	0.5741	0.8345	0.9410	0.9702	(89)
MIT 2	17.8550	18.2441	18.7767	19.3877	19.7729	19.9516	19.9901	19.9866	19.8792	19.3517	18.5122	17.7967	(90)
Living area fraction									fLA = Living area / (4) =			0.1919	(91)
MIT	18.1071	18.4810	18.9936	19.5843	19.9618	20.1397	20.1803	20.1758	20.0652	19.5463	18.7367	18.0503	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9571	18.3310	18.8436	19.4343	19.8118	19.9897	20.0303	20.0258	19.9152	19.3963	18.5867	17.9003	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9498	0.9191	0.8664	0.7624	0.6167	0.4414	0.3013	0.3416	0.5680	0.8123	0.9213	0.9561	(94)
Useful gains	722.1638	830.6547	897.2372	907.1198	791.7777	562.2523	367.6589	385.7781	580.2766	705.4325	700.5059	691.2350	(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	1521.0027	1492.3767	1368.4609	1155.4533	887.9509	584.4496	371.9700	392.4848	632.8832	962.8808	1262.5069	1512.2023	(97)
Space heating kWh	594.3361	444.6772	350.5904	178.8001	71.5528	0.0000	0.0000	0.0000	0.0000	191.5415	404.6407	610.7997	(98a)
Space heating requirement - total per year (kWh/year)												2846.9385	
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	594.3361	444.6772	350.5904	178.8001	71.5528	0.0000	0.0000	0.0000	0.0000	191.5415	404.6407	610.7997	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2846.9385	
Space heating per m2											(98c) / (4) =	28.9441	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												88.6000	(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	594.3361	444.6772	350.5904	178.8001	71.5528	0.0000	0.0000	0.0000	0.0000	191.5415	404.6407	610.7997	(98)
Space heating efficiency (main heating system 1)	88.6000	88.6000	88.6000	88.6000	88.6000	0.0000	0.0000	0.0000	0.0000	88.6000	88.6000	88.6000	(210)
Space heating fuel (main heating system)	670.8083	501.8930	395.7002	201.8060	80.7594	0.0000	0.0000	0.0000	0.0000	216.1868	456.7051	689.3901	(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	284.0794	251.3249	267.0283	234.6080	227.3601	204.7838	201.9364	209.9290	212.2255	236.7761	251.9595	280.9341	(64)
Efficiency of water heater												79.6000	(216)
(217)m	85.4746	85.1246	84.4707	83.2578	81.5838	79.6000	79.6000	79.6000	79.6000	83.3880	84.9158	85.5526	(217)
Fuel for water heating, kWh/month	332.3554	295.2437	316.1193	281.7850	278.6829	257.2661	253.6890	263.7299	266.6150	283.9451	296.7170	328.3760	(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	26.0580	20.9047	18.8223	13.7901	10.6518	8.7026	9.7170	12.6305	16.4057	21.5252	24.3127	26.7822	(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												3213.2489	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												79.6000	
Water heating fuel used												3454.5244	(219)
Space cooling fuel												0.0000	(221)

Electricity for pumps and fans:		
central heating pump	41.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	86.0000	(231)
Electricity for lighting (calculated in Appendix L)	210.3029	(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	6964.0761	(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	3213.2489	0.2100	674.7823	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3454.5244	0.2100	725.4501	(264)
Space and water heating			1400.2324	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	210.3029	0.1443	30.3532	(268)
Total CO2, kg/year			1442.5148	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			14.6700	(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	3213.2489	1.1300	3630.9712	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3454.5244	1.1300	3903.6126	(278)
Space and water heating			7534.5838	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	210.3029	1.5338	322.5695	(282)
Total Primary energy kWh/year			7987.2541	(286)
Dwelling Primary energy Rate (DPER)			81.2000	(287)

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Main dwelling						
Ground floor	49.9900 (1b)	x	2.4000 (2b)	=	119.9760 (1b) - (3b)	
First floor	48.3700 (1c)	x	2.6000 (2c)	=	125.7620 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 98.3600						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	245.7380	(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) =	0.1221	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3721	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3163	(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	0.4032	0.3953	0.3874	0.3479	0.3400	0.3005	0.3005	0.2925	0.3163	0.3400	0.3558	0.3716	(22b)
Effective ac	0.5813	0.5781	0.5751	0.5605	0.5578	0.5451	0.5451	0.5428	0.5500	0.5578	0.5633	0.5690	(25)

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3. Heat losses and heat loss parameter

Element	Gross	Openings	NetArea	U-value	A x U	K-value	A x K	
Main dwelling	m2	m2	m2	W/m2K	W/K	kJ/m2K	kJ/K	
TER Opaque door			2.0400	1.0000	2.0400			(26)
TER Opening Type			21.4200	1.1450	24.5267			(27)
Heatloss Floor 1			49.9900	0.1300	6.4987			(28a)
Cavity Wall	105.9100	23.4600	82.4500	0.1800	14.8410			(29a)
External Roof 1	48.3700		48.3700	0.1100	5.3207			(30)
External Roof 2	1.6200		1.6200	0.1100	0.1782			(30)
Total net area of external elements Aum(A, m2)			205.8900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		53.4053			(33)
Main dwelling								
Party Wall 1			43.8200	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 145.8858 (35)

List of Thermal Bridges

	Length	Psi-value	Total	
K1 Element				
E2 Other lintels (including other steel lintels)	16.1900	0.0500	0.8095	
E3 Sill	12.8100	0.0500	0.6405	
E4 Jamb	33.3400	0.0500	1.6670	
E5 Ground floor (normal)	30.8900	0.1600	4.9424	
E6 Intermediate floor within a dwelling	29.0800	0.0000	0.0000	
E10 Eaves (insulation at ceiling level)	12.3200	0.0600	0.7392	
E12 Gable (insulation at ceiling level)	4.6300	0.0600	0.2778	
E16 Corner (normal)	24.8000	0.0900	2.2320	
E17 Corner (inverted - internal area greater than external area)	9.8000	-0.0900	-0.8820	
E18 Party wall between dwellings	8.7600	0.0600	0.5256	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 10.9520 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 64.3573 (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	47.1399	46.8839	46.6329	45.4542	45.2337	44.2071	44.2071	44.0170	44.6025	45.2337	45.6798	46.1462	(38)
Heat transfer coeff	111.4972	111.2412	110.9902	109.8115	109.5910	108.5644	108.5644	108.3743	108.9598	109.5910	110.0371	110.5035	(39)

Average = Sum(39)m / 12 = 109.8105

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1336	1.1310	1.1284	1.1164	1.1142	1.1037	1.1037	1.1018	1.1078	1.1142	1.1187	1.1235	(40)
HLP (average)												1.1164	
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 2.7238 (42)

Hot water usage for mixer showers

69.8892	68.8389	67.3084	64.3801	62.2191	59.8091	58.4393	59.9582	61.6232	64.2108	67.2020	69.6215	(42a)

Hot water usage for baths

30.1779	29.7297	29.0986	27.9349	27.0635	26.0973	25.5754	26.2021	26.8845	27.9184	29.1060	30.0759	(42b)

Hot water usage for other uses

42.5246	40.9783	39.4319	37.8856	36.3392	34.7929	34.7929	36.3392	37.8856	39.4319	40.9783	42.5246	(42c)

Average daily hot water use (litres/day) 131.0739 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	142.5917	139.5469	135.8389	130.2005	125.6218	120.6993	118.8076	122.4995	126.3933	131.5611	137.2863	142.2219	(44)
Energy conte	225.8304	198.7129	208.7793	178.2380	169.1111	148.4138	143.6874	151.6800	155.8555	178.5271	195.5895	222.6851	(45)
Energy content (annual)										Total = Sum(45)m =		2177.1103	
Distribution loss (46)m = 0.15 x (45)m	33.8746	29.8069	31.3169	26.7357	25.3667	22.2621	21.5531	22.7520	23.3783	26.7791	29.3384	33.4028	(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)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	276.7565	244.7106	259.7054	227.5213	220.0371	197.6971	194.6135	202.6061	205.1388	229.4532	244.8728	273.6112	(62)
WWHRS	-31.9504	-28.2572	-29.5893	-24.5011	-22.8342	-19.5394	-18.3150	-19.4762	-20.2162	-23.8327	-26.9995	-31.3588	(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	244.8061	216.4534	230.1161	203.0202	197.2030	178.1578	176.2985	183.1299	184.9227	205.6205	217.8733	242.2525	(64)
										Total per year (kWh/year) = Sum(64)m =		2479.8537	(64)
12Total per year (kWh/year)												2480	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000	(64a)
Heat gains from water heating, kWh/month	115.8295	102.8702	110.1600	98.6908	96.9703	88.7742	88.5169	91.1745	91.2486	100.1011	104.4601	114.7837	(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	136.1908	136.1908	136.1908	136.1908	136.1908	136.1908	136.1908	136.1908	136.1908	136.1908	136.1908	136.1908	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	128.0281	141.7454	128.0281	132.2957	128.0281	132.2957	128.0281	128.0281	132.2957	128.0281	132.2957	128.0281	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	253.6489	256.2810	249.6482	235.5278	217.7034	200.9510	189.7593	187.1272	193.7600	207.8804	225.7048	242.4572	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.6191	36.6191	36.6191	36.6191	36.6191	36.6191	36.6191	36.6191	36.6191	36.6191	36.6191	36.6191	(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)	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	-108.9527	(71)
Water heating gains (Table 5)													

	155.6848	153.0807	148.0645	137.0705	130.3364	123.2976	118.9744	122.5463	126.7342	134.5445	145.0835	154.2791	(72)
Total internal gains	604.2190	617.9643	592.5980	571.7513	542.9252	520.4015	500.6190	501.5589	516.6471	537.3102	569.9413	591.6217	(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	0.7400	10.6334	0.6300	0.7000	0.7700	2.4048	(74)
East	7.3500	19.6403	0.6300	0.7000	0.7700	44.1171	(76)
South	2.6200	46.7521	0.6300	0.7000	0.7700	37.4347	(78)
West	10.7100	19.6403	0.6300	0.7000	0.7700	64.2848	(80)

Solar gains	148.2413	277.9611	435.1329	610.1369	733.0758	745.5856	711.7095	619.9395	497.1360	323.2209	182.5039	123.4962	(83)
Total gains	752.4603	895.9254	1027.7310	1181.8882	1276.0010	1265.9871	1212.3286	1121.4984	1013.7831	860.5312	752.4451	715.1179	(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	35.7491	35.8314	35.9124	36.2979	36.3709	36.7148	36.7148	36.7793	36.5816	36.3709	36.2235	36.0706	
alpha	3.3833	3.3888	3.3942	3.4199	3.4247	3.4477	3.4477	3.4520	3.4388	3.4247	3.4149	3.4047	
util living area	0.9717	0.9498	0.9084	0.8168	0.6806	0.5152	0.3842	0.4291	0.6483	0.8685	0.9529	0.9758	(86)
MIT	19.1544	19.4648	19.8955	20.4041	20.7526	20.9300	20.9805	20.9715	20.8445	20.3562	19.6685	19.1038	(87)
Th 2	19.9735	19.9756	19.9777	19.9874	19.9893	19.9978	19.9978	19.9994	19.9945	19.9893	19.9856	19.9817	(88)
util rest of house	0.9662	0.9405	0.8916	0.7851	0.6296	0.4448	0.3008	0.3418	0.5779	0.8376	0.9426	0.9711	(89)
MIT 2	17.8364	18.2270	18.7624	19.3781	19.7680	19.9495	19.9888	19.9852	19.8755	19.3405	18.4955	17.7778	(90)
Living area fraction									fLA = Living area / (4) =			0.1919	(91)
MIT	18.0894	18.4646	18.9799	19.5750	19.9570	20.1377	20.1791	20.1745	20.0615	19.5354	18.7206	18.0323	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.0894	18.4646	18.9799	19.5750	19.9570	20.1377	20.1791	20.1745	20.0615	19.5354	18.7206	18.0323	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9524	0.9227	0.8717	0.7706	0.6278	0.4550	0.3162	0.3575	0.5829	0.8212	0.9255	0.9585	(94)
Useful gains	716.6497	826.6905	895.9175	910.7233	801.0887	576.0574	383.3089	400.9753	590.9419	706.6534	696.4165	685.4148	(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	1537.4782	1508.9442	1385.1423	1172.2387	904.8884	601.1983	388.5658	409.0595	649.5636	979.2447	1278.7011	1528.5167	(97)
Space heating kWh	610.6964	458.4745	363.9832	188.2911	77.2270	0.0000	0.0000	0.0000	0.0000	202.8079	419.2449	627.2678	(98a)
Space heating requirement - total per year (kWh/year)												2947.9927	
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	610.6964	458.4745	363.9832	188.2911	77.2270	0.0000	0.0000	0.0000	0.0000	202.8079	419.2449	627.2678	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2947.9927	
Space heating per m2											(98c) / (4) =	29.9715	(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	610.6964	458.4745	363.9832	188.2911	77.2270	0.0000	0.0000	0.0000	0.0000	202.8079	419.2449	627.2678	(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)	661.6429	496.7221	394.3480	203.9990	83.6696	0.0000	0.0000	0.0000	0.0000	219.7268	454.2198	679.5967	(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	244.8061	216.4534	230.1161	203.0202	197.2030	178.1578	176.2985	183.1299	184.9227	205.6205	217.8733	242.2525	(64)
Efficiency of water heater												79.8000	(216)
(217)m	86.0237	85.7002	85.0832	83.8912	82.1428	79.8000	79.8000	79.8000	79.8000	84.0289	85.5024	86.0948	(217)
Fuel for water heating, kWh/month	284.5796	252.5704	270.4601	242.0041	240.0733	223.2553	220.9254	229.4860	231.7326	244.7022	254.8155	281.3788	(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	26.6017	21.3409	19.2151	14.0778	10.8741	8.8842	9.9197	12.8940	16.7481	21.9744	24.8200	27.3411	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-45.6073	-63.7137	-90.7575	-101.0832	-108.1731	-100.6359	-99.3378	-94.1425	-84.9083	-72.3420	-49.9097	-39.4945	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													

(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-27.5879	-57.8142	-114.5210	-171.4638	-226.2273	-227.1652	-224.5418	-190.3896	-139.8760	-82.5609	-36.7907	-21.8372	(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	3193.9250	(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	2975.9834	(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)	214.6910	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-2470.8810	(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	3999.7184	(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	3193.9250	0.2100	670.7242	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2975.9834	0.2100	624.9565	(264)
Space and water heating			1295.6808	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	214.6910	0.1443	30.9866	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-950.1055	0.1348	-128.0659	
PV Unit electricity exported	-1520.7755	0.1260	-191.5933	
Total			-319.6592	(269)
Total CO2, kg/year			1018.9374	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			10.3600	(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	3193.9250	1.1300	3609.1352	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2975.9834	1.1300	3362.8612	(278)
Space and water heating			6971.9964	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	214.6910	1.5338	329.3003	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-950.1055	1.4982	-1423.4263	
PV Unit electricity exported	-1520.7755	0.4625	-703.2847	
Total			-2126.7110	(283)
Total Primary energy kWh/year			5304.6865	(286)
Target Primary Energy Rate (TPER)			53.9300	(287)

Building Regulations England Part L (BREL) Compliance Report

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

Date: Fri 14 Mar 2025 09:30:50

Project Information			
Assessed By	Richard Millard	Building Type	House, Detached
OCDEA Registration	EES/025661	Assessment Date	2025-03-14

Dwelling Details			
Assessment Type	As designed	Total Floor Area	147 m^2
Site Reference	P	Plot Reference	Proposed
Address	22		

Client Details	
Name	Ian White
Company	Cotswold Homes Ltd
Address	West House, Yate, Bristol, BS37 5NG

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

1a Target emission rate and dwelling emission rate		
Fuel for main heating system	Electricity	
Target carbon dioxide emission rate	*8.69 $kgCO_2/m^2$*	
Dwelling carbon dioxide emission rate	2.82 $kgCO_2/m^2$	OK
1b Target primary energy rate and dwelling primary energy		
Target primary energy	*45.38 kWh_{PE}/m^2*	
Dwelling primary energy	31.93 kWh_{PE}/m^2	OK
1c Target fabric energy efficiency and dwelling fabric energy efficiency		
Target fabric energy efficiency	*36.6 kWh/m^2*	
Dwelling fabric energy efficiency	35.2 kWh/m^2	OK

2a Fabric U-values				
Element	***Maximum permitted average U-Value [W/m^2K]***	**Dwelling average U-Value [W/m^2K]**	**Element with highest individual U-Value**	
External walls	*0.26*	0.18	Walls (1) (0.18)	OK
Party walls	*0.2*	N/A	N/A	**N/A**
Curtain walls	*1.6*	N/A	N/A	**N/A**
Floors	*0.18*	0.12	Heatloss Floor 1 (0.12)	OK
Roofs	*0.16*	0.11	Roof (1) (0.11)	OK
Windows, doors, and roof windows	*1.6*	1.2	WG01 (1.2)	OK
Rooflights	*2.2*	N/A	N/A	**N/A**

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))		
Name	**Net area [m^2]**	**U-Value [W/m^2K]**
Exposed wall: Walls (1)	125.27	0.18
Ground floor: Heatloss Floor 1, Heatloss Floor 1	73.41	0.12
Exposed roof: Roof (1)	73.41	0.11

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	**Area [m^2]**	**Orientation**	**Frame factor**	**U-Value [W/m^2K]**
WG01, Windows	2.4	North East	0.7	1.2
WG02, Windows	1.65	North East	0.7	1.2
WG03, Windows	1.43	South East	0.7	1.2
FG01, Windows	2.13	North East	0.7	1.2
FG02, Windows	1.08	North East	0.7	1.2
FG03, Windows	1.48	North East	0.7	1.2
FG04, Windows	0.67	North West	0.7	1.2
FG05, Windows	1.43	South West	0.7	1.2
FG06, Windows	1.43	South West	0.7	1.2
ED01, Doors	2	North East	N/A	1.2
ED02, Doors	2	North West	N/A	1.2
ED03, Glazed Doors	3.78	South West	0.7	1.2
WG04, Windows	2.06	South West	0.7	1.2
WG05, Windows	1.62	South East	0.7	1.2

Name	Area [m^2]	Orientation	Frame factor	U-Value [W/m^2K]
FG07, Windows	1.43	South West	0.7	1.2
FG08, Windows	0.67	South East	0.7	1.2

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))				
Building part **1**: Thermal bridging calculated from linear thermal transmittances for each junction				
Main element	**Junction detail**	**Source**	**Psi value [W/mK]**	**Drawing / reference**
External wall	E1: Steel lintel with perforated steel base plate	Calculated by person with suitable expertise	0.241	EMPF125E101
External wall	E3: Sill	Calculated by person with suitable expertise	0.026 **(!)**	EMPF125E301
External wall	E4: Jamb	Calculated by person with suitable expertise	0.02 **(!)**	EMPF125E401
External wall	E5: Ground floor (normal)	Calculated by person with suitable expertise	0.045	EMPF125E504
External wall	E6: Intermediate floor within a dwelling	Calculated by person with suitable expertise	0.002 **(!)**	EMPF125E601
External wall	E10: Eaves (insulation at ceiling level)	Calculated by person with suitable expertise	0.05	EMPF125E1001
External wall	E12: Gable (insulation at ceiling level)	Calculated by person with suitable expertise	0.031 **(!)**	EMPF125E1201
External wall	E16: Corner (normal)	Calculated by person with suitable expertise	0.037 **(!)**	EMPF125E21601
External wall	E17: Corner (inverted - internal area greater than external area)	Calculated by person with suitable expertise	-0.09	EMPF125E21701

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

4 Space heating	
Main heating system 1: Heat pump with radiators or underfloor heating - Electricity	
Efficiency	243.3%
Emitter type	Radiators
Flow temperature	55°C
System type	Heat Pump
Manufacturer	Daikin Europe NV
Model	EDLA08EV3
Commissioning	
Secondary heating system: N/A	
Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water	
Cylinder/store - type: Cylinder	
Capacity	210 litres
Declared heat loss	1.7 kWh/day
Primary pipework insulated	Yes
Manufacturer	
Model	
Commissioning	
Waste water heat recovery system 1 - type: N/A	
Efficiency	
Manufacturer	
Model	

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

Water heating - type: Cylinder thermostat and HW separately timed	
Manufacturer	
Model	

7 Lighting		
Minimum permitted light source efficacy	*75 lm/W*	
Lowest light source efficacy	85 lm/W	**OK**
External lights control	N/A	

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

9 Local generation	
Technology type: **Photovoltaic system (1)**	
Peak power	2.01 kWp
Orientation	South West
Pitch	30°
Overshading	Modest
Manufacturer	
MCS certificate	

10 Heat networks
N/A

11 Supporting documentary evidence
N/A

12 Declarations

a. Assessor Declaration

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

b. Client Declaration

N/A

Full SAP Calculation Printout

Property Reference	P	**Issued on Date**	14/03/2025
Assessment Reference	Proposed	**Prop Type Ref**	Proposed 22
Property	22		

SAP Rating	86 B	**DER**	2.82	**TER**	8.69
Environmental	97 A	**% DER < TER**			67.55
CO_2 Emissions (t/year)	0.37	**DFEE**	35.23	**TFEE**	36.62
Compliance Check	See BREL	**% DFEE < TFEE**			3.81
% DPER < TPER	29.65	**DPER**	31.93	**TPER**	45.38

Assessor Details	Mr. Richard Millard	**Assessor ID**	U367-0001
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)	
Main dwelling						
Ground floor	73.3400 (1b)	x	2.4000 (2b)	=	176.0160	(1b) - (3b)
First floor	73.3400 (1c)	x	2.6000 (2c)	=	190.6840	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	146.6800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	366.7000	(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		6 * 10 =	60.0000	(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) =		60.0000 / (5) =	0.1636	(8)
Pressure test			Yes	
Pressure Test Method			Blower Door	
Measured/design AP50			5.0000	(17)
Infiltration rate			0.4136	(18)
Number of sides sheltered			3	(19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor		(21) = (18) x (20) =	0.3206	(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	0.4087	0.4007	0.3927	0.3526	0.3446	0.3045	0.3045	0.2965	0.3206	0.3446	0.3606	0.3767	(22b)
Effective ac	0.5835	0.5803	0.5771	0.5622	0.5594	0.5464	0.5464	0.5440	0.5514	0.5594	0.5650	0.5709	(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	
Main dwelling								
Windows			19.4800	1.1450	22.3053			(27)
Glazed Doors			3.7800	1.1450	4.3282			(27)
Doors			4.0000	1.2000	4.8000			(26)
Heatloss Floor 1			73.4100	0.1200	8.8092	75.0000	5505.7500	(28a)
Cavity Wall	152.5300	27.2600	125.2700	0.1800	22.5486	60.0000	7516.1999	(29a)
External Roof 1	73.4100		73.4100	0.1100	8.0751	9.0000	660.6900	(30)
Total net area of external elements Aum(A, m2)			299.3500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		70.8665			(33)
Main dwelling								
Internal Wall 1 - Block			73.8800			75.0000	5540.9998	(32c)
Internal Wall 2 - Stud			31.4100			9.0000	282.6900	(32c)
Internal Wall 3 - Up			190.3800			9.0000	1713.4200	(32c)
Internal Floor 1			73.4100			18.0000	1321.3800	(32d)
Internal Ceiling 1			73.4100			9.0000	660.6900	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	23201.8198 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		158.1799 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total

E1 Steel lintel with perforated steel base plate	19.6600	0.2410	4.7381	
E3 Sill	15.9300	0.0260	0.4142	
E4 Jamb	43.8600	0.0200	0.8772	
E5 Ground floor (normal)	36.0200	0.0450	1.6209	
E6 Intermediate floor within a dwelling	36.0200	0.0020	0.0720	
E10 Eaves (insulation at ceiling level)	16.9800	0.0500	0.8490	
E12 Gable (insulation at ceiling level)	19.0400	0.0310	0.5902	
E16 Corner (normal)	25.0000	0.0370	0.9250	
E17 Corner (inverted - internal area greater than external area)	5.0000	-0.0900	-0.4500	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 9.6366 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 80.5031 (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	70.6126	70.2201	69.8354	68.0285	67.6904	66.1166	66.1166	65.8252	66.7228	67.6904	68.3743	69.0893	(38)
Heat transfer coeff	151.1157	150.7232	150.3385	148.5316	148.1935	146.6198	146.6198	146.3283	147.2259	148.1935	148.8774	149.5924	(39)

Average = Sum(39)m / 12 = 148.5300

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0302	1.0276	1.0249	1.0126	1.0103	0.9996	0.9996	0.9976	1.0037	1.0103	1.0150	1.0199	(40)
HLP (average)												1.0126	
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 2.9289 (42)

Hot water usage for mixer showers

73.3274	72.2254	70.6196	67.5472	65.2799	62.7514	61.3142	62.9078	64.6547	67.3696	70.5080	73.0464	(42a)

Hot water usage for baths

31.6564	31.1862	30.5242	29.3035	28.3894	27.3759	26.8284	27.4858	28.2016	29.2862	30.5320	31.5494	(42b)

Hot water usage for other uses

44.6246	43.0019	41.3791	39.7564	38.1337	36.5110	36.5110	38.1337	39.7564	41.3791	43.0019	44.6246	(42c)

Average daily hot water use (litres/day) 137.5236 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	149.6083	146.4135	142.5229	136.6071	131.8030	126.6383	124.6536	128.5274	132.6128	138.0349	144.0418	149.2204	(44)
Energy conte	236.9430	208.4909	219.0525	187.0084	177.4322	155.7165	150.7577	159.1437	163.5249	187.3121	205.2140	233.6430	(45)
Energy content (annual)										Total = Sum(45)m =		2284.2389	
Distribution loss (46)m = 0.15 x (45)m	35.5415	31.2736	32.8579	28.0513	26.6148	23.3575	22.6137	23.8716	24.5287	28.0968	30.7821	35.0465	(46)

Water storage loss:

Store volume 210.0000 (47)

a) If manufacturer declared loss factor is known (kWh/day): 1.7000 (48)

Temperature factor from Table 2b 0.5400 (49)

Enter (49) or (54) in (55) 0.9180 (55)

Total storage loss

28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(56)

If cylinder contains dedicated solar storage

28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(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

288.6634	255.2061	270.7729	237.0604	229.1526	205.7685	202.4781	210.8641	213.5769	239.0325	255.2660	285.3634	(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

288.6634	255.2061	270.7729	237.0604	229.1526	205.7685	202.4781	210.8641	213.5769	239.0325	255.2660	285.3634	(64)

Total per year (kWh/year) = Sum(64)m = 2893.2049 (64)

12Total per year (kWh/year) 2893 (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

120.1599	106.6954	114.2113	102.2219	100.3725	91.8173	91.5033	94.2916	94.4136	103.6576	108.2753	119.0626	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	146.4435	146.4435	146.4435	146.4435	146.4435	146.4435	146.4435	146.4435	146.4435	146.4435	146.4435	146.4435	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	167.0467	184.9446	167.0467	172.6150	167.0467	172.6150	167.0467	167.0467	172.6150	167.0467	172.6150	167.0467	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	316.8875	320.1758	311.8894	294.2486	271.9803	251.0512	237.0693	233.7810	242.0674	259.7082	281.9765	302.9056	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.6444	37.6444	37.6444	37.6444	37.6444	37.6444	37.6444	37.6444	37.6444	37.6444	37.6444	37.6444	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-117.1548	-117.1548	-117.1548	-117.1548	-117.1548	-117.1548	-117.1548	-117.1548	-117.1548	-117.1548	-117.1548	-117.1548	(71)
Water heating gains (Table 5)	161.5052	158.7729	153.5098	141.9748	134.9093	127.5241	122.9883	126.7360	131.1300	139.3247	150.3823	160.0304	(72)
Total internal gains	712.3725	730.8264	699.3790	675.7715	640.8694	618.1233	594.0373	594.4968	612.7454	633.0127	671.9068	696.9158	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	8.7400	11.2829	0.6300	0.7000	0.7700	30.1374	(75)
Southeast	3.7200	36.7938	0.6300	0.7000	0.7700	41.8302	(77)
Southwest	6.3500	36.7938	0.6300	0.7000	0.7700	71.4037	(79)
Northwest	0.6700	11.2829	0.6300	0.7000	0.7700	2.3103	(81)
Southwest	3.7800	36.7938	0.6300	0.7000	0.7700	42.5049	(79)

Solar gains	188.1864	331.3289	481.9665	645.1644	766.4359	780.1588	744.1390	650.7196	538.0190	373.9078	227.3667	159.7783	(83)
Total gains	900.5590	1062.1553	1181.3454	1320.9358	1407.3053	1398.2821	1338.1763	1245.2164	1150.7644	1006.9205	899.2735	856.6941	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	42.6491	42.7602	42.8696	43.3911	43.4901	43.9569	43.9569	44.0444	43.7759	43.4901	43.2903	43.0834	
alpha	3.8433	3.8507	3.8580	3.8927	3.8993	3.9305	3.9305	3.9363	3.9184	3.8993	3.8860	3.8722	
util living area	0.9877	0.9762	0.9546	0.8973	0.7875	0.6176	0.4675	0.5174	0.7443	0.9247	0.9774	0.9897	(86)
Living	19.2637	19.5224	19.8805	20.3468	20.7116	20.9198	20.9791	20.9691	20.8295	20.3483	19.7301	19.2258	
Non living	18.0210	18.3504	18.8028	19.3833	19.8071	20.0266	20.0737	20.0695	19.9444	19.3976	18.6239	17.9785	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	20.1118	19.5224	19.8805	20.3468	20.7116	20.9198	20.9791	20.9691	20.8295	20.3483	19.7301	19.4740	(87)
Th 2	20.0582	20.0604	20.0626	20.0728	20.0747	20.0837	20.0837	20.0853	20.0802	20.0747	20.0709	20.0668	(88)
util rest of house	0.9851	0.9713	0.9449	0.8752	0.7431	0.5453	0.3763	0.4238	0.6791	0.9038	0.9719	0.9876	(89)
MIT 2	19.2461	18.3504	18.8028	19.3833	19.8071	20.0266	20.0737	20.0695	19.9444	19.3976	18.6239	18.3548	(90)
Living area fraction										fLA = Living area / (4) =		0.1436	(91)
MIT	19.3704	18.5187	18.9575	19.5216	19.9370	20.1548	20.2037	20.1986	20.0715	19.5341	18.7827	18.5155	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.3704	18.5187	18.9575	19.5216	19.9370	20.1548	20.2037	20.1986	20.0715	19.5341	18.7827	18.5155	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9827	0.9602	0.9301	0.8596	0.7358	0.5512	0.3886	0.4359	0.6784	0.8885	0.9612	0.9825	(94)
Useful gains	884.9885	1019.8792	1098.8274	1135.4949	1035.4842	770.7683	520.0008	542.7418	780.7062	894.6267	864.4242	841.7230	(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	2277.3667	2052.6492	1872.8461	1577.6423	1220.6632	814.4493	528.3773	555.8488	879.1530	1323.9717	1739.2882	2141.4898	(97)
Space heating kWh	1035.9294	694.0214	575.8699	318.3461	137.7731	0.0000	0.0000	0.0000	0.0000	319.4327	629.9021	967.0265	(98a)
Space heating requirement - total per year (kWh/year)												4678.3012	
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	1035.9294	694.0214	575.8699	318.3461	137.7731	0.0000	0.0000	0.0000	0.0000	319.4327	629.9021	967.0265	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4678.3012	
Space heating per m2											(98c) / (4) =	31.8946	(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 %) 243.2750 (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	1035.9294	694.0214	575.8699	318.3461	137.7731	0.0000	0.0000	0.0000	0.0000	319.4327	629.9021	967.0265	(98)
Space heating efficiency (main heating system 1)	243.2750	243.2750	243.2750	243.2750	243.2750	0.0000	0.0000	0.0000	0.0000	243.2750	243.2750	243.2750	(210)
Space heating fuel (main heating system)	425.8265	285.2827	236.7157	130.8586	56.6327	0.0000	0.0000	0.0000	0.0000	131.3052	258.9260	397.5035	(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	288.6634	255.2061	270.7729	237.0604	229.1526	205.7685	202.4781	210.8641	213.5769	239.0325	255.2660	285.3634	(64)
Efficiency of water heater												165.8789	(216)
(217)m	165.8789	165.8789	165.8789	165.8789	165.8789	165.8789	165.8789	165.8789	165.8789	165.8789	165.8789	165.8789	(217)
Fuel for water heating, kWh/month	174.0206	153.8509	163.2353	142.9117	138.1446	124.0475	122.0638	127.1193	128.7547	144.1006	153.8870	172.0312	(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	33.9996	27.2757	24.5588	17.9928	13.8982	11.3549	12.6784	16.4798	21.4057	28.0854	31.7224	34.9445	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-29.4267	-46.1779	-73.9534	-90.3288	-101.5067	-93.6440	-92.2088	-83.9684	-69.8497	-54.8848	-33.5306	-24.7462	(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	-6.0148	-14.5796	-33.1160	-57.2395	-83.4967	-89.1388	-87.7958	-71.6679	-49.3201	-23.8303	-8.8435	-4.6769	(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												1923.0508	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												165.8789	

Water heating fuel used	1744.1672	(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)	274.3961	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-1323.9458	(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	2617.6683	(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	1923.0508	0.1556	299.2091	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1744.1672	0.1410	245.8839	(264)
Space and water heating			545.0930	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	274.3961	0.1443	39.6038	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-794.2259	0.1332	-105.7754	
PV Unit electricity exported	-529.7199	0.1219	-64.5938	
Total			-170.3692	(269)
Total CO2, kg/year			414.3277	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			2.8200	(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	1923.0508	1.5760	3030.7113	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1744.1672	1.5213	2653.3632	(278)
Space and water heating			5684.0746	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	274.3961	1.5338	420.8778	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-794.2259	1.4921	-1185.1006	
PV Unit electricity exported	-529.7199	0.4474	-236.9837	
Total			-1422.0843	(283)
Total Primary energy kWh/year			4682.8681	(286)
Dwelling Primary energy Rate (DPER)			31.9300	(287)

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Main dwelling						
Ground floor	73.3400 (1b)	x	2.4000 (2b)	=	176.0160	(1b) - (3b)
First floor	73.3400 (1c)	x	2.6000 (2c)	=	190.6840	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 146.6800						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	366.7000	(5)

2. Ventilation rate

	m3 per hour		
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	4 * 10 =	40.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1091	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3591	(18)
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2783	(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	0.3548	0.3479	0.3409	0.3061	0.2992	0.2644	0.2644	0.2574	0.2783	0.2992	0.3131	0.3270	(22b)
Effective ac	0.5629	0.5605	0.5581	0.5469	0.5447	0.5349	0.5349	0.5331	0.5387	0.5447	0.5490	0.5535	(25)

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3. Heat losses and heat loss parameter

Element	Gross	Openings	NetArea	U-value	A x U	K-value	A x K	
	m2	m2	m2	W/m2K	W/K	kJ/m2K	kJ/K	
Main dwelling								
TER Opaque door			4.0000	1.0000	4.0000			(26)
TER Opening Type			23.2600	1.1450	26.6336			(27)
Heatloss Floor 1			73.4100	0.1300	9.5433			(28a)
Cavity Wall	152.5300	27.2600	125.2700	0.1800	22.5486			(29a)
External Roof 1	73.4100		73.4100	0.1100	8.0751			(30)
Total net area of external elements Aum(A, m2)			299.3500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	70.8006			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 158.1799 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	19.6600	0.0500	0.9830
E3 Sill	15.9300	0.0500	0.7965
E4 Jamb	43.8600	0.0500	2.1930
E5 Ground floor (normal)	36.0200	0.1600	5.7632
E6 Intermediate floor within a dwelling	36.0200	0.0000	0.0000
E10 Eaves (insulation at ceiling level)	16.9800	0.0600	1.0188
E12 Gable (insulation at ceiling level)	19.0400	0.0600	1.1424
E16 Corner (normal)	25.0000	0.0900	2.2500
E17 Corner (inverted - internal area greater than external area)	5.0000	-0.0900	-0.4500

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 13.6969 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 84.4975 (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	68.1228	67.8270	67.5371	66.1753	65.9205	64.7344	64.7344	64.5148	65.1913	65.9205	66.4360	66.9748	(38)
Heat transfer coeff	152.6203	152.3245	152.0346	150.6728	150.4180	149.2319	149.2319	149.0123	149.6888	150.4180	150.9334	151.4723	(39)
Average = Sum(39)m / 12 =												150.6716	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0405	1.0385	1.0365	1.0272	1.0255	1.0174	1.0174	1.0159	1.0205	1.0255	1.0290	1.0327	(40)
HLP (average)												1.0272	
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 2.9289 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	73.3274	72.2254	70.6196	67.5472	65.2799	62.7514	61.3142	62.9078	64.6547	67.3696	70.5080	73.0464	(42a)
Hot water usage for baths	31.6564	31.1862	30.5242	29.3035	28.3894	27.3759	26.8284	27.4858	28.2016	29.2862	30.5320	31.5494	(42b)
Hot water usage for other uses	44.6246	43.0019	41.3791	39.7564	38.1337	36.5110	36.5110	38.1337	39.7564	41.3791	43.0019	44.6246	(42c)
Average daily hot water use (litres/day)												137.5236	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	149.6083	146.4135	142.5229	136.6071	131.8030	126.6383	124.6536	128.5274	132.6128	138.0349	144.0418	149.2204	(44)
Energy conte	236.9430	208.4909	219.0525	187.0084	177.4322	155.7165	150.7577	159.1437	163.5249	187.3121	205.2140	233.6430	(45)
Energy content (annual)										Total = Sum(45)m =		2284.2389	
Distribution loss (46)m = 0.15 x (45)m	35.5415	31.2736	32.8579	28.0513	26.6148	23.3575	22.6137	23.8716	24.5287	28.0968	30.7821	35.0465	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7016	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9188	(55)
Total storage loss	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(56)
If cylinder contains dedicated solar storage	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(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	288.6896	255.2297	270.7991	237.0857	229.1788	205.7939	202.5043	210.8903	213.6022	239.0587	255.2914	285.3896	(62)
WWHRS	-33.5222	-29.6473	-31.0450	-25.7065	-23.9575	-20.5006	-19.2160	-20.4343	-21.2107	-25.0051	-28.3277	-32.9014	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	255.1674	225.5824	239.7541	211.3792	205.2213	185.2933	183.2883	190.4560	192.3915	214.0536	226.9636	252.4882	(64)
									Total per year (kWh/year) = Sum(64)m =			2582.0389	(64)
12Total per year (kWh/year)												2582	(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	120.1808	106.7143	114.2322	102.2422	100.3935	91.8376	91.5242	94.3126	94.4339	103.6785	108.2955	119.0836	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	146.4435	146.4435	146.4435	146.4435	146.4435	146.4435	146.4435	146.4435	146.4435	146.4435	146.4435	146.4435	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	167.0467	184.9446	167.0467	172.6150	167.0467	172.6150	167.0467	167.0467	172.6150	167.0467	172.6150	167.0467	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													

	316.8875	320.1758	311.8894	294.2486	271.9803	251.0512	237.0693	233.7810	242.0674	259.7082	281.9765	302.9056 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	37.6444	37.6444	37.6444	37.6444	37.6444	37.6444	37.6444	37.6444	37.6444	37.6444	37.6444	37.6444 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)												
	-117.1548	-117.1548	-117.1548	-117.1548	-117.1548	-117.1548	-117.1548	-117.1548	-117.1548	-117.1548	-117.1548	-117.1548 (71)
Water heating gains (Table 5)												
	161.5334	158.8010	153.5379	142.0030	134.9375	127.5523	123.0164	126.7642	131.1582	139.3529	150.4105	160.0586 (72)
Total internal gains												
	715.4007	733.8545	702.4071	678.7996	643.8976	618.1515	594.0655	594.5250	612.7736	636.0409	674.9350	699.9440 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	8.7400	11.2829	0.6300	0.7000	0.7700	30.1374	(75)
Southeast	3.7200	36.7938	0.6300	0.7000	0.7700	41.8302	(77)
Southwest	10.1300	36.7938	0.6300	0.7000	0.7700	113.9085	(79)
Northwest	0.6700	11.2829	0.6300	0.7000	0.7700	2.3103	(81)

Solar gains	188.1864	331.3289	481.9665	645.1644	766.4359	780.1588	744.1390	650.7196	538.0190	373.9078	227.3667	159.7783 (83)
Total gains	903.5871	1065.1834	1184.3736	1323.9640	1410.3335	1398.3103	1338.2045	1245.2446	1150.7926	1009.9487	902.3017	859.7223 (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	42.2286	42.3106	42.3913	42.7745	42.8469	43.1875	43.1875	43.2511	43.0557	42.8469	42.7006	42.5487	
alpha	3.8152	3.8207	3.8261	3.8516	3.8565	3.8792	3.8792	3.8834	3.8704	3.8565	3.8467	3.8366	
util living area													
	0.9876	0.9762	0.9548	0.8987	0.7908	0.6246	0.4744	0.5247	0.7497	0.9255	0.9774	0.9896	(86)
MIT	19.2448	19.5024	19.8611	20.3266	20.6984	20.9129	20.9768	20.9658	20.8188	20.3302	19.7075	19.2014	(87)
Th 2	20.0497	20.0514	20.0530	20.0607	20.0622	20.0689	20.0689	20.0701	20.0663	20.0622	20.0592	20.0562	(88)
util rest of house													
	0.9849	0.9712	0.9451	0.8767	0.7464	0.5512	0.3808	0.4289	0.6842	0.9046	0.9719	0.9874	(89)
MIT 2	17.9915	18.3191	18.7720	19.3499	19.7821	20.0068	20.0578	20.0526	19.9218	19.3664	18.5876	17.9404	(90)
Living area fraction										fLA = Living area / (4) =		0.1436	(91)
MIT	18.1714	18.4890	18.9284	19.4901	19.9136	20.1369	20.1898	20.1837	20.0506	19.5048	18.7484	18.1215	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.1714	18.4890	18.9284	19.4901	19.9136	20.1369	20.1898	20.1837	20.0506	19.5048	18.7484	18.1215	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9774	0.9600	0.9302	0.8607	0.7385	0.5569	0.3934	0.4411	0.6830	0.8890	0.9611	0.9808	(94)
Useful gains	883.1327	1022.6087	1101.6967	1139.5592	1041.5985	778.7110	526.3874	549.2947	785.9528	897.8854	867.1640	843.2164	(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													
	2117.0650	2069.9343	1889.5394	1595.6464	1235.4779	826.2820	535.7101	563.8201	890.7306	1339.4443	1758.1315	2108.7198	(97)
Space heating kWh													
	918.0456	703.8028	586.1550	328.3828	144.2463	0.0000	0.0000	0.0000	0.0000	328.5198	641.4965	941.5345	(98a)
Space heating requirement - total per year (kWh/year)												4592.1834	
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													
	918.0456	703.8028	586.1550	328.3828	144.2463	0.0000	0.0000	0.0000	0.0000	328.5198	641.4965	941.5345	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4592.1834	
Space heating per m2											(98c) / (4) =	31.3075	(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													
	918.0456	703.8028	586.1550	328.3828	144.2463	0.0000	0.0000	0.0000	0.0000	328.5198	641.4965	941.5345	(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)													
	994.6323	762.5166	635.0541	355.7777	156.2798	0.0000	0.0000	0.0000	0.0000	355.9261	695.0125	1020.0807	(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													
	255.1674	225.5824	239.7541	211.3792	205.2213	185.2933	183.2883	190.4560	192.3915	214.0536	226.9636	252.4882	(64)
Efficiency of water heater												79.8000	(216)
(217)m	86.6739	86.4339	85.9849	85.0439	83.2841	79.8000	79.8000	79.8000	79.8000	85.0172	86.2576	86.7315	(217)
Fuel for water heating, kWh/month													
	294.3992	260.9884	278.8328	248.5532	246.4112	232.1971	229.6845	238.6666	241.0921	251.7767	263.1230	291.1146	(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	34.7090	27.8449	25.0712	18.3682	14.1882	11.5918	12.9429	16.8237	21.8523	28.6714	32.3843	35.6737	(232)

Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	-64.0766	-88.1000	-123.4913	-135.2164	-142.7125	-131.9855	-130.2138	-124.3408	-113.6604	-98.8716	-69.5881	-55.6519 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233b)m	-43.3076	-90.1929	-177.6714	-264.6355	-347.8840	-348.9292	-344.9478	-293.0944	-216.1191	-128.3854	-57.6096	-34.3275 (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	4975.2799	(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	3076.8395	(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)	280.1216	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-3625.0131	(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	4793.2280	(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	4975.2799	0.2100	1044.8088	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3076.8395	0.2100	646.1363	(264)
Space and water heating			1690.9451	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	280.1216	0.1443	40.4302	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1277.9087	0.1352	-172.7190	
PV Unit electricity exported	-2347.1044	0.1261	-296.0520	
Total			-468.7709	(269)
Total CO2, kg/year			1274.5336	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			8.6900	(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	4975.2799	1.1300	5622.0663	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3076.8395	1.1300	3476.8287	(278)
Space and water heating			9098.8949	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	280.1216	1.5338	429.6599	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1277.9087	1.4996	-1916.2895	
PV Unit electricity exported	-2347.1044	0.4630	-1086.7381	
Total			-3003.0276	(283)
Total Primary energy kWh/year			6655.6280	(286)
Target Primary Energy Rate (TPER)			45.3800	(287)

Building Regulations England Part L (BREL) Compliance Report

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

Date: Fri 14 Mar 2025 09:30:56

Project Information			
Assessed By	Richard Millard	Building Type	House, Detached
OCDEA Registration	EES/025661	Assessment Date	2025-03-14

Dwelling Details			
Assessment Type	As designed	Total Floor Area	147 m^2
Site Reference	P	Plot Reference	Regulated (Baseline)
Address	22		

Client Details	
Name	Ian White
Company	Cotswold Homes Ltd
Address	West House, Yate, Bristol, BS37 5NG

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

1a Target emission rate and dwelling emission rate		
Fuel for main heating system	Mains gas	
Target carbon dioxide emission rate	*8.69 $kgCO_2/m^2$*	
Dwelling carbon dioxide emission rate	12.69 $kgCO_2/m^2$	**FAIL**
1b Target primary energy rate and dwelling primary energy		
Target primary energy	*45.38 kWh_{PE}/m^2*	
Dwelling primary energy	70.16 kWh_{PE}/m^2	**FAIL**
1c Target fabric energy efficiency and dwelling fabric energy efficiency		
Target fabric energy efficiency	*36.6 kWh/m^2*	
Dwelling fabric energy efficiency	36.5 kWh/m^2	**OK**

2a Fabric U-values				
Element	***Maximum permitted average U-Value [W/m^2K]***	**Dwelling average U-Value [W/m^2K]**	**Element with highest individual U-Value**	
External walls	*0.26*	0.18	Walls (1) (0.18)	**OK**
Party walls	*0.2*	N/A	N/A	**N/A**
Curtain walls	*1.6*	N/A	N/A	**N/A**
Floors	*0.18*	0.13	Heatloss Floor 1 (0.13)	**OK**
Roofs	*0.16*	0.11	Roof (1) (0.11)	**OK**
Windows, doors, and roof windows	*1.6*	1.2	WG01 (1.2)	**OK**
Rooflights	*2.2*	N/A	N/A	**N/A**

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))		
Name	**Net area [m^2]**	**U-Value [W/m^2K]**
Exposed wall: Walls (1)	125.27	0.18
Ground floor: Heatloss Floor 1, Heatloss Floor 1	73.41	0.13
Exposed roof: Roof (1)	73.41	0.11

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	**Area [m^2]**	**Orientation**	**Frame factor**	**U-Value [W/m^2K]**
WG01, Windows	2.4	North East	0.7	1.2
WG02, Windows	1.65	North East	0.7	1.2
WG03, Windows	1.43	South East	0.7	1.2
FG01, Windows	2.13	North East	0.7	1.2
FG02, Windows	1.08	North East	0.7	1.2
FG03, Windows	1.48	North East	0.7	1.2
FG04, Windows	0.67	North West	0.7	1.2
FG05, Windows	1.43	South West	0.7	1.2
FG06, Windows	1.43	South West	0.7	1.2
ED01, Doors	2	North East	N/A	1.2
ED02, Doors	2	North West	N/A	1.2
ED03, Glazed Doors	3.78	South West	0.7	1.2
WG04, Windows	2.06	South West	0.7	1.2
WG05, Windows	1.62	South East	0.7	1.2

Name	Area [m^2]	Orientation	Frame factor	U-Value [W/m^2K]
FG07, Windows	1.43	South West	0.7	1.2
FG08, Windows	0.67	South East	0.7	1.2

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))

Building part **1**: Thermal bridging calculated from linear thermal transmittances for each junction

Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E2: Other lintels (including other steel lintels)	Calculated by person with suitable expertise	0.05	mpf125e2-04
External wall	E3: Sill	Calculated by person with suitable expertise	0.05	mpf125e3-01
External wall	E4: Jamb	Calculated by person with suitable expertise	0.022 **(!)**	mpf125e4-01
External wall	E5: Ground floor (normal)	Calculated by person with suitable expertise	0.16	mpf125e5-04
External wall	E6: Intermediate floor within a dwelling	Calculated by person with suitable expertise	0.003 **(!)**	mpf125e6-01
External wall	E10: Eaves (insulation at ceiling level)	Calculated by person with suitable expertise	0.06	mpf125e10-01
External wall	E12: Gable (insulation at ceiling level)	Calculated by person with suitable expertise	0.06	mpf125e12-01
External wall	E16: Corner (normal)	Calculated by person with suitable expertise	0.09	mpf125e16-01
External wall	E17: Corner (inverted - internal area greater than external area)	Calculated by person with suitable expertise	-0.085	mpf125e17-01

3 Air permeability (better than typically expected values are flagged with a subsequent (!))

Maximum permitted air permeability at 50Pa	*8 m^3/hm^2*	
Dwelling air permeability at 50Pa	5 m^3/hm^2, Design value	OK
Air permeability test certificate reference		

4 Space heating

Main heating system 1: Boiler with radiators or underfloor heating - Mains gas	
Efficiency	88.6%
Emitter type	Radiators
Flow temperature	45°C
System type	Regular boiler
Manufacturer	Bosch Thermotechnology
Model	Greenstar 8000 Life
Commissioning	
Secondary heating system: N/A	
Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water

Cylinder/store - type: Cylinder	
Capacity	210 litres
Declared heat loss	1.7 kWh/day
Primary pipework insulated	Yes
Manufacturer	
Model	
Commissioning	
Waste water heat recovery system 1 - type: N/A	
Efficiency	
Manufacturer	
Model	

6 Controls

Main heating 1 - type: Time and temperature zone control by arrangement of plumbing and electrical services	
Function	
Ecodesign class	
Manufacturer	
Model	

Water heating - type: Cylinder thermostat and HW separately timed	
Manufacturer	
Model	

7 Lighting		
Minimum permitted light source efficacy	*75 lm/W*	
Lowest light source efficacy	85 lm/W	**OK**
External lights control	N/A	

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

9 Local generation
N/A

10 Heat networks
N/A

11 Supporting documentary evidence
N/A

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

Full SAP Calculation Printout

Property Reference	P	**Issued on Date**	14/03/2025
Assessment Reference	Regulated (Baseline)	**Prop Type Ref**	Proposed 22
Property	22		

SAP Rating	86 B	**DER**	12.69	**TER**	8.69
Environmental	87 B	**% DER < TER**			-46.03
CO_2 Emissions (t/year)	1.74	**DFEE**	36.52	**TFEE**	36.62
Compliance Check	See BREL	**% DFEE < TFEE**			0.28
% DPER < TPER	-54.60	**DPER**	70.16	**TPER**	45.38

Assessor Details	Mr. Richard Millard	**Assessor ID**	U367-0001
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)	
Main dwelling						
Ground floor	73.3400 (1b)	x	2.4000 (2b)	=	176.0160	(1b) - (3b)
First floor	73.3400 (1c)	x	2.6000 (2c)	=	190.6840	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	146.6800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	366.7000	(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		6 * 10 =	60.0000	(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) =		60.0000 / (5) =	0.1636	(8)
Pressure test			Yes	
Pressure Test Method			Blower Door	
Measured/design AP50			5.0000	(17)
Infiltration rate			0.4136	(18)
Number of sides sheltered			3	(19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor		(21) = (18) x (20) =	0.3206	(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	0.4087	0.4007	0.3927	0.3526	0.3446	0.3045	0.3045	0.2965	0.3206	0.3446	0.3606	0.3767	(22b)
Effective ac	0.5835	0.5803	0.5771	0.5622	0.5594	0.5464	0.5464	0.5440	0.5514	0.5594	0.5650	0.5709	(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	
Main dwelling								
Windows			19.4800	1.1450	22.3053			(27)
Glazed Doors			3.7800	1.1450	4.3282			(27)
Doors			4.0000	1.2000	4.8000			(26)
Heatloss Floor 1			73.4100	0.1300	9.5433	75.0000	5505.7500	(28a)
Cavity Wall	152.5300	27.2600	125.2700	0.1800	22.5486	60.0000	7516.2000	(29a)
External Roof 1	73.4100		73.4100	0.1100	8.0751	9.0000	660.6900	(30)
Total net area of external elements Aum(A, m2)			299.3500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.6006			(33)
Main dwelling								
Internal Wall 1 - Block			73.8800			75.0000	5541.0000	(32c)
Internal Wall 2 - Stud			31.4100			9.0000	282.6900	(32c)
Internal Wall 3 - Up			190.3800			9.0000	1713.4200	(32c)
Internal Floor 1			73.4100			18.0000	1321.3800	(32d)
Internal Ceiling 1			73.4100			9.0000	660.6900	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		23201.8200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							158.1798	(35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total

E2 Other lintels (including other steel lintels)	19.6600	0.0500	0.9830	
E3 Sill	15.9300	0.0500	0.7965	
E4 Jamb	43.8600	0.0220	0.9649	
E5 Ground floor (normal)	36.0200	0.1600	5.7632	
E6 Intermediate floor within a dwelling	36.0200	0.0030	0.1081	
E10 Eaves (insulation at ceiling level)	16.9800	0.0600	1.0188	
E12 Gable (insulation at ceiling level)	19.0400	0.0600	1.1424	
E16 Corner (normal)	25.0000	0.0900	2.2500	
E17 Corner (inverted - internal area greater than external area)	5.0000	-0.0850	-0.4250	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 12.6019 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 84.2025 (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	70.6126	70.2201	69.8354	68.0285	67.6904	66.1166	66.1166	65.8252	66.7228	67.6904	68.3743	69.0893	(38)
Heat transfer coeff	154.8150	154.4226	154.0379	152.2309	151.8929	150.3191	150.3191	150.0277	150.9253	151.8929	152.5768	153.2918	(39)

Average = Sum(39)m / 12 = 152.2293

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0555	1.0528	1.0502	1.0378	1.0355	1.0248	1.0248	1.0228	1.0289	1.0355	1.0402	1.0451	(40)
HLP (average)												1.0378	
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 2.9289 (42)

Hot water usage for mixer showers

73.3274	72.2254	70.6196	67.5472	65.2799	62.7514	61.3142	62.9078	64.6547	67.3696	70.5080	73.0464	(42a)

Hot water usage for baths

31.6564	31.1862	30.5242	29.3035	28.3894	27.3759	26.8284	27.4858	28.2016	29.2862	30.5320	31.5494	(42b)

Hot water usage for other uses

44.6246	43.0019	41.3791	39.7564	38.1337	36.5110	36.5110	38.1337	39.7564	41.3791	43.0019	44.6246	(42c)

Average daily hot water use (litres/day) 137.5236 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	149.6083	146.4135	142.5229	136.6071	131.8030	126.6383	124.6536	128.5274	132.6128	138.0349	144.0418	149.2204	(44)
Energy conte	236.9430	208.4909	219.0525	187.0084	177.4322	155.7165	150.7577	159.1437	163.5249	187.3121	205.2140	233.6430	(45)

Energy content (annual) Total = Sum(45)m = 2284.2389

Distribution loss (46)m = 0.15 x (45)m	35.5415	31.2736	32.8579	28.0513	26.6148	23.3575	22.6137	23.8716	24.5287	28.0968	30.7821	35.0465	(46)

Water storage loss:

Store volume 210.0000 (47)

a) If manufacturer declared loss factor is known (kWh/day): 1.7000 (48)

Temperature factor from Table 2b 0.5400 (49)

Enter (49) or (54) in (55) 0.9180 (55)

Total storage loss

28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(56)

If cylinder contains dedicated solar storage

28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(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

288.6634	255.2061	270.7729	237.0604	229.1526	205.7685	202.4781	210.8641	213.5769	239.0325	255.2660	285.3634	(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

288.6634	255.2061	270.7729	237.0604	229.1526	205.7685	202.4781	210.8641	213.5769	239.0325	255.2660	285.3634	(64)

Total per year (kWh/year) = Sum(64)m = 2893.2049 (64)

12Total per year (kWh/year) 2893 (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

120.1599	106.6954	114.2113	102.2219	100.3725	91.8173	91.5033	94.2916	94.4136	103.6576	108.2753	119.0626	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	146.4435	146.4435	146.4435	146.4435	146.4435	146.4435	146.4435	146.4435	146.4435	146.4435	146.4435	146.4435	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	167.0467	184.9446	167.0467	172.6150	167.0467	172.6150	167.0467	167.0467	172.6150	167.0467	172.6150	167.0467	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	316.8875	320.1759	311.8894	294.2486	271.9803	251.0512	237.0693	233.7810	242.0674	259.7082	281.9765	302.9056	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.6444	37.6444	37.6444	37.6444	37.6444	37.6444	37.6444	37.6444	37.6444	37.6444	37.6444	37.6444	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-117.1548	-117.1548	-117.1548	-117.1548	-117.1548	-117.1548	-117.1548	-117.1548	-117.1548	-117.1548	-117.1548	-117.1548	(71)
Water heating gains (Table 5)	161.5052	158.7729	153.5098	141.9748	134.9093	127.5241	122.9883	126.7360	131.1300	139.3247	150.3823	160.0304	(72)
Total internal gains	715.3726	733.8264	702.3790	678.7715	643.8694	618.1233	594.0374	594.4968	612.7455	636.0127	674.9069	699.9158	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	8.7400	11.2829	0.6300	0.7000	0.7700	30.1374	(75)
Southeast	3.7200	36.7938	0.6300	0.7000	0.7700	41.8302	(77)
Southwest	6.3500	36.7938	0.6300	0.7000	0.7700	71.4037	(79)
Northwest	0.6700	11.2829	0.6300	0.7000	0.7700	2.3103	(81)
Southwest	3.7800	36.7938	0.6300	0.7000	0.7700	42.5049	(79)

Solar gains	188.1864	331.3289	481.9665	645.1644	766.4359	780.1588	744.1390	650.7196	538.0190	373.9078	227.3667	159.7783	(83)
Total gains	903.5590	1065.1553	1184.3454	1323.9359	1410.3054	1398.2821	1338.1763	1245.2165	1150.7644	1009.9205	902.2736	859.6941	(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	41.6300	41.7358	41.8400	42.3367	42.4309	42.8751	42.8751	42.9584	42.7029	42.4309	42.2407	42.0437	
alpha	3.7753	3.7824	3.7893	3.8224	3.8287	3.8583	3.8583	3.8639	3.8469	3.8287	3.8160	3.8029	
util living area	0.9876	0.9764	0.9554	0.9001	0.7936	0.6275	0.4772	0.5274	0.7523	0.9265	0.9776	0.9897	(86)
MIT	19.2131	19.4726	19.8353	20.3104	20.6886	20.9099	20.9757	20.9645	20.8133	20.3167	19.6873	19.1749	(87)
Th 2	20.0374	20.0396	20.0417	20.0519	20.0538	20.0627	20.0627	20.0644	20.0593	20.0538	20.0500	20.0459	(88)
util rest of house	0.9850	0.9715	0.9458	0.8782	0.7491	0.5536	0.3827	0.4308	0.6867	0.9057	0.9721	0.9875	(89)
MIT 2	17.9431	18.2735	18.7319	19.3239	19.7646	19.9985	20.0512	20.0462	19.9104	19.3441	18.5558	17.9001	(90)
Living area fraction									fLA = Living area / (4) =			0.1436	(91)
MIT	18.1254	18.4457	18.8903	19.4656	19.8973	20.1294	20.1840	20.1781	20.0400	19.4837	18.7183	18.0831	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9754	18.2957	18.7403	19.3156	19.7473	19.9794	20.0340	20.0281	19.8900	19.3337	18.5683	17.9331	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9766	0.9589	0.9284	0.8574	0.7328	0.5466	0.3797	0.4269	0.6733	0.8852	0.9597	0.9801	(94)
Useful gains	882.3909	1021.3564	1099.5851	1135.1794	1033.4410	764.3119	508.0774	531.5615	774.8503	894.0154	865.8752	842.5862	(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	2117.1591	2068.5949	1885.4732	1585.5728	1222.3221	808.6238	516.1912	544.3084	873.8574	1326.5869	1749.7951	2105.1719	(97)
Space heating kWh	918.6676	703.7443	584.7008	324.2833	140.5275	0.0000	0.0000	0.0000	0.0000	321.8332	636.4224	939.3638	(98a)
Space heating requirement - total per year (kWh/year)												4569.5427	
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	918.6676	703.7443	584.7008	324.2833	140.5275	0.0000	0.0000	0.0000	0.0000	321.8332	636.4224	939.3638	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4569.5427	
Space heating per m2											(98c) / (4) =	31.1531	(99)

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

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

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

Efficiency of main space heating system 1 (in %) 88.6000 (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	918.6676	703.7443	584.7008	324.2833	140.5275	0.0000	0.0000	0.0000	0.0000	321.8332	636.4224	939.3638	(98)
Space heating efficiency (main heating system 1)	88.6000	88.6000	88.6000	88.6000	88.6000	0.0000	0.0000	0.0000	0.0000	88.6000	88.6000	88.6000	(210)
Space heating fuel (main heating system)	1036.8708	794.2938	659.9332	366.0082	158.6089	0.0000	0.0000	0.0000	0.0000	363.2429	718.3097	1060.2300	(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	288.6634	255.2061	270.7729	237.0604	229.1526	205.7685	202.4781	210.8641	213.5769	239.0325	255.2660	285.3634	(64)
Efficiency of water heater												79.6000	(216)
(217)m	86.2679	86.0119	85.5388	84.5623	82.7971	79.6000	79.6000	79.6000	79.6000	84.5269	85.8222	86.3258	(217)
Fuel for water heating, kWh/month	334.6127	296.7102	316.5497	280.3382	276.7640	258.5032	254.3695	264.9047	268.3126	282.7886	297.4360	330.5656	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	33.9996	27.2757	24.5588	17.9928	13.8982	11.3549	12.6784	16.4798	21.4057	28.0854	31.7224	34.9445	(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 5157.4975 (211)

Space heating fuel - main system 2 0.0000 (213)

Space heating fuel - secondary 0.0000 (215)

Efficiency of water heater 79.6000

Water heating fuel used 3461.8551 (219)

Space cooling fuel 0.0000 (221)

Electricity for pumps and fans:

central heating pump 41.0000 (230c)

main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	86.0000	(231)
Electricity for lighting (calculated in Appendix L)	274.3961	(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	8979.7486	(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	5157.4975	0.2100	1083.0745	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3461.8551	0.2100	726.9896	(264)
Space and water heating			1810.0640	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	274.3961	0.1443	39.6038	(268)
Total CO2, kg/year			1861.5971	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			12.6900	(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	5157.4975	1.1300	5827.9721	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3461.8551	1.1300	3911.8963	(278)
Space and water heating			9739.8684	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	274.3961	1.5338	420.8779	(282)
Total Primary energy kWh/year			10290.8470	(286)
Dwelling Primary energy Rate (DPER)			70.1600	(287)

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Main dwelling						
Ground floor	73.3400 (1b)	x	2.4000 (2b)	=	176.0160	(1b) - (3b)
First floor	73.3400 (1c)	x	2.6000 (2c)	=	190.6840	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	146.8800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	366.7000	(5)

2. Ventilation rate

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	4 * 10 =	40.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1091	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3591	(18)
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2783	(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	0.3548	0.3479	0.3409	0.3061	0.2992	0.2644	0.2644	0.2574	0.2783	0.2992	0.3131	0.3270	(22b)
Effective ac	0.5629	0.5605	0.5581	0.5469	0.5447	0.5349	0.5349	0.5331	0.5387	0.5447	0.5490	0.5535	(25)

3. Heat losses and heat loss parameter

Element	Gross	Openings	NetArea	U-value	A x U	K-value	A x K	
Main dwelling	m2	m2	m2	W/m2K	W/K	kJ/m2K	kJ/K	
TER Opaque door			4.0000	1.0000	4.0000			(26)
TER Opening Type			23.2600	1.1450	26.6336			(27)
Heatloss Floor 1			73.4100	0.1300	9.5433			(28a)
Cavity Wall	152.5300	27.2600	125.2700	0.1800	22.5486			(29a)
External Roof 1	73.4100		73.4100	0.1100	8.0751			(30)
Total net area of external elements Aum(A, m2)			299.3500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		70.8006			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 158.1798 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	19.6600	0.0500	0.9830
E3 Sill	15.9300	0.0500	0.7965
E4 Jamb	43.8600	0.0500	2.1930
E5 Ground floor (normal)	36.0200	0.1600	5.7632
E6 Intermediate floor within a dwelling	36.0200	0.0000	0.0000
E10 Eaves (insulation at ceiling level)	16.9800	0.0600	1.0188
E12 Gable (insulation at ceiling level)	19.0400	0.0600	1.1424
E16 Corner (normal)	25.0000	0.0900	2.2500
E17 Corner (inverted - internal area greater than external area)	5.0000	-0.0900	-0.4500

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 13.6969 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 84.4975 (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	68.1228	67.8271	67.5371	66.1753	65.9205	64.7344	64.7344	64.5148	65.1913	65.9205	66.4360	66.9748	(38)
Heat transfer coeff	152.6203	152.3245	152.0346	150.6728	150.4180	149.2319	149.2319	149.0123	149.6888	150.4180	150.9334	151.4723	(39)

Average = Sum(39)m / 12 = 150.6716

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0405	1.0385	1.0365	1.0272	1.0255	1.0174	1.0174	1.0159	1.0205	1.0255	1.0290	1.0327	(40)
HLP (average)												1.0272	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.9289 (42)

Hot water usage for mixer showers

73.3274	72.2254	70.6196	67.5472	65.2799	62.7514	61.3142	62.9078	64.6547	67.3696	70.5080	73.0464	(42a)

Hot water usage for baths

31.6564	31.1862	30.5242	29.3035	28.3894	27.3759	26.8284	27.4858	28.2016	29.2862	30.5320	31.5494	(42b)

Hot water usage for other uses

44.6246	43.0019	41.3791	39.7564	38.1337	36.5110	36.5110	38.1337	39.7564	41.3791	43.0019	44.6246	(42c)

Average daily hot water use (litres/day) 137.5236 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	149.6083	146.4135	142.5229	136.6071	131.8030	126.6383	124.6536	128.5274	132.6128	138.0349	144.0418	149.2204	(44)
Energy conte	236.9430	208.4909	219.0525	187.0084	177.4322	155.7165	150.7577	159.1437	163.5249	187.3121	205.2140	233.6430	(45)
Energy content (annual)										Total = Sum(45)m =		2284.2389	
Distribution loss (46)m = 0.15 x (45)m	35.5415	31.2736	32.8579	28.0513	26.6148	23.3575	22.6137	23.8716	24.5287	28.0968	30.7821	35.0465	(46)

Water storage loss:
Store volume 210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.7016 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 0.9188 (55)
Total storage loss

28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(56)

If cylinder contains dedicated solar storage

28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(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

288.6896	255.2297	270.7991	237.0857	229.1788	205.7939	202.5043	210.8903	213.6022	239.0587	255.2914	285.3896	(62)
WWHRS -33.5222	-29.6473	-31.0450	-25.7065	-23.9575	-20.5006	-19.2160	-20.4343	-21.2107	-25.0051	-28.3277	-32.9014	(63a)
PV diverter -0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)

Output from w/h

255.1674	225.5824	239.7541	211.3792	205.2213	185.2933	183.2883	190.4560	192.3915	214.0536	226.9636	252.4882	(64)
								Total per year (kWh/year) = Sum(64)m =			2582.0389	(64)

12Total per year (kWh/year) 2582 (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

120.1808	106.7143	114.2322	102.2422	100.3935	91.8376	91.5242	94.3126	94.4339	103.6785	108.2955	119.0836	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	146.4435	146.4435	146.4435	146.4435	146.4435	146.4435	146.4435	146.4435	146.4435	146.4435	146.4435	146.4435	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	167.0467	184.9446	167.0467	172.6150	167.0467	172.6150	167.0467	167.0467	172.6150	167.0467	172.6150	167.0467	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	316.8875	320.1759	311.8894	294.2486	271.9803	251.0512	237.0693	233.7810	242.0674	259.7082	281.9765	302.9056	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.6444	37.6444	37.6444	37.6444	37.6444	37.6444	37.6444	37.6444	37.6444	37.6444	37.6444	37.6444	(69)
Pumps, fans 3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000		(70)
Losses e.g. evaporation (negative values) (Table 5)	-117.1548	-117.1548	-117.1548	-117.1548	-117.1548	-117.1548	-117.1548	-117.1548	-117.1548	-117.1548	-117.1548	-117.1548	(71)
Water heating gains (Table 5)	161.5334	158.8010	153.5379	142.0030	134.9375	127.5523	123.0164	126.7642	131.1582	139.3529	150.4105	160.0586	(72)
Total internal gains	715.4007	733.8546	702.4072	678.7997	643.8976	618.1515	594.0655	594.5250	612.7736	636.0409	674.9350	699.9440	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	8.7400	11.2829	0.6300	0.7000	0.7700	30.1374	(75)
Southeast	3.7200	36.7938	0.6300	0.7000	0.7700	41.8302	(77)
Southwest	10.1300	36.7938	0.6300	0.7000	0.7700	113.9085	(79)
Northwest	0.6700	11.2829	0.6300	0.7000	0.7700	2.3103	(81)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	188.1864	331.3289	481.9665	645.1644	766.4359	780.1588	744.1390	650.7196	538.0190	373.9078	227.3667	159.7783	(83)
Total gains	903.5871	1065.1834	1184.3736	1323.9640	1410.3335	1398.3103	1338.2045	1245.2446	1150.7926	1009.9487	902.3017	859.7223	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	42.2286	42.3106	42.3913	42.7745	42.8469	43.1875	43.1875	43.2511	43.0557	42.8469	42.7006	42.5487	
alpha	3.8152	3.8207	3.8261	3.8516	3.8565	3.8792	3.8792	3.8834	3.8704	3.8565	3.8467	3.8366	
util living area	0.9876	0.9762	0.9548	0.8987	0.7908	0.6246	0.4744	0.5247	0.7497	0.9255	0.9774	0.9896	(86)
MIT	19.2448	19.5024	19.8611	20.3266	20.6984	20.9129	20.9768	20.9658	20.8188	20.3302	19.7075	19.2014	(87)
Th 2	20.0497	20.0514	20.0530	20.0607	20.0622	20.0689	20.0689	20.0701	20.0663	20.0622	20.0592	20.0562	(88)
util rest of house	0.9849	0.9712	0.9451	0.8767	0.7464	0.5512	0.3808	0.4289	0.6842	0.9046	0.9719	0.9874	(89)
MIT 2	17.9915	18.3191	18.7720	19.3499	19.7821	20.0068	20.0578	20.0526	19.9218	19.3664	18.5876	17.9404	(90)
Living area fraction									fLA = Living area / (4) =			0.1436	(91)
MIT	18.1714	18.4890	18.9284	19.4901	19.9136	20.1369	20.1898	20.1837	20.0506	19.5048	18.7484	18.1215	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.1714	18.4890	18.9284	19.4901	19.9136	20.1369	20.1898	20.1837	20.0506	19.5048	18.7484	18.1215	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9774	0.9600	0.9302	0.8607	0.7385	0.5569	0.3934	0.4411	0.6830	0.8890	0.9611	0.9808	(94)
Useful gains	883.1327	1022.6087	1101.6967	1139.5592	1041.5985	778.7110	526.3875	549.2947	785.9528	897.8854	867.1641	843.2164	(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	2117.0650	2069.9344	1889.5395	1595.6464	1235.4779	826.2820	535.7101	563.8201	890.7306	1339.4443	1758.1315	2108.7199	(97)
Space heating kWh	918.0456	703.8028	586.1550	328.3828	144.2463	0.0000	0.0000	0.0000	0.0000	328.5198	641.4965	941.5346	(98a)
Space heating requirement - total per year (kWh/year)												4592.1835	
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	918.0456	703.8028	586.1550	328.3828	144.2463	0.0000	0.0000	0.0000	0.0000	328.5198	641.4965	941.5346	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4592.1835	
Space heating per m2											(98c) / (4) =	31.3075	(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	918.0456	703.8028	586.1550	328.3828	144.2463	0.0000	0.0000	0.0000	0.0000	328.5198	641.4965	941.5346	(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)	994.6323	762.5166	635.0542	355.7777	156.2798	0.0000	0.0000	0.0000	0.0000	355.9261	695.0125	1020.0808	(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	255.1674	225.5824	239.7541	211.3792	205.2213	185.2933	183.2883	190.4560	192.3915	214.0536	226.9636	252.4882	(64)
Efficiency of water heater												79.8000	(216)
(217)m	86.6739	86.4339	85.9849	85.0439	83.2841	79.8000	79.8000	79.8000	79.8000	85.0172	86.2576	86.7315	(217)
Fuel for water heating, kWh/month	294.3992	260.9884	278.8328	248.5532	246.4112	232.1971	229.6846	238.6666	241.0921	251.7767	263.1230	291.1146	(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	34.7090	27.8449	25.0712	18.3682	14.1882	11.5918	12.9429	16.8237	21.8523	28.6714	32.3843	35.6737	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-64.0766	-88.1000	-123.4913	-135.2164	-142.7125	-131.9855	-130.2138	-124.3408	-113.6604	-98.8716	-69.5881	-55.6519	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-43.3076	-90.1929	-177.6714	-264.6355	-347.8840	-348.9292	-344.9478	-293.0944	-216.1191	-128.3854	-57.6096	-34.3275	(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	4975.2801	(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	3076.8395	(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)	280.1216	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-3625.0132	(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	4793.2279	(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	4975.2801	0.2100	1044.8088	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3076.8395	0.2100	646.1363	(264)
Space and water heating			1690.9451	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	280.1216	0.1443	40.4302	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1277.9088	0.1352	-172.7190	
PV Unit electricity exported	-2347.1045	0.1261	-296.0520	
Total			-468.7710	(269)
Total CO2, kg/year			1274.5336	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			8.6900	(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	4975.2801	1.1300	5622.0665	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3076.8395	1.1300	3476.8287	(278)
Space and water heating			9098.8951	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	280.1216	1.5338	429.6599	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1277.9088	1.4996	-1916.2896	
PV Unit electricity exported	-2347.1045	0.4630	-1086.7382	
Total			-3003.0277	(283)
Total Primary energy kWh/year			6655.6281	(286)
Target Primary Energy Rate (TPER)			45.3800	(287)

Building Regulations England Part L (BREL) Compliance Report

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

Date: Fri 14 Mar 2025 09:30:51

Project Information			
Assessed By	Richard Millard	Building Type	House, Detached
OCDEA Registration	EES/025661	Assessment Date	2025-03-14

Dwelling Details			
Assessment Type	As designed	Total Floor Area	147 m^2
Site Reference	P+	Plot Reference	Proposed
Address	30		

Client Details	
Name	Ian White
Company	Cotswold Homes Ltd
Address	West House, Yate, Bristol, BS37 5NG

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

1a Target emission rate and dwelling emission rate		
Fuel for main heating system	Electricity	
Target carbon dioxide emission rate	*8.9 $kgCO_2/m^2$*	
Dwelling carbon dioxide emission rate	2.59 $kgCO_2/m^2$	OK
1b Target primary energy rate and dwelling primary energy		
Target primary energy	*46.5 kWh_{PE}/m^2*	
Dwelling primary energy	30.44 kWh_{PE}/m^2	OK
1c Target fabric energy efficiency and dwelling fabric energy efficiency		
Target fabric energy efficiency	*37.9 kWh/m^2*	
Dwelling fabric energy efficiency	36.5 kWh/m^2	OK

2a Fabric U-values				
Element	***Maximum permitted average U-Value [W/m^2K]***	**Dwelling average U-Value [W/m^2K]**	**Element with highest individual U-Value**	
External walls	*0.26*	0.18	Walls (1) (0.18)	OK
Party walls	*0.2*	N/A	N/A	**N/A**
Curtain walls	*1.6*	N/A	N/A	**N/A**
Floors	*0.18*	0.12	Heatloss Floor 1 (0.12)	OK
Roofs	*0.16*	0.11	Roof (2) (0.13)	OK
Windows, doors, and roof windows	*1.6*	1.2	WG02 (1.2)	OK
Rooflights	*2.2*	N/A	N/A	**N/A**

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))		
Name	**Net area [m^2]**	**U-Value [W/m^2K]**
Exposed wall: Walls (1)	125.95	0.18
Ground floor: Heatloss Floor 1, Heatloss Floor 1	75.03	0.12
Exposed roof: Roof (1)	73.41	0.11
Exposed roof: Roof (2)	1.62	0.13

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	**Area [m^2]**	**Orientation**	**Frame factor**	**U-Value [W/m^2K]**
WG02, Windows	1.65	North West	0.7	1.2
WG03, Windows	1.43	North East	0.7	1.2
FG01, Windows	2.13	North West	0.7	1.2
FG02, Windows	1.08	North West	0.7	1.2
FG03, Windows	1.48	North West	0.7	1.2
FG04, Windows	0.67	South West	0.7	1.2
FG05, Windows	1.43	South East	0.7	1.2
FG06, Windows	1.43	South East	0.7	1.2
ED01, Doors	2	North West	N/A	1.2
ED02, Doors	2	South West	N/A	1.2
ED03, Glazed Doors	3.78	South East	0.7	1.2
WG04, Windows	2.06	South East	0.7	1.2
WG05, Windows	1.33	South East	0.7	1.2

Name	Area [m^2]	Orientation	Frame factor	U-Value [W/m^2K]
FG07, Windows	1.43	South East	0.7	1.2
FG08, Windows	0.67	North East	0.7	1.2
WG01, Windows	2.4	North West	0.7	1.2
WG06, Windows	2.62	North East	0.7	1.2
WG07, Windows	1.33	South East	0.7	1.2

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))				
Building part **1**: Thermal bridging calculated from linear thermal transmittances for each junction				
Main element	**Junction detail**	**Source**	**Psi value [W/mK]**	**Drawing / reference**
External wall	E1: Steel lintel with perforated steel base plate	Calculated by person with suitable expertise	0.241	EMPF125E101
External wall	E3: Sill	Calculated by person with suitable expertise	0.026 **(!)**	EMPF125E301
External wall	E4: Jamb	Calculated by person with suitable expertise	0.02 **(!)**	EMPF125E401
External wall	E5: Ground floor (normal)	Calculated by person with suitable expertise	0.045	EMPF125E504
External wall	E6: Intermediate floor within a dwelling	Calculated by person with suitable expertise	0.002 **(!)**	EMPF125E601
External wall	E10: Eaves (insulation at ceiling level)	Calculated by person with suitable expertise	0.05	EMPF125E1001
External wall	E12: Gable (insulation at ceiling level)	Calculated by person with suitable expertise	0.031 **(!)**	EMPF125E1201
External wall	E16: Corner (normal)	Calculated by person with suitable expertise	0.037 **(!)**	EMPF125E21601
External wall	E17: Corner (inverted - internal area greater than external area)	Calculated by person with suitable expertise	-0.09	EMPF125E21701

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

4 Space heating	
Main heating system 1: Heat pump with radiators or underfloor heating - Electricity	
Efficiency	244.3%
Emitter type	Radiators
Flow temperature	55°C
System type	Heat Pump
Manufacturer	Daikin Europe NV
Model	EDLA08EV3
Commissioning	
Secondary heating system: N/A	
Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water	
Cylinder/store - type: Cylinder	
Capacity	210 litres
Declared heat loss	1.7 kWh/day
Primary pipework insulated	Yes
Manufacturer	
Model	
Commissioning	
Waste water heat recovery system 1 - type: N/A	
Efficiency	
Manufacturer	
Model	

6 Controls		
Main heating 1 - type: Time and temperature zone control by arrangement of plumbing and electrical services		
Function		
Ecodesign class		
Manufacturer		
Model		
Water heating - type: Cylinder thermostat and HW separately timed		
Manufacturer		
Model		

7 Lighting		
Minimum permitted light source efficacy	*75 lm/W*	
Lowest light source efficacy	85 lm/W	**OK**
External lights control	N/A	

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

9 Local generation	
Technology type: **Photovoltaic system (1)**	
Peak power	2.01 kWp
Orientation	South East
Pitch	30°
Overshading	None or very little
Manufacturer	
MCS certificate	

10 Heat networks
N/A

11 Supporting documentary evidence
N/A

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

Full SAP Calculation Printout

Property Reference	P+	**Issued on Date**	14/03/2025
Assessment Reference	Proposed	**Prop Type Ref**	Proposed 30
Property	30		

SAP Rating	86 B	**DER**	2.59	**TER**	8.90
Environmental	97 A	**% DER < TER**			70.90
CO_2 Emissions (t/year)	0.33	**DFEE**	36.52	**TFEE**	37.86
Compliance Check	See BREL	**% DFEE < TFEE**			3.53
% DPER < TPER	34.55	**DPER**	30.44	**TPER**	46.50

Assessor Details	Mr. Richard Millard	**Assessor ID**	U367-0001
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)	
Main dwelling						
Ground floor	73.3400 (1b)	x	2.4000 (2b)	=	176.0160	(1b) - (3b)
First floor	73.3400 (1c)	x	2.6000 (2c)	=	190.6840	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	146.6800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	366.7000	(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			6 * 10 =	60.0000	(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) =			60.0000 / (5) =	0.1636	(8)
Pressure test				Yes	
Pressure Test Method				Blower Door	
Measured/design AP50				5.0000	(17)
Infiltration rate				0.4136	(18)
Number of sides sheltered				3	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3206	(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	0.4087	0.4007	0.3927	0.3526	0.3446	0.3045	0.3045	0.2965	0.3206	0.3446	0.3606	0.3767	(22b)
Effective ac	0.5835	0.5803	0.5771	0.5622	0.5594	0.5464	0.5464	0.5440	0.5514	0.5594	0.5650	0.5709	(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	
Main dwelling								
Windows			23.1400	1.1450	26.4962			(27)
Glazed Doors			3.7800	1.1450	4.3282			(27)
Doors			4.0000	1.2000	4.8000			(26)
Heatloss Floor 1			75.0300	0.1200	9.0036	75.0000	5627.2500	(28a)
Cavity Wall	156.8700	30.9200	125.9500	0.1800	22.6710	60.0000	7556.9997	(29a)
External Roof 1	73.4100		73.4100	0.1100	8.0751	9.0000	660.6900	(30)
External Roof 2	1.6200		1.6200	0.1300	0.2106	9.0000	14.5800	(30)
Total net area of external elements Aum(A, m2)			306.9300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		75.5847			(33)
Main dwelling								
Internal Wall 1 - Block			73.8800			75.0000	5540.9998	(32c)
Internal Wall 2 - Stud			31.4100			9.0000	282.6900	(32c)
Internal Wall 3 - Up			190.3800			9.0000	1713.4200	(32c)
Internal Floor 1			73.4100			18.0000	1321.3800	(32d)
Internal Ceiling 1			75.0300			9.0000	675.2700	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		23393.2795	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							159.4851	(35)
List of Thermal Bridges								

	Length	Psi-value	Total	
K1 Element				
E1 Steel lintel with perforated steel base plate	20.0500	0.2410	4.8320	
E3 Sill	18.3400	0.0260	0.4768	
E4 Jamb	47.1800	0.0200	0.9436	
E5 Ground floor (normal)	36.0200	0.0450	1.6209	
E6 Intermediate floor within a dwelling	36.0200	0.0020	0.0720	
E10 Eaves (insulation at ceiling level)	18.7600	0.0500	0.9380	
E12 Gable (insulation at ceiling level)	20.8500	0.0310	0.6464	
E16 Corner (normal)	20.2000	0.0370	0.7474	
E17 Corner (inverted - internal area greater than external area)	9.8000	-0.0900	-0.8820	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			9.3952	(36)
Point Thermal bridges		(36a) =	0.0000	
Total fabric heat loss		(33) + (36) + (36a) =	84.9799	(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	70.6126	70.2201	69.8354	68.0285	67.6904	66.1166	66.1166	65.8252	66.7228	67.6904	68.3743	69.0893	(38)
Heat transfer coeff	155.5925	155.2000	154.8153	153.0084	152.6703	151.0966	151.0966	150.8051	151.7027	152.6703	153.3542	154.0692	(39)
Average = Sum(39)m / 12 =												153.0068	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0608	1.0581	1.0555	1.0431	1.0408	1.0301	1.0301	1.0281	1.0342	1.0408	1.0455	1.0504	(40)
HLP (average)												1.0431	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.9289	(42)
Hot water usage for mixer showers	73.3274	72.2254	70.6196	67.5472	65.2799	62.7514	61.3142	62.9078	64.6547	67.3696	70.5080	73.0464	(42a)
Hot water usage for baths	31.6564	31.1862	30.5242	29.3035	28.3894	27.3759	26.8284	27.4858	28.2016	29.2862	30.5320	31.5494	(42b)
Hot water usage for other uses	44.6246	43.0019	41.3791	39.7564	38.1337	36.5110	36.5110	38.1337	39.7564	41.3791	43.0019	44.6246	(42c)
Average daily hot water use (litres/day)												137.5236	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	149.6083	146.4135	142.5229	136.6071	131.8030	126.6383	124.6536	128.5274	132.6128	138.0349	144.0418	149.2204	(44)
Energy conte	236.9430	208.4909	219.0525	187.0084	177.4322	155.7165	150.7577	159.1437	163.5249	187.3121	205.2140	233.6430	(45)
Energy content (annual)										Total = Sum(45)m =		2284.2389	
Distribution loss (46)m = 0.15 x (45)m	35.5415	31.2736	32.8579	28.0513	26.6148	23.3575	22.6137	23.8716	24.5287	28.0968	30.7821	35.0465	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9180	(55)
Total storage loss	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(56)
If cylinder contains dedicated solar storage	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(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	288.6634	255.2061	270.7729	237.0604	229.1526	205.7685	202.4781	210.8641	213.5769	239.0325	255.2660	285.3634	(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	288.6634	255.2061	270.7729	237.0604	229.1526	205.7685	202.4781	210.8641	213.5769	239.0325	255.2660	285.3634	(64)
										Total per year (kWh/year) = Sum(64)m =		2893.2049	(64)
12Total per year (kWh/year)												2893	(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	120.1599	106.6954	114.2113	102.2219	100.3725	91.8173	91.5033	94.2916	94.4136	103.6576	108.2753	119.0626	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	146.4435	146.4435	146.4435	146.4435	146.4435	146.4435	146.4435	146.4435	146.4435	146.4435	146.4435	146.4435	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	162.7548	180.1928	162.7548	168.1799	162.7548	168.1799	162.7548	162.7548	168.1799	162.7548	168.1799	162.7548	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	316.8875	320.1758	311.8894	294.2486	271.9803	251.0512	237.0693	233.7810	242.0674	259.7082	281.9765	302.9056	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.6444	37.6444	37.6444	37.6444	37.6444	37.6444	37.6444	37.6444	37.6444	37.6444	37.6444	37.6444	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-117.1548	-117.1548	-117.1548	-117.1548	-117.1548	-117.1548	-117.1548	-117.1548	-117.1548	-117.1548	-117.1548	-117.1548	(71)
Water heating gains (Table 5)	161.5052	158.7729	153.5098	141.9748	134.9093	127.5241	122.9883	126.7360	131.1300	139.3247	150.3823	160.0304	(72)
Total internal gains	708.0806	726.0746	695.0870	671.3364	636.5774	613.6883	589.7454	590.2049	608.3104	628.7207	667.4718	692.6239	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	4.7200	11.2829	0.6300	0.7000	0.7700	16.2756	(75)
Southeast	9.0100	36.7938	0.6300	0.7000	0.7700	101.3145	(77)
Southwest	0.6700	36.7938	0.6300	0.7000	0.7700	7.5339	(79)
Northwest	8.7400	11.2829	0.6300	0.7000	0.7700	30.1374	(81)
Southeast	3.7800	36.7938	0.6300	0.7000	0.7700	42.5049	(77)

Solar gains	197.7663	352.2856	522.9615	716.6115	865.3131	886.6126	843.3212	728.1701	589.3594	400.3915	239.6859	167.4300	(83)
Total gains	905.8468	1078.3601	1218.0486	1387.9479	1501.8905	1500.3008	1433.0665	1318.3750	1197.6698	1029.1123	907.1577	860.0539	(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	41.7638	41.8694	41.9735	42.4691	42.5632	43.0065	43.0065	43.0896	42.8346	42.5632	42.3734	42.1767	
alpha	3.7843	3.7913	3.7982	3.8313	3.8375	3.8671	3.8671	3.8726	3.8556	3.8375	3.8249	3.8118	
util living area	0.9878	0.9761	0.9526	0.8895	0.7704	0.5970	0.4508	0.5045	0.7375	0.9241	0.9778	0.9899	(86)
Living	19.2151	19.4837	19.8622	20.3508	20.7233	20.9247	20.9802	20.9698	20.8275	20.3293	19.6907	19.1752	
Non living	17.9418	18.2837	18.7612	19.3670	19.7959	20.0057	20.0492	20.0448	19.9190	19.3551	18.5563	17.8965	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	20.0869	19.4837	19.8622	20.3508	20.7233	20.9247	20.9802	20.9698	20.8275	20.3293	19.6907	19.4304	(87)
Th 2	20.0330	20.0352	20.0374	20.0475	20.0494	20.0583	20.0583	20.0600	20.0549	20.0494	20.0456	20.0416	(88)
util rest of house	0.9852	0.9710	0.9424	0.8659	0.7238	0.5238	0.3599	0.4102	0.6705	0.9026	0.9722	0.9878	(89)
MIT 2	19.1993	18.2837	18.7612	19.3670	19.7959	20.0057	20.0492	20.0448	19.9190	19.3551	18.5563	18.2831	(90)
Living area fraction									fLA = Living area / (4) =			0.1546	(91)
MIT	19.3365	18.4692	18.9314	19.5191	19.9392	20.1477	20.1931	20.1878	20.0594	19.5056	18.7316	18.4604	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.3365	18.4692	18.9314	19.5191	19.9392	20.1477	20.1931	20.1878	20.0594	19.5056	18.7316	18.4604	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9829	0.9598	0.9273	0.8504	0.7179	0.5311	0.3733	0.4235	0.6708	0.8872	0.9615	0.9828	(94)
Useful gains	890.3719	1035.0071	1129.5085	1180.3416	1078.1568	796.8636	534.9250	558.3053	803.4431	913.0242	872.2506	845.2291	(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	2339.5644	2105.9379	1924.5709	1624.8067	1257.8832	838.2427	542.8981	571.2151	904.0638	1359.6249	1783.7609	2197.0866	(97)
Space heating kWh	1078.1993	719.6655	591.5265	320.0149	133.7165	0.0000	0.0000	0.0000	0.0000	332.2709	656.2875	1005.7820	(98a)
Space heating requirement - total per year (kWh/year)												4837.4630	
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	1078.1993	719.6655	591.5265	320.0149	133.7165	0.0000	0.0000	0.0000	0.0000	332.2709	656.2875	1005.7820	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4837.4630	
Space heating per m2											(98c) / (4) =	32.9797	(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 %)	244.2973	(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	1078.1993	719.6655	591.5265	320.0149	133.7165	0.0000	0.0000	0.0000	0.0000	332.2709	656.2875	1005.7820	(98)
Space heating efficiency (main heating system 1)	244.2973	244.2973	244.2973	244.2973	0.0000	0.0000	0.0000	0.0000	244.2973	244.2973	244.2973	244.2973	(210)
Space heating fuel (main heating system)	441.3471	294.5859	242.1338	130.9940	54.7351	0.0000	0.0000	0.0000	0.0000	136.0109	268.6429	411.7040	(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	288.6634	255.2061	270.7729	237.0604	229.1526	205.7685	202.4781	210.8641	213.5769	239.0325	255.2660	285.3634	(64)
Efficiency of water heater												165.9862	(216)
(217)m	165.9862	165.9862	165.9862	165.9862	165.9862	165.9862	165.9862	165.9862	165.9862	165.9862	165.9862	165.9862	(217)
Fuel for water heating, kWh/month	173.9081	153.7514	163.1297	142.8193	138.0552	123.9672	121.9849	127.0371	128.6714	144.0074	153.7875	171.9200	(219)
Space cooling fuel requirement	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)
(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	(231)
Pumps and Fa	33.1260	26.5749	23.9278	17.5305	13.5411	11.0632	12.3526	16.0564	20.8557	27.3638	30.9073	34.0467	(232)
Lighting													
Electricity generated by PVs (Appendix M) (negative quantity)	-36.0212	-55.9328	-88.5118	-106.3917	-117.8299	-107.9350	-106.2752	-97.3807	-81.8194	-65.7682	-40.8071	-30.3336	(233a)
(233a)m													
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
(234a)m													
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
(235a)m													
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	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)
(235c)m													
Electricity generated by PVs (Appendix M) (negative quantity)	-8.2807	-20.0140	-45.3250	-78.0686	-113.4244	-120.5436	-118.7305	-97.1647	-67.1429	-32.6257	-12.1604	-6.4453	(233b)
(233b)m													
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
(234b)m													
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
(235b)m													
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	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)
(235d)m													

Annual totals kWh/year

Space heating fuel - main system 1	1980.1538	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)

Efficiency of water heater	165.9862	
Water heating fuel used	1743.0394	(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)	267.3459	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-1654.9322	(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	2335.6068	(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	1980.1538	0.1557	308.2473	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1743.0394	0.1410	245.7249	(264)
Space and water heating			553.9722	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	267.3459	0.1443	38.5863	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-935.0066	0.1335	-124.8186	
PV Unit electricity exported	-719.9257	0.1221	-87.8838	
Total			-212.7025	(269)
Total CO2, kg/year			379.8560	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			2.5900	(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	1980.1538	1.5763	3121.2705	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1743.0394	1.5213	2651.6474	(278)
Space and water heating			5772.9179	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	267.3459	1.5338	410.0641	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-935.0066	1.4933	-1396.2712	
PV Unit electricity exported	-719.9257	0.4479	-322.4402	
Total			-1718.7114	(283)
Total Primary energy kWh/year			4464.2706	(286)
Dwelling Primary energy Rate (DPER)			30.4400	(287)

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Main dwelling						
Ground floor	73.3400	(1b) x	2.4000	(2b) =	176.0160	(1b) - (3b)
First floor	73.3400	(1c) x	2.6000	(2c) =	190.6840	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	146.6800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		366.7000	(5)

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2. Ventilation rate

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		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	4 * 10 =	40.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1091	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3591	(18)
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2783	(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													
	0.3548	0.3479	0.3409	0.3061	0.2992	0.2644	0.2644	0.2574	0.2783	0.2992	0.3131	0.3270	(22b)
Effective ac	0.5629	0.5605	0.5581	0.5469	0.5447	0.5349	0.5349	0.5331	0.5387	0.5447	0.5490	0.5535	(25)

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3. Heat losses and heat loss parameter

Element	Gross	Openings	NetArea	U-value	A x U	K-value	A x K	
Main dwelling	m2	m2	m2	W/m2K	W/K	kJ/m2K	kJ/K	
TER Opaque door			4.0000	1.0000	4.0000			(26)
TER Opening Type			26.9200	1.1450	30.8244			(27)
Heatloss Floor 1			75.0300	0.1300	9.7539			(28a)
Cavity Wall	156.8700	30.9200	125.9500	0.1800	22.6710			(29a)
External Roof 1	73.4100		73.4100	0.1100	8.0751			(30)
External Roof 2	1.6200		1.6200	0.1100	0.1782			(30)
Total net area of external elements Aum(A, m2)			306.9300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		75.5026			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 159.4851 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	20.0500	0.0500	1.0025
E3 Sill	18.3400	0.0500	0.9170
E4 Jamb	47.1800	0.0500	2.3590
E5 Ground floor (normal)	36.0200	0.1600	5.7632
E6 Intermediate floor within a dwelling	36.0200	0.0000	0.0000
E10 Eaves (insulation at ceiling level)	18.7600	0.0600	1.1256
E12 Gable (insulation at ceiling level)	20.8500	0.0600	1.2510
E16 Corner (normal)	20.2000	0.0900	1.8180
E17 Corner (inverted - internal area greater than external area)	9.8000	-0.0900	-0.8820

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 13.3543 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 88.8569 (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	68.1228	67.8270	67.5371	66.1753	65.9205	64.7344	64.7344	64.5148	65.1913	65.9205	66.4360	66.9748	(38)
Heat transfer coeff													
	156.9798	156.6840	156.3940	155.0322	154.7774	153.5914	153.5914	153.3717	154.0482	154.7774	155.2929	155.8317	(39)
Average = Sum(39)m / 12 =												155.0310	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0702	1.0682	1.0662	1.0569	1.0552	1.0471	1.0471	1.0456	1.0502	1.0552	1.0587	1.0624	(40)
HLP (average)												1.0569	
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 2.9289 (42)

Hot water usage for mixer showers

73.3274	72.2254	70.6196	67.5472	65.2799	62.7514	61.3142	62.9078	64.6547	67.3696	70.5080	73.0464	(42a)

Hot water usage for baths

31.6564	31.1862	30.5242	29.3035	28.3894	27.3759	26.8284	27.4858	28.2016	29.2862	30.5320	31.5494	(42b)

Hot water usage for other uses

44.6246	43.0019	41.3791	39.7564	38.1337	36.5110	36.5110	38.1337	39.7564	41.3791	43.0019	44.6246	(42c)

Average daily hot water use (litres/day) 137.5236 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	149.6083	146.4135	142.5229	136.6071	131.8030	126.6383	124.6536	128.5274	132.6128	138.0349	144.0418	149.2204	(44)
Energy conte	236.9430	208.4909	219.0525	187.0084	177.4322	155.7165	150.7577	159.1437	163.5249	187.3121	205.2140	233.6430	(45)
Energy content (annual)										Total = Sum(45)m =		2284.2389	
Distribution loss (46)m = 0.15 x (45)m													
	35.5415	31.2736	32.8579	28.0513	26.6148	23.3575	22.6137	23.8716	24.5287	28.0968	30.7821	35.0465	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7016	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9188	(55)
Total storage loss													
	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(56)
If cylinder contains dedicated solar storage													
	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(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													
	288.6896	255.2297	270.7991	237.0857	229.1788	205.7939	202.5043	210.8903	213.6022	239.0587	255.2914	285.3896	(62)
WWHRS	-33.5222	-29.6473	-31.0450	-25.7065	-23.9575	-20.5006	-19.2160	-20.4343	-21.2107	-25.0051	-28.3277	-32.9014	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h													
	255.1674	225.5824	239.7541	211.3792	205.2213	185.2933	183.2883	190.4560	192.3915	214.0536	226.9636	252.4882	(64)
										Total per year (kWh/year) = Sum(64)m =		2582.0389	(64)
12Total per year (kWh/year)												2582	(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													
	120.1808	106.7143	114.2322	102.2422	100.3935	91.8376	91.5242	94.3126	94.4339	103.6785	108.2955	119.0836	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	146.4435	146.4435	146.4435	146.4435	146.4435	146.4435	146.4435	146.4435	146.4435	146.4435	146.4435	146.4435	(66)

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

	162.7548	180.1928	162.7548	168.1799	162.7548	168.1799	162.7548	162.7548	168.1799	162.7548	168.1799	162.7548	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	316.8875	320.1758	311.8894	294.2486	271.9803	251.0512	237.0693	233.7810	242.0674	259.7082	281.9765	302.9056	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.6444	37.6444	37.6444	37.6444	37.6444	37.6444	37.6444	37.6444	37.6444	37.6444	37.6444	37.6444	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-117.1548	-117.1548	-117.1548	-117.1548	-117.1548	-117.1548	-117.1548	-117.1548	-117.1548	-117.1548	-117.1548	-117.1548	(71)
Water heating gains (Table 5)													
	161.5334	158.8010	153.5379	142.0030	134.9375	127.5523	123.0164	126.7642	131.1582	139.3529	150.4105	160.0586	(72)
Total internal gains													
	711.1087	729.1027	698.1152	674.3646	639.6056	613.7164	589.7735	590.2330	608.3386	631.7489	670.5000	695.6520	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	4.7200	11.2829	0.6300	0.7000	0.7700	16.2756	(75)
Southeast	12.7900	36.7938	0.6300	0.7000	0.7700	143.8194	(77)
Southwest	0.6700	36.7938	0.6300	0.7000	0.7700	7.5339	(79)
Northwest	8.7400	11.2829	0.6300	0.7000	0.7700	30.1374	(81)

Solar gains	197.7663	352.2856	522.9615	716.6115	865.3131	886.6126	843.3212	728.1701	589.3594	400.3915	239.6859	167.4300	(83)
Total gains	908.8750	1081.3883	1221.0767	1390.9761	1504.9187	1500.3290	1433.0947	1318.4032	1197.6980	1032.1404	910.1859	863.0821	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	41.3947	41.4729	41.5497	41.9147	41.9837	42.3079	42.3079	42.3685	42.1825	41.9837	41.8444	41.6997	
alpha	3.7596	3.7649	3.7700	3.7943	3.7989	3.8205	3.8205	3.8246	3.8122	3.7989	3.7896	3.7800	
util living area													
	0.9877	0.9760	0.9528	0.8909	0.7737	0.6035	0.4571	0.5112	0.7425	0.9248	0.9777	0.9898	(86)
MIT	19.1983	19.4658	19.8447	20.3322	20.7113	20.9185	20.9782	20.9668	20.8176	20.3125	19.6701	19.1529	(87)
Th 2	20.0252	20.0269	20.0285	20.0362	20.0376	20.0443	20.0443	20.0455	20.0417	20.0376	20.0347	20.0317	(88)
util rest of house													
	0.9851	0.9710	0.9426	0.8673	0.7269	0.5292	0.3639	0.4148	0.6752	0.9033	0.9721	0.9876	(89)
MIT 2	17.9154	18.2555	18.7332	19.3363	19.7730	19.9873	20.0342	20.0289	19.8979	19.3262	18.5229	17.8618	(90)
Living area fraction										fLA = Living area / (4) =		0.1546	(91)
MIT	18.1136	18.4425	18.9050	19.4902	19.9180	20.1313	20.1801	20.1738	20.0400	19.4786	18.7002	18.0613	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.1136	18.4425	18.9050	19.4902	19.9180	20.1313	20.1801	20.1738	20.0400	19.4786	18.7002	18.0613	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9775	0.9596	0.9273	0.8515	0.7205	0.5364	0.3775	0.4282	0.6750	0.8876	0.9613	0.9810	(94)
Useful gains	888.4700	1037.7141	1132.3306	1184.3865	1084.2964	804.7073	541.0581	564.5976	808.4779	916.1761	874.9681	846.7144	(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													
	2168.4633	2121.8978	1940.0702	1641.8221	1271.9623	849.5531	549.8678	578.8007	915.0487	1374.2090	1801.4342	2160.0354	(97)
Space heating kWh													
	952.3150	728.5715	600.9583	329.3536	139.6234	0.0000	0.0000	0.0000	0.0000	340.7765	667.0556	977.1108	(98a)
Space heating requirement - total per year (kWh/year)												4735.7647	
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													
	952.3150	728.5715	600.9583	329.3536	139.6234	0.0000	0.0000	0.0000	0.0000	340.7765	667.0556	977.1108	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4735.7647	
Space heating per m2											(98c) / (4) =	32.2864	(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													
	952.3150	728.5715	600.9583	329.3536	139.6234	0.0000	0.0000	0.0000	0.0000	340.7765	667.0556	977.1108	(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)													
	1031.7606	789.3515	651.0924	356.8295	151.2713	0.0000	0.0000	0.0000	0.0000	369.2053	722.7038	1058.6249	(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													
	255.1674	225.5824	239.7541	211.3792	205.2213	185.2933	183.2883	190.4560	192.3915	214.0536	226.9636	252.4882	(64)
Efficiency of water heater												79.8000	(216)
(217)m	86.7329	86.4937	86.0329	85.0503	83.2148	79.8000	79.8000	79.8000	79.8000	85.0973	86.3283	86.7900	(217)
Fuel for water heating, kWh/month													
	294.1992	260.8078	278.6772	248.5344	246.6164	232.1971	229.6845	238.6666	241.0921	251.5398	262.9077	290.9184	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)

Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	33.8172	27.1294	24.4270	17.8963	13.8236	11.2940	12.6104	16.3914	21.2908	27.9347	31.5522	34.7571	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-64.0400	-88.0389	-123.4000	-135.1180	-142.6166	-131.9007	-130.1190	-124.2307	-113.5472	-98.7812	-69.5385	-55.6204	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-43.3442	-90.2539	-177.7626	-264.7338	-347.9799	-349.0140	-345.0426	-293.2044	-216.2323	-128.4758	-57.6592	-34.3590	(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	5130.8393	(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	3075.8411	(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)	272.9244	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-3625.0131	(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	4940.5917	(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	5130.8393	0.2100	1077.4763	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3075.8411	0.2100	645.9266	(264)
Space and water heating			1723.4029	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	272.9244	0.1443	39.3914	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1276.9512	0.1352	-172.5908	
PV Unit electricity exported	-2348.0619	0.1261	-296.1816	
Total			-468.7724	(269)
Total CO2, kg/year			1305.9512	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			8.9000	(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	5130.8393	1.1300	5797.8484	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3075.8411	1.1300	3475.7005	(278)
Space and water heating			9273.5489	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	272.9244	1.5338	418.6205	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1276.9512	1.4996	-1914.8582	
PV Unit electricity exported	-2348.0619	0.4630	-1087.2143	
Total			-3002.0725	(283)
Total Primary energy kWh/year			6820.1976	(286)
Target Primary Energy Rate (TPER)			46.5000	(287)

Building Regulations England Part L (BREL) Compliance Report

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

Date: Fri 14 Mar 2025 09:30:58

Project Information			
Assessed By	Richard Millard	Building Type	House, Detached
OCDEA Registration	EES/025661	Assessment Date	2025-03-14

Dwelling Details			
Assessment Type	As designed	Total Floor Area	186 m^2
Site Reference	W	Plot Reference	Regulated (Baseline)
Address	31, Yatton Keynell		

Client Details	
Name	Ian White
Company	Cotswold Homes Ltd
Address	West House, Yate, Bristol, BS37 5NG

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

1a Target emission rate and dwelling emission rate		
Fuel for main heating system	Mains gas	
Target carbon dioxide emission rate	*8.83 $kgCO_2/m^2$*	
Dwelling carbon dioxide emission rate	12.91 $kgCO_2/m^2$	**FAIL**
1b Target primary energy rate and dwelling primary energy		
Target primary energy	*46.46 kWh_{PE}/m^2*	
Dwelling primary energy	71.19 kWh_{PE}/m^2	**FAIL**
1c Target fabric energy efficiency and dwelling fabric energy efficiency		
Target fabric energy efficiency	*41.9 kWh/m^2*	
Dwelling fabric energy efficiency	41.7 kWh/m^2	**OK**

2a Fabric U-values				
Element	***Maximum permitted average U-Value [W/m^2K]***	**Dwelling average U-Value [W/m^2K]**	**Element with highest individual U-Value**	
External walls	*0.26*	0.18	Walls (1) (0.18)	**OK**
Party walls	*0.2*	N/A	N/A	**N/A**
Curtain walls	*1.6*	N/A	N/A	**N/A**
Floors	*0.18*	0.13	Heatloss Floor 1 (0.13)	**OK**
Roofs	*0.16*	0.11	Roof (1) (0.11)	**OK**
Windows, doors, and roof windows	*1.6*	1.2	F-W01 (1.2)	**OK**
Rooflights	*2.2*	N/A	N/A	**N/A**

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))		
Name	**Net area [m^2]**	**U-Value [W/m^2K]**
Exposed wall: Walls (1)	185.69	0.18
Ground floor: Heatloss Floor 1, Heatloss Floor 1	90.64	0.13
Exposed roof: Roof (1)	90.64	0.11

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	**Area [m^2]**	**Orientation**	**Frame factor**	**U-Value [W/m^2K]**
F-W01, Windows	2.43	South East	0.7	1.2
F-W02, Windows	2.43	South East	0.7	1.2
F-ED01, Half Glazed Door	3.28	South East	N/A	1.2
F-W03, Windows	1.44	South East	0.7	1.2
F-ED02, Windows	5.17	North West	0.7	1.2
F-ED03, Windows	5.17	South West	0.7	1.2
F-W04, Windows	1.44	South East	0.7	1.2
F-W05, Windows	1.44	South East	0.7	1.2
F-W06, Windows	1.11	South East	0.7	1.2
F-W07, Windows	2.02	North East	0.7	1.2
F-W08, Windows	1.05	North East	0.7	1.2
F-W09, Windows	1.2	North East	0.7	1.2
F-W10, Windows	1.44	North East	0.7	1.2
F-W11, Windows	1.05	North East	0.7	1.2

Name	Area [m^2]	Orientation	Frame factor	U-Value [W/m^2K]
F-W12, Windows	1.44	North East	0.7	1.2
F-W13, Windows	1.2	North East	0.7	1.2
F-W14, Windows	1.44	North East	0.7	1.2
F-W15, Windows	0.43	North West	0.7	1.2
F-W16, Windows	0.43	North West	0.7	1.2
F-W17, Windows	0.58	North West	0.7	1.2
F-W18, Windows	1.05	North West	0.7	1.2
F-W19, Windows	1.11	North West	0.7	1.2
F-W20, Windows	1.44	South West	0.7	1.2

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))

Building part **1**: Thermal bridging calculated from linear thermal transmittances for each junction

Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E2: Other lintels (including other steel lintels)	Not government-approved scheme	0.05	MCPF-125-E2-01
External wall	E3: Sill	Not government-approved scheme	0.05	MCPF-125-E3-01
External wall	E4: Jamb	Not government-approved scheme	0.022 **(!)**	MCPF-125-E4-01
External wall	E5: Ground floor (normal)	Not government-approved scheme	0.16	MCPF-125-E5-04
External wall	E6: Intermediate floor within a dwelling	Not government-approved scheme	0.001 **(!)**	MCPF-125-E6-01
External wall	E10: Eaves (insulation at ceiling level)	Not government-approved scheme	0.06	MCPF-125-E10-01
External wall	E12: Gable (insulation at ceiling level)	Not government-approved scheme	0.06	MCPF-125-E12-01
External wall	E16: Corner (normal)	Not government-approved scheme	0.09	MCPF-125-E16-01
External wall	E17: Corner (inverted - internal area greater than external area)	Not government-approved scheme	-0.07	MCPF-125-E17-01
External wall	E24: Eaves (insulation at ceiling level - inverted)	SAP table default	0.15	

3 Air permeability (better than typically expected values are flagged with a subsequent (!))

Maximum permitted air permeability at 50Pa	*8 m^3/hm^2*	
Dwelling air permeability at 50Pa	5 m^3/hm^2, Design value	OK
Air permeability test certificate reference		

4 Space heating

Main heating system 1: Boiler with radiators or underfloor heating - Mains gas

Efficiency	88.6%
Emitter type	Radiators
Flow temperature	55°C
System type	Regular boiler
Manufacturer	Bosch Thermotechnology
Model	Greenstar 8000 Life
Commissioning	

Secondary heating system: N/A

Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water

Cylinder/store - type: Cylinder

Capacity	210 litres
Declared heat loss	1.7 kWh/day
Primary pipework insulated	Yes
Manufacturer	
Model	
Commissioning	

Waste water heat recovery system 1 - type: N/A	
Efficiency	
Manufacturer	
Model	

6 Controls		
Main heating 1 - type: Time and temperature zone control by arrangement of plumbing and electrical services		
Function		
Ecodesign class		
Manufacturer		
Model		
Water heating - type: Cylinder thermostat and HW separately timed		
Manufacturer		
Model		

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

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

9 Local generation
N/A

10 Heat networks
N/A

11 Supporting documentary evidence
N/A

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

Full SAP Calculation Printout

Property Reference	W	**Issued on Date**	14/03/2025
Assessment Reference	Regulated (Baseline)	**Prop Type Ref**	Proposed 31
Property	31, Yatton Keynell		

SAP Rating	86 B	**DER**	12.91	**TER**	8.83
Environmental	86 B	**% DER < TER**			-46.21
CO_2 Emissions (t/year)	2.23	**DFEE**	41.72	**TFEE**	41.93
Compliance Check	See BREL	**% DFEE < TFEE**			0.49
% DPER < TPER	-53.22	**DPER**	71.19	**TPER**	46.46

Assessor Details	Mr. Richard Millard	**Assessor ID**	U367-0001
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)	
Main dwelling						
Ground floor	96.6400 (1b)	x	2.4000 (2b)	=	231.9360	(1b) - (3b)
First floor	89.4100 (1c)	x	2.6000 (2c)	=	232.4660	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	186.0500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	464.4020	(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	6 * 10 =	60.0000	(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) =	60.0000 / (5) =	0.1292	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3792	(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) =	0.3792	(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	0.4835	0.4740	0.4645	0.4171	0.4076	0.3602	0.3602	0.3508	0.3792	0.4076	0.4266	0.4456	(22b)
Effective ac	0.6169	0.6123	0.6079	0.5870	0.5831	0.5649	0.5649	0.5615	0.5719	0.5831	0.5910	0.5993	(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	
Main dwelling								
Windows			36.5100	1.1450	41.8053			(27)
Half Glazed Door			3.2800	1.2000	3.9360			(26a)
Heatloss Floor 1			90.6400	0.1300	11.7832	75.0000	6798.0000	(28a)
External Wall 1	225.4800	39.7900	185.6900	0.1800	33.4242	60.0000	11141.3997	(29a)
External Roof 1	90.6400		90.6400	0.1100	9.9704	9.0000	815.7600	(30)
Total net area of external elements Aum(A, m2)			406.7600					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		100.9191			(33)
Main dwelling								
Internal Wall 1			144.5300			75.0000	10839.7499	(32c)
Internal Wall 2			220.0600			9.0000	1980.5400	(32c)
Internal Floor 1			89.4100			18.0000	1609.3800	(32d)
Internal Ceiling 1			89.4100			9.0000	804.6900	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		33989.5196	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							182.6902	(35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	27.2000	0.0500	1.3600
E3 Sill	20.7000	0.0500	1.0350

E4 Jamb	57.6000	0.0220	1.2672	
E5 Ground floor (normal)	45.9600	0.1600	7.3536	
E6 Intermediate floor within a dwelling	44.3100	0.0010	0.0443	
E10 Eaves (insulation at ceiling level)	30.6400	0.0600	1.8384	
E12 Gable (insulation at ceiling level)	16.8200	0.0600	1.0092	
E16 Corner (normal)	34.8000	0.0900	3.1320	
E17 Corner (inverted - internal area greater than external area)	14.8000	-0.0700	-1.0360	
E24 Eaves (insulation at ceiling level - inverted)	1.5000	0.1500	0.2250	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			16.2287	(36)
Point Thermal bridges		(36a) =	0.0000	
Total fabric heat loss		(33) + (36) + (36a) =	117.1479	(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	94.5378	93.8423	93.1605	89.9584	89.3593	86.5703	86.5703	86.0538	87.6445	89.3593	90.5713	91.8383	(38)
Heat transfer coeff	211.6857	210.9901	210.3084	207.1062	206.5071	203.7181	203.7181	203.2016	204.7924	206.5071	207.7191	208.9862	(39)
Average = Sum(39)m / 12 =												207.1033	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1378	1.1341	1.1304	1.1132	1.1100	1.0950	1.0950	1.0922	1.1007	1.1100	1.1165	1.1233	(40)
HLP (average)												1.1132	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.9837	(42)
Hot water usage for mixer showers													
	74.2473	73.1315	71.5056	68.3947	66.0989	63.5387	62.0834	63.6971	65.4659	68.2148	71.3926	73.9629	(42a)
Hot water usage for baths													
	32.0520	31.5760	30.9057	29.6697	28.7442	27.7180	27.1637	27.8293	28.5541	29.6522	30.9136	31.9436	(42b)
Hot water usage for other uses													
	45.1865	43.5433	41.9002	40.2570	38.6139	36.9707	36.9707	38.6139	40.2570	41.9002	43.5433	45.1865	(42c)
Average daily hot water use (litres/day)												139.2494	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	151.4858	148.2509	144.3114	138.3214	133.4570	128.2274	126.2179	130.1403	134.2770	139.7672	145.8495	151.0930	(44)
Energy conte	239.9165	211.1072	221.8013	189.3551	179.6588	157.6706	152.6496	161.1408	165.5770	189.6627	207.7893	236.5751	(45)
Energy content (annual)										Total = Sum(45)m =		2312.9040	
Distribution loss (46)m = 0.15 x (45)m													
	35.9875	31.6661	33.2702	28.4033	26.9488	23.6506	22.8974	24.1711	24.8365	28.4494	31.1684	35.4863	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9180	(55)
Total storage loss													
	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(56)
If cylinder contains dedicated solar storage													
	28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(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													
	291.6369	257.8224	273.5217	239.4071	231.3792	207.7226	204.3700	212.8612	215.6290	241.3831	257.8413	288.2955	(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													
	291.6369	257.8224	273.5217	239.4071	231.3792	207.7226	204.3700	212.8612	215.6290	241.3831	257.8413	288.2955	(64)
										Total per year (kWh/year) = Sum(64)m =		2921.8700	(64)
12Total per year (kWh/year)												2922	(64)
Electric shower(s)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000	(64a)
Heat gains from water heating, kWh/month													
	121.1486	107.5653	115.1253	103.0022	101.1129	92.4671	92.1323	94.9557	95.0959	104.4392	109.1315	120.0375	(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	149.1869	149.1869	149.1869	149.1869	149.1869	149.1869	149.1869	149.1869	149.1869	149.1869	149.1869	149.1869	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	182.0126	201.5139	182.0126	188.0796	182.0126	188.0796	182.0126	182.0126	188.0796	182.0126	188.0796	182.0126	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	357.5865	361.2971	351.9465	332.0400	306.9117	283.2946	267.5169	263.8063	273.1570	293.0634	318.1917	341.8088	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.9187	37.9187	37.9187	37.9187	37.9187	37.9187	37.9187	37.9187	37.9187	37.9187	37.9187	37.9187	(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)													
	-119.3495	-119.3495	-119.3495	-119.3495	-119.3495	-119.3495	-119.3495	-119.3495	-119.3495	-119.3495	-119.3495	-119.3495	(71)
Water heating gains (Table 5)													
	162.8341	160.0674	154.7383	143.0586	135.9044	128.4265	123.8337	127.6286	132.0777	140.3752	151.5716	161.3408	(72)
Total internal gains													
	773.1892	793.6345	759.4533	733.9343	695.5847	667.5568	641.1193	641.2035	661.0704	686.2073	728.5991	755.9182	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	10.8400	11.2829	0.6300	0.7000	0.7700	37.3786	(75)
Southeast	10.2900	36.7938	0.6300	0.7000	0.7700	115.7077	(77)
Southwest	6.6100	36.7938	0.6300	0.7000	0.7700	74.3273	(79)
Northwest	8.7700	11.2829	0.6300	0.7000	0.7700	30.2408	(81)

Solar gains	257.6545	461.3413	690.8863	956.0392	1162.1167	1193.8609	1134.3015	974.4205	781.7422	525.9660	312.7009	217.8518	(83)

Total gains	1030.8437	1254.9758	1450.3396	1689.9735	1857.7014	1861.4177	1775.4208	1615.6240	1442.8125	1212.1733	1041.3000	973.7701	(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	44.6017	44.7487	44.8938	45.5879	45.7201	46.3461	46.3461	46.4639	46.1029	45.7201	45.4534	45.1778	
alpha	3.9734	3.9832	3.9929	4.0392	4.0480	4.0897	4.0897	4.0976	4.0735	4.0480	4.0302	4.0119	
util living area													
	0.9947	0.9880	0.9724	0.9231	0.8150	0.6420	0.4891	0.5510	0.7944	0.9545	0.9894	0.9958	(86)
MIT	19.1577	19.4153	19.7947	20.3017	20.6997	20.9193	20.9793	20.9669	20.8024	20.2681	19.6301	19.1283	(87)
Th 2	19.9701	19.9731	19.9761	19.9901	19.9927	20.0049	20.0049	20.0072	20.0002	19.9927	19.9874	19.9819	(88)
util rest of house													
	0.9933	0.9849	0.9651	0.9028	0.7680	0.5612	0.3856	0.4438	0.7261	0.9383	0.9863	0.9947	(89)
MIT 2	17.8101	18.1403	18.6227	19.2595	19.7218	19.9513	19.9963	19.9920	19.8476	19.2321	18.4256	17.7802	(90)
Living area fraction										fLA = Living area / (4) =		0.1247	(91)
MIT	17.9782	18.2993	18.7689	19.3895	19.8437	20.0720	20.1188	20.1136	19.9666	19.3613	18.5758	17.9483	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8282	18.1493	18.6189	19.2395	19.6937	19.9220	19.9688	19.9636	19.8166	19.2113	18.4258	17.7983	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9889	0.9769	0.9517	0.8837	0.7520	0.5540	0.3817	0.4388	0.7115	0.9211	0.9788	0.9910	(94)
Useful gains	1019.3903	1225.9693	1380.3448	1493.4386	1396.9034	1031.1628	677.5936	708.9593	1026.5336	1116.5658	1019.1989	965.0165	(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													
	2863.7231	2795.4617	2548.6964	2141.3725	1650.7595	1084.1828	686.2939	724.1225	1170.7221	1778.2989	2352.5813	2841.8571	(97)
Space heating kWh													
	1372.1836	1054.6989	869.2536	466.5124	188.8689	0.0000	0.0000	0.0000	0.0000	492.3294	960.0353	1396.3694	(98a)
Space heating requirement - total per year (kWh/year)												6800.2516	
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													
	1372.1836	1054.6989	869.2536	466.5124	188.8689	0.0000	0.0000	0.0000	0.0000	492.3294	960.0353	1396.3694	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												6800.2516	
Space heating per m2											(98c) / (4) =	36.5507	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												88.6000	(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													
	1372.1836	1054.6989	869.2536	466.5124	188.8689	0.0000	0.0000	0.0000	0.0000	492.3294	960.0353	1396.3694	(98)
Space heating efficiency (main heating system 1)													
	88.6000	88.6000	88.6000	88.6000	88.6000	0.0000	0.0000	0.0000	0.0000	88.6000	88.6000	88.6000	(210)
Space heating fuel (main heating system)													
	1548.7400	1190.4051	981.0989	526.5377	213.1703	0.0000	0.0000	0.0000	0.0000	555.6765	1083.5613	1576.0377	(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													
	291.6369	257.8224	273.5217	239.4071	231.3792	207.7226	204.3700	212.8612	215.6290	241.3831	257.8413	288.2955	(64)
Efficiency of water heater												79.6000	(216)
(217)m	86.8782	86.6750	86.2655	85.3281	83.4078	79.6000	79.6000	79.6000	79.6000	85.4225	86.5287	86.9182	(217)
Fuel for water heating, kWh/month													
	335.6847	297.4589	317.0697	280.5725	277.4072	260.9580	256.7462	267.4136	270.8907	282.5755	297.9835	331.6858	(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	41.4083	33.2193	29.9103	21.9136	16.9267	13.8292	15.4411	20.0709	26.0701	34.2054	38.6349	42.5592	(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												7675.2275	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												79.6000	
Water heating fuel used												3476.4464	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
central heating pump												41.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												86.0000	(231)

Electricity for lighting (calculated in Appendix L)	334.1891	(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	11571.8630	(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	7675.2275	0.2100	1611.7978	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3476.4464	0.2100	730.0537	(264)
Space and water heating			2341.8515	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	334.1891	0.1443	48.2338	(268)
Total CO2, kg/year			2402.0146	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			12.9100	(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	7675.2275	1.1300	8673.0071	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3476.4464	1.1300	3928.3844	(278)
Space and water heating			12601.3915	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	334.1891	1.5338	512.5903	(282)
Total Primary energy kWh/year			13244.0826	(286)
Dwelling Primary energy Rate (DPER)			71.1900	(287)

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Main dwelling						
Ground floor	96.6400 (1b)	x	2.4000 (2b)	=	231.9360	(1b) - (3b)
First floor	89.4100 (1c)	x	2.6000 (2c)	=	232.4660	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 186.0500						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	464.4020	(5)

2. Ventilation rate

	m3 per hour		
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	4 * 10 =	40.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0861	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3361	(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) =	0.3361	(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	0.4286	0.4202	0.4118	0.3697	0.3613	0.3193	0.3193	0.3109	0.3361	0.3613	0.3781	0.3950	(22b)
Effective ac	0.5918	0.5883	0.5848	0.5684	0.5653	0.5510	0.5510	0.5483	0.5565	0.5653	0.5715	0.5780	(25)

3. Heat losses and heat loss parameter

Element	Gross	Openings	NetArea	U-value	A x U	K-value	A x K

Main dwelling	m2	m2	m2	W/m2K	W/K	kJ/m2K	kJ/K	
TER Semi-glazed door			3.2800	1.0000	3.2800			(26a)
TER Opening Type			36.5100	1.1450	41.8053			(27)
Heatloss Floor 1			90.6400	0.1300	11.7832			(28a)
External Wall 1	225.4800	39.7900	185.6900	0.1800	33.4242			(29a)
External Roof 1	90.6400		90.6400	0.1100	9.9704			(30)
Total net area of external elements Aum(A, m2)			406.7600					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		100.2631			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 182.6902 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	27.2000	0.0500	1.3600
E3 Sill	20.7000	0.0500	1.0350
E4 Jamb	57.6000	0.0500	2.8800
E5 Ground floor (normal)	45.9600	0.1600	7.3536
E6 Intermediate floor within a dwelling	44.3100	0.0000	0.0000
E10 Eaves (insulation at ceiling level)	30.6400	0.0600	1.8384
E12 Gable (insulation at ceiling level)	16.8200	0.0600	1.0092
E16 Corner (normal)	34.8000	0.0900	3.1320
E17 Corner (inverted - internal area greater than external area)	14.8000	-0.0900	-1.3320
E24 Eaves (insulation at ceiling level - inverted)	1.5000	0.2400	0.3600

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 17.6362 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 117.8993 (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	90.7004	90.1539	89.6182	87.1021	86.6313	84.4398	84.4398	84.0340	85.2840	86.6313	87.5836	88.5793	(38)
Heat transfer coeff	208.5997	208.0532	207.5175	205.0014	204.5306	202.3392	202.3392	201.9333	203.1833	204.5306	205.4830	206.4786	(39)

Average = Sum(39)m / 12 = 204.9991

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1212	1.1183	1.1154	1.1019	1.0993	1.0876	1.0876	1.0854	1.0921	1.0993	1.1045	1.1098	(40)
HLP (average)												1.1018	
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 2.9837 (42)

Hot water usage for mixer showers

74.2473	73.1315	71.5056	68.3947	66.0989	63.5387	62.0834	63.6971	65.4659	68.2148	71.3926	73.9629	(42a)

Hot water usage for baths

32.0520	31.5760	30.9057	29.6697	28.7442	27.7180	27.1637	27.8293	28.5541	29.6522	30.9136	31.9436	(42b)

Hot water usage for other uses

45.1865	43.5433	41.9002	40.2570	38.6139	36.9707	36.9707	38.6139	40.2570	41.9002	43.5433	45.1865	(42c)

Average daily hot water use (litres/day) 139.2494 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	151.4858	148.2509	144.3114	138.3214	133.4570	128.2274	126.2179	130.1403	134.2770	139.7672	145.8495	151.0930	(44)
Energy conte	239.9165	211.1072	221.8013	189.3551	179.6588	157.6706	152.6496	161.1408	165.5770	189.6627	207.7893	236.5751	(45)
Energy content (annual)										Total = Sum(45)m =		2312.9040	
Distribution loss (46)m = 0.15 x (45)m	35.9875	31.6661	33.2702	28.4033	26.9488	23.6506	22.8974	24.1711	24.8365	28.4494	31.1684	35.4863	(46)

Water storage loss:

Store volume 210.0000 (47)

a) If manufacturer declared loss factor is known (kWh/day): 1.7016 (48)

Temperature factor from Table 2b 0.5400 (49)

Enter (49) or (54) in (55) 0.9188 (55)

Total storage loss

28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(56)

If cylinder contains dedicated solar storage

28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(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

291.6631	257.8461	273.5479	239.4324	231.4054	207.7479	204.3962	212.8874	215.6543	241.4093	257.8667	288.3217	(62)
-33.9428	-30.0193	-31.4345	-26.0290	-24.2581	-20.7578	-19.4571	-20.6907	-21.4768	-25.3188	-28.6831	-33.3142	(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

257.7203	227.8268	242.1135	213.4035	207.1473	186.9901	184.9390	192.1967	194.1775	216.0905	229.1835	255.0075	(64)

Total per year (kWh/year) = Sum(64)m = 2606.7962 (64)

12Total per year (kWh/year) 2607 (64)

Electric shower(s)

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

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

Heat gains from water heating, kWh/month

121.1695	107.5842	115.1462	103.0224	101.1338	92.4873	92.1533	94.9766	95.1162	104.4601	109.1518	120.0585	(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	149.1869	149.1869	149.1869	149.1869	149.1869	149.1869	149.1869	149.1869	149.1869	149.1869	149.1869	149.1869	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	182.0126	201.5139	182.0126	188.0796	182.0126	188.0796	182.0126	182.0126	188.0796	182.0126	188.0796	182.0126	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	357.5865	361.2971	351.9465	332.0400	306.9117	283.2946	267.5169	263.8063	273.1570	293.0634	318.1917	341.8088	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.9187	37.9187	37.9187	37.9187	37.9187	37.9187	37.9187	37.9187	37.9187	37.9187	37.9187	37.9187	(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)	-119.3495	-119.3495	-119.3495	-119.3495	-119.3495	-119.3495	-119.3495	-119.3495	-119.3495	-119.3495	-119.3495	-119.3495	(71)
Water heating gains (Table 5)	162.8622	160.0956	154.7664	143.0867	135.9325	128.4546	123.8619	127.6567	132.1059	140.4034	151.5998	161.3689	(72)
Total internal gains	773.2174	793.6627	759.4815	733.9625	695.6129	667.5849	641.1475	641.2317	661.0985	686.2354	728.6272	755.9464	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	10.8400	11.2829	0.6300	0.7000	0.7700	37.3786	(75)
Southeast	10.2900	36.7938	0.6300	0.7000	0.7700	115.7077	(77)
Southwest	6.6100	36.7938	0.6300	0.7000	0.7700	74.3273	(79)
Northwest	8.7700	11.2829	0.6300	0.7000	0.7700	30.2408	(81)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	257.6545	461.3413	690.8863	956.0392	1162.1167	1193.8609	1134.3015	974.4205	781.7422	525.9660	312.7009	217.8518	(83)
Total gains	1030.8718	1255.0040	1450.3678	1690.0016	1857.7296	1861.4458	1775.4490	1615.6522	1442.8407	1212.2015	1041.3281	973.7982	(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	45.2615	45.3804	45.4975	46.0559	46.1620	46.6619	46.6619	46.7557	46.4681	46.1620	45.9480	45.7264	
alpha	4.0174	4.0254	4.0332	4.0704	4.0775	4.1108	4.1108	4.1170	4.0979	4.0775	4.0632	4.0484	
util living area	0.9947	0.9879	0.9720	0.9220	0.8124	0.6392	0.4864	0.5483	0.7921	0.9539	0.9894	0.9958	(86)
MIT	19.1886	19.4442	19.8199	20.3173	20.7090	20.9219	20.9801	20.9681	20.8078	20.2810	19.6492	19.1535	(87)
Th 2	19.9836	19.9859	19.9883	19.9993	20.0014	20.0110	20.0110	20.0128	20.0073	20.0014	19.9972	19.9928	(88)
util rest of house	0.9934	0.9849	0.9647	0.9015	0.7654	0.5589	0.3838	0.4420	0.7238	0.9377	0.9862	0.9947	(89)
MIT 2	17.8584	18.1856	18.6629	19.2853	19.7390	19.9591	20.0027	19.9981	19.8589	19.2542	18.4564	17.8197	(90)
Living area fraction									fLA = Living area / (4) =			0.1247	(91)
MIT	18.0243	18.3426	18.8071	19.4139	19.8600	20.0791	20.1246	20.1190	19.9772	19.3822	18.6052	17.9860	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.0243	18.3426	18.8071	19.4139	19.8600	20.0791	20.1246	20.1190	19.9772	19.3822	18.6052	17.9860	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9894	0.9777	0.9532	0.8868	0.7578	0.5648	0.3960	0.4540	0.7215	0.9243	0.9797	0.9914	(94)
Useful gains	1019.9122	1227.0176	1382.4604	1498.6891	1407.8747	1051.3217	703.0205	733.4990	1040.9428	1120.4438	1020.1702	965.4301	(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	2862.8748	2796.7715	2553.9486	2155.3732	1668.9667	1108.6443	713.1564	751.0000	1194.1481	1796.2328	2364.1126	2846.5107	(97)
Space heating kWh	1371.1641	1054.8746	871.5872	472.8126	194.2525	0.0000	0.0000	0.0000	0.0000	502.7870	967.6386	1399.5240	(98a)
Space heating requirement - total per year (kWh/year)												6834.6406	
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	1371.1641	1054.8746	871.5872	472.8126	194.2525	0.0000	0.0000	0.0000	0.0000	502.7870	967.6386	1399.5240	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												6834.6406	
Space heating per m2											(98c) / (4) =	36.7355	(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	1371.1641	1054.8746	871.5872	472.8126	194.2525	0.0000	0.0000	0.0000	0.0000	502.7870	967.6386	1399.5240	(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)	1485.5516	1142.8761	944.2982	512.2563	210.4577	0.0000	0.0000	0.0000	0.0000	544.7313	1048.3625	1516.2773	(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	257.7203	227.8268	242.1135	213.4035	207.1473	186.9901	184.9390	192.1967	194.1775	216.0905	229.1835	255.0075	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.2432	87.0561	86.6749	85.7910	83.9159	79.8000	79.8000	79.8000	79.8000	85.8882	86.9227	87.2828	(217)
Fuel for water heating, kWh/month	295.4044	261.7011	279.3352	248.7481	246.8511	234.3234	231.7532	240.8480	243.3302	251.5950	263.6635	292.1624	(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	37.8186	30.3395	27.3174	20.0139	15.4593	12.6304	14.1025	18.3309	23.8101	31.2401	35.2856	38.8697	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-80.6867	-109.1270	-150.4932	-162.0137	-168.7139	-155.1752	-153.0049	-147.1428	-136.2497	-121.0132	-86.9332	-70.2911	(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	-60.8133	-125.8092	-246.3484	-364.8705	-477.7444	-478.5254	-473.1148	-402.9109	-298.3003	-178.4428	-80.6750	-48.2746	(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	(235d)

Annual totals kWh/year		
Space heating fuel - main system 1	7404.8110	(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	3089.7156	(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)	305.2179	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-4776.6741	(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	6109.0705	(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	7404.8110	0.2100	1555.0103	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3089.7156	0.2100	648.8403	(264)
Space and water heating			2203.8506	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	305.2179	0.1443	44.0524	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1540.8446	0.1355	-208.8251	
PV Unit electricity exported	-3235.8295	0.1263	-408.6916	
Total			-617.5167	(269)
Total CO2, kg/year			1642.3155	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			8.8300	(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	7404.8110	1.1300	8367.4365	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3089.7156	1.1300	3491.3787	(278)
Space and water heating			11858.8151	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	305.2179	1.5338	468.1534	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1540.8446	1.5009	-2312.7069	
PV Unit electricity exported	-3235.8295	0.4636	-1500.2354	
Total			-3812.9423	(283)
Total Primary energy kWh/year			8644.1271	(286)
Target Primary Energy Rate (TPER)			46.4600	(287)

Building Regulations England Part L (BREL) Compliance Report

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

Date: Fri 14 Mar 2025 09:30:50

Project Information			
Assessed By	Richard Millard	Building Type	House, Detached
OCDEA Registration	EES/025661	Assessment Date	2025-03-14

Dwelling Details			
Assessment Type	As designed	Total Floor Area	186 m^2
Site Reference	W	Plot Reference	Proposed
Address	31, Yatton Keynell		

Client Details	
Name	Ian White
Company	Cotswold Homes Ltd
Address	West House, Yate, Bristol, BS37 5NG

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

1a Target emission rate and dwelling emission rate		
Fuel for main heating system	Electricity	
Target carbon dioxide emission rate	*8.83 $kgCO_2/m^2$*	
Dwelling carbon dioxide emission rate	2.74 $kgCO_2/m^2$	OK
1b Target primary energy rate and dwelling primary energy		
Target primary energy	*46.46 kWh_{PE}/m^2*	
Dwelling primary energy	30.9 kWh_{PE}/m^2	OK
1c Target fabric energy efficiency and dwelling fabric energy efficiency		
Target fabric energy efficiency	*41.9 kWh/m^2*	
Dwelling fabric energy efficiency	40.5 kWh/m^2	OK

2a Fabric U-values				
Element	***Maximum permitted average U-Value [W/m^2K]***	**Dwelling average U-Value [W/m^2K]**	**Element with highest individual U-Value**	
External walls	*0.26*	0.18	Walls (1) (0.18)	OK
Party walls	*0.2*	N/A	N/A	**N/A**
Curtain walls	*1.6*	N/A	N/A	**N/A**
Floors	*0.18*	0.12	Heatloss Floor 1 (0.12)	OK
Roofs	*0.16*	0.11	Roof (1) (0.11)	OK
Windows, doors, and roof windows	*1.6*	1.2	F-W01 (1.2)	OK
Rooflights	*2.2*	N/A	N/A	**N/A**

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))		
Name	**Net area [m^2]**	**U-Value [W/m^2K]**
Exposed wall: Walls (1)	185.69	0.18
Ground floor: Heatloss Floor 1, Heatloss Floor 1	90.64	0.12
Exposed roof: Roof (1)	90.64	0.11

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	**Area [m^2]**	**Orientation**	**Frame factor**	**U-Value [W/m^2K]**
F-W01, Windows	2.43	South East	0.7	1.2
F-W02, Windows	2.43	South East	0.7	1.2
F-ED01, Half Glazed Door	3.28	South East	N/A	1.2
F-W03, Windows	1.44	South East	0.7	1.2
F-ED02, Windows	5.17	North West	0.7	1.2
F-ED03, Windows	5.17	South West	0.7	1.2
F-W04, Windows	1.44	South East	0.7	1.2
F-W05, Windows	1.44	South East	0.7	1.2
F-W06, Windows	1.11	South East	0.7	1.2
F-W07, Windows	2.02	North East	0.7	1.2
F-W08, Windows	1.05	North East	0.7	1.2
F-W09, Windows	1.2	North East	0.7	1.2
F-W10, Windows	1.44	North East	0.7	1.2
F-W11, Windows	1.05	North East	0.7	1.2

Name	Area [m^2]	Orientation	Frame factor	U-Value [W/m^2K]
F-W12, Windows	1.44	North East	0.7	1.2
F-W13, Windows	1.2	North East	0.7	1.2
F-W14, Windows	1.44	North East	0.7	1.2
F-W15, Windows	0.43	North West	0.7	1.2
F-W16, Windows	0.43	North West	0.7	1.2
F-W17, Windows	0.58	North West	0.7	1.2
F-W18, Windows	1.05	North West	0.7	1.2
F-W19, Windows	1.11	North West	0.7	1.2
F-W20, Windows	1.44	South West	0.7	1.2

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))

Building part **1**: Thermal bridging calculated from linear thermal transmittances for each junction

Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E1: Steel lintel with perforated steel base plate	Calculated by person with suitable expertise	0.241	EMPF125E101
External wall	E3: Sill	Not government-approved scheme	0.026 **(!)**	EMPF125E301
External wall	E4: Jamb	Not government-approved scheme	0.02 **(!)**	EMPF125E401
External wall	E5: Ground floor (normal)	Not government-approved scheme	0.045	EMPF125E504
External wall	E6: Intermediate floor within a dwelling	Not government-approved scheme	0.002 **(!)**	EMPF125E601
External wall	E10: Eaves (insulation at ceiling level)	Not government-approved scheme	0.05	EMPF125E1001
External wall	E12: Gable (insulation at ceiling level)	Not government-approved scheme	0.031 **(!)**	EMPF125E1201
External wall	E16: Corner (normal)	Not government-approved scheme	0.037 **(!)**	EMPF125E21601
External wall	E17: Corner (inverted - internal area greater than external area)	Not government-approved scheme	-0.09	EMPF125E21701
External wall	E24: Eaves (insulation at ceiling level - inverted)	SAP table default	0.15	

3 Air permeability (better than typically expected values are flagged with a subsequent (!))

Maximum permitted air permeability at 50Pa	*8 m^3/hm^2*	
Dwelling air permeability at 50Pa	5 m^3/hm^2, Design value	OK
Air permeability test certificate reference		

4 Space heating

Main heating system 1: Heat pump with radiators or underfloor heating - Electricity

Efficiency	255.1%
Emitter type	Radiators
Flow temperature	55°C
System type	Heat Pump
Manufacturer	Daikin Europe NV
Model	EDLA08EV3
Commissioning	

Secondary heating system: N/A

Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water

Cylinder/store - type: Cylinder

Capacity	210 litres
Declared heat loss	1.7 kWh/day
Primary pipework insulated	Yes
Manufacturer	
Model	
Commissioning	

Waste water heat recovery system 1 - type: N/A	
Efficiency	
Manufacturer	
Model	

6 Controls		
Main heating 1 - type: Time and temperature zone control by arrangement of plumbing and electrical services		
Function		
Ecodesign class		
Manufacturer		
Model		
Water heating - type: Cylinder thermostat and HW separately timed		
Manufacturer		
Model		

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

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

9 Local generation	
Technology type: **Photovoltaic system (1)**	
Peak power	2.01 kWp
Orientation	South East
Pitch	30°
Overshading	None or very little
Manufacturer	
MCS certificate	

10 Heat networks
N/A

11 Supporting documentary evidence
N/A

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

Full SAP Calculation Printout

Property Reference	W	**Issued on Date**	14/03/2025
Assessment Reference	Proposed	**Prop Type Ref**	Proposed 31
Property	31, Yatton Keynell		

SAP Rating	85 B	**DER**	2.74	**TER**	8.83
Environmental	97 A	**% DER < TER**			68.97
CO_2 Emissions (t/year)	0.45	**DFEE**	40.48	**TFEE**	41.93
Compliance Check	See BREL	**% DFEE < TFEE**			3.45
% DPER < TPER	33.49	**DPER**	30.90	**TPER**	46.46

Assessor Details	Mr. Richard Millard	**Assessor ID**	U367-0001
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)	
Main dwelling						
Ground floor	96.6400 (1b)	x	2.4000 (2b)	=	231.9360	(1b) - (3b)
First floor	89.4100 (1c)	x	2.6000 (2c)	=	232.4660	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	186.0500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	464.4020	(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		6 * 10 =	60.0000	(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) =		60.0000 / (5) =	0.1292	(8)
Pressure test			Yes	
Pressure Test Method			Blower Door	
Measured/design AP50			5.0000	(17)
Infiltration rate			0.3792	(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) =	0.3792	(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	0.4835	0.4740	0.4645	0.4171	0.4076	0.3602	0.3602	0.3508	0.3792	0.4076	0.4266	0.4456	(22b)
Effective ac	0.6169	0.6123	0.6079	0.5870	0.5831	0.5649	0.5649	0.5615	0.5719	0.5831	0.5910	0.5993	(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	
Main dwelling								
Windows			36.5100	1.1450	41.8053			(27)
Half Glazed Door			3.2800	1.2000	3.9360			(26a)
Heatloss Floor 1			90.6400	0.1200	10.8768	75.0000	6798.0000	(28a)
External Wall 1	225.4800	39.7900	185.6900	0.1800	33.4242	60.0000	11141.3997	(29a)
External Roof 1	90.6400		90.6400	0.1100	9.9704	9.0000	815.7600	(30)
Total net area of external elements Aum(A, m2)			406.7600					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		100.0127			(33)
Main dwelling								
Internal Wall 1			144.5300			75.0000	10839.7499	(32c)
Internal Wall 2			220.0600			9.0000	1980.5400	(32c)
Internal Floor 1			89.4100			18.0000	1609.3800	(32d)
Internal Ceiling 1			89.4100			9.0000	804.6900	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	33989.5196 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		182.6902 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	27.2000	0.2410	6.5552
E3 Sill	20.7000	0.0260	0.5382

E4 Jamb	57.6000	0.0200	1.1520	
E5 Ground floor (normal)	45.9600	0.0450	2.0682	
E6 Intermediate floor within a dwelling	44.3100	0.0020	0.0886	
E10 Eaves (insulation at ceiling level)	30.6400	0.0500	1.5320	
E12 Gable (insulation at ceiling level)	16.8200	0.0310	0.5214	
E16 Corner (normal)	34.8000	0.0370	1.2876	
E17 Corner (inverted - internal area greater than external area)	14.8000	-0.0900	-1.3320	
E24 Eaves (insulation at ceiling level - inverted)	1.5000	0.1500	0.2250	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 12.6362 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 112.6490 (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	94.5378	93.8423	93.1605	89.9584	89.3593	86.5703	86.5703	86.0538	87.6445	89.3593	90.5713	91.8383	(38)
Heat transfer coeff	207.1868	206.4913	205.8095	202.6073	202.0082	199.2192	199.2192	198.7028	200.2935	202.0082	203.2202	204.4873	(39)
Average = Sum(39)m / 12 =												202.6045	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1136	1.1099	1.1062	1.0890	1.0858	1.0708	1.0708	1.0680	1.0766	1.0858	1.0923	1.0991	(40)
HLP (average)												1.0890	
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 2.9837 (42)

Hot water usage for mixer showers

74.2473	73.1315	71.5056	68.3947	66.0989	63.5387	62.0834	63.6971	65.4659	68.2148	71.3926	73.9629	(42a)

Hot water usage for baths

32.0520	31.5760	30.9057	29.6697	28.7442	27.7180	27.1637	27.8293	28.5541	29.6522	30.9136	31.9436	(42b)

Hot water usage for other uses

45.1865	43.5433	41.9002	40.2570	38.6139	36.9707	36.9707	38.6139	40.2570	41.9002	43.5433	45.1865	(42c)

Average daily hot water use (litres/day) 139.2494 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	151.4858	148.2509	144.3114	138.3214	133.4570	128.2274	126.2179	130.1403	134.2770	139.7672	145.8495	151.0930	(44)
Energy conte	239.9165	211.1072	221.8013	189.3551	179.6588	157.6706	152.6496	161.1408	165.5770	189.6627	207.7893	236.5751	(45)
Energy content (annual)										Total = Sum(45)m =		2312.9040	
Distribution loss (46)m = 0.15 x (45)m	35.9875	31.6661	33.2702	28.4033	26.9488	23.6506	22.8974	24.1711	24.8365	28.4494	31.1684	35.4863	(46)

Water storage loss:

Store volume	210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):	1.7000 (48)
Temperature factor from Table 2b	0.5400 (49)
Enter (49) or (54) in (55)	0.9180 (55)

Total storage loss

28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(56)

If cylinder contains dedicated solar storage

28.4580	25.7040	28.4580	27.5400	28.4580	27.5400	28.4580	28.4580	27.5400	28.4580	27.5400	28.4580	(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

291.6369	257.8224	273.5217	239.4071	231.3792	207.7226	204.3700	212.8612	215.6290	241.3831	257.8413	288.2955	(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

291.6369	257.8224	273.5217	239.4071	231.3792	207.7226	204.3700	212.8612	215.6290	241.3831	257.8413	288.2955	(64)
									Total per year (kWh/year) = Sum(64)m =		2921.8700	(64)
12Total per year (kWh/year)											2922	(64)

Electric shower(s)

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

Heat gains from water heating, kWh/month

121.1486	107.5653	115.1253	103.0022	101.1129	92.4671	92.1323	94.9557	95.0959	104.4392	109.1315	120.0375	(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	149.1869	149.1869	149.1869	149.1869	149.1869	149.1869	149.1869	149.1869	149.1869	149.1869	149.1869	149.1869	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	182.0126	201.5139	182.0126	188.0796	182.0126	188.0796	182.0126	182.0126	188.0796	182.0126	188.0796	182.0126	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	357.5865	361.2971	351.9465	332.0400	306.9117	283.2946	267.5169	263.8063	273.1570	293.0634	318.1917	341.8088	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.9187	37.9187	37.9187	37.9187	37.9187	37.9187	37.9187	37.9187	37.9187	37.9187	37.9187	37.9187	(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)	-119.3495	-119.3495	-119.3495	-119.3495	-119.3495	-119.3495	-119.3495	-119.3495	-119.3495	-119.3495	-119.3495	-119.3495	(71)
Water heating gains (Table 5)	162.8341	160.0674	154.7383	143.0586	135.9044	128.4265	123.8337	127.6286	132.0777	140.3752	151.5716	161.3408	(72)
Total internal gains	770.1892	790.6345	756.4533	730.9343	692.5847	667.5568	641.1193	641.2035	661.0704	683.2073	725.5991	752.9182	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	10.8400	11.2829	0.6300	0.7000	0.7700	37.3786	(75)
Southeast	10.2900	36.7938	0.6300	0.7000	0.7700	115.7077	(77)
Southwest	6.6100	36.7938	0.6300	0.7000	0.7700	74.3273	(79)
Northwest	8.7700	11.2829	0.6300	0.7000	0.7700	30.2408	(81)

Solar gains 257.6545	461.3413	690.8863	956.0392	1162.1167	1193.8609	1134.3015	974.4205	781.7422	525.9660	312.7009	217.8518	(83)

Total gains	1027.8437	1251.9758	1447.3396	1686.9735	1854.7014	1861.4177	1775.4208	1615.6240	1442.8125	1209.1733	1038.3000	970.7701	(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	45.5702	45.7236	45.8751	46.6002	46.7384	47.3927	47.3927	47.5159	47.1385	46.7384	46.4596	46.1717	
alpha	4.0380	4.0482	4.0583	4.1067	4.1159	4.1595	4.1595	4.1677	4.1426	4.1159	4.0973	4.0781	
util living area													
	0.9948	0.9880	0.9720	0.9211	0.8097	0.6328	0.4801	0.5416	0.7878	0.9536	0.9895	0.9958	(86)
Living	19.2006	19.4576	19.8335	20.3335	20.7199	20.9277	20.9820	20.9709	20.8173	20.2957	19.6666	19.1715	
Non living	17.8778	18.2072	18.6851	19.3127	19.7601	19.9767	20.0172	20.0136	19.8791	19.2802	18.4850	17.8483	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	20.0795	19.4576	19.8335	20.3335	20.7199	20.9277	20.9820	20.9709	20.8173	20.2957	19.6666	19.4273	(87)
Th 2	19.9897	19.9928	19.9958	20.0098	20.0125	20.0248	20.0248	20.0270	20.0200	20.0125	20.0071	20.0016	(88)
util rest of house													
	0.9934	0.9849	0.9647	0.9005	0.7626	0.5536	0.3798	0.4374	0.7196	0.9373	0.9863	0.9948	(89)
MIT 2	19.1478	18.2072	18.6851	19.3127	19.7601	19.9767	20.0172	20.0136	19.8791	19.2802	18.4850	18.2363	(90)
Living area fraction										fLA = Living area / (4) =		0.1247	(91)
MIT	19.2640	18.3631	18.8283	19.4400	19.8797	20.0953	20.1375	20.1330	19.9961	19.4069	18.6324	18.3849	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.2640	18.3631	18.8283	19.4400	19.8797	20.0953	20.1375	20.1330	19.9961	19.4069	18.6324	18.3849	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9922	0.9778	0.9533	0.8861	0.7555	0.5597	0.3918	0.4493	0.7177	0.9241	0.9799	0.9923	(94)
Useful gains	1019.8540	1224.2443	1379.6775	1494.7442	1401.2497	1041.7663	695.5529	725.8265	1035.5415	1117.4060	1017.3879	963.3022	(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													
	3100.3352	2780.0185	2537.2813	2135.4825	1652.3749	1094.7614	704.7360	741.7555	1180.9515	1779.0563	2343.6130	2900.6227	(97)
Space heating kWh													
	1547.8780	1045.4803	861.2573	461.3315	186.8372	0.0000	0.0000	0.0000	0.0000	492.2678	954.8821	1441.3664	(98a)
Space heating requirement - total per year (kWh/year)												6991.3006	
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													
	1547.8780	1045.4803	861.2573	461.3315	186.8372	0.0000	0.0000	0.0000	0.0000	492.2678	954.8821	1441.3664	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												6991.3006	
Space heating per m2											(98c) / (4) =	37.5775	(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 %)												255.1106	(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													
	1547.8780	1045.4803	861.2573	461.3315	186.8372	0.0000	0.0000	0.0000	0.0000	492.2678	954.8821	1441.3664	(98)
Space heating efficiency (main heating system 1)													
	255.1106	255.1106	255.1106	255.1106	255.1106	0.0000	0.0000	0.0000	0.0000	255.1106	255.1106	255.1106	(210)
Space heating fuel (main heating system)													
	606.7479	409.8146	337.6016	180.8359	73.2377	0.0000	0.0000	0.0000	0.0000	192.9625	374.3013	564.9968	(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													
	291.6369	257.8224	273.5217	239.4071	231.3792	207.7226	204.3700	212.8612	215.6290	241.3831	257.8413	288.2955	(64)
Efficiency of water heater												166.7368	(216)
(217)m	166.7368	166.7368	166.7368	166.7368	166.7368	166.7368	166.7368	166.7368	166.7368	166.7368	166.7368	166.7368	(217)
Fuel for water heating, kWh/month													
	174.9085	154.6284	164.0440	143.5838	138.7691	124.5811	122.5704	127.6630	129.3230	144.7689	154.6397	172.9045	(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	41.4083	33.2193	29.9103	21.9136	16.9267	13.8292	15.4411	20.0709	26.0701	34.2054	38.6349	42.5592	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-36.7368	-57.4885	-91.6062	-110.5803	-122.2698	-111.4874	-109.7789	-100.3416	-84.0066	-67.7937	-41.7563	-30.8852	(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	-7.5651	-18.4583	-42.2306	-73.8800	-108.9845	-116.9911	-115.2268	-94.2038	-64.9557	-30.6002	-11.2113	-5.8936	(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												2740.4983	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												166.7368	
Water heating fuel used												1752.3845	(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)	334.1891	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-1654.9322	(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	3172.1397	(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	2740.4983	0.1556	426.5071	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1752.3845	0.1410	247.0527	(264)
Space and water heating			673.5598	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	334.1891	0.1443	48.2338	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-964.7313	0.1335	-128.7650	
PV Unit electricity exported	-690.2009	0.1216	-83.9294	
Total			-212.6945	(269)
Total CO2, kg/year			509.0991	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			2.7400	(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	2740.4983	1.5761	4319.4194	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1752.3845	1.5213	2665.9029	(278)
Space and water heating			6985.3223	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	334.1891	1.5338	512.5903	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-964.7313	1.4932	-1440.5809	
PV Unit electricity exported	-690.2009	0.4461	-307.9058	
Total			-1748.4867	(283)
Total Primary energy kWh/year			5749.4260	(286)
Dwelling Primary energy Rate (DPER)			30.9000	(287)

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Main dwelling						
Ground floor	96.6400	(1b) x	2.4000	(2b) =	231.9360	(1b) - (3b)
First floor	89.4100	(1c) x	2.6000	(2c) =	232.4660	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	186.0500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		464.4020	(5)

2. Ventilation rate

	m3 per hour		
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	4 * 10 =	40.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0861	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3361	(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) =	0.3361	(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													
	0.4286	0.4202	0.4118	0.3697	0.3613	0.3193	0.3193	0.3109	0.3361	0.3613	0.3781	0.3950	(22b)
Effective ac	0.5918	0.5883	0.5848	0.5684	0.5653	0.5510	0.5510	0.5483	0.5565	0.5653	0.5715	0.5780	(25)

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3. Heat losses and heat loss parameter

Element	Gross	Openings	NetArea	U-value	A x U	K-value	A x K	
	m2	m2	m2	W/m2K	W/K	kJ/m2K	kJ/K	
Main dwelling								
TER Semi-glazed door			3.2800	1.0000	3.2800			(26a)
TER Opening Type			36.5100	1.1450	41.8053			(27)
Heatloss Floor 1			90.6400	0.1300	11.7832			(28a)
External Wall 1	225.4800	39.7900	185.6900	0.1800	33.4242			(29a)
External Roof 1	90.6400		90.6400	0.1100	9.9704			(30)
Total net area of external elements Aum(A, m2)			406.7600					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		100.2631			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 182.6902 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	27.2000	0.0500	1.3600
E3 Sill	20.7000	0.0500	1.0350
E4 Jamb	57.6000	0.0500	2.8800
E5 Ground floor (normal)	45.9600	0.1600	7.3536
E6 Intermediate floor within a dwelling	44.3100	0.0000	0.0000
E10 Eaves (insulation at ceiling level)	30.6400	0.0600	1.8384
E12 Gable (insulation at ceiling level)	16.8200	0.0600	1.0092
E16 Corner (normal)	34.8000	0.0900	3.1320
E17 Corner (inverted - internal area greater than external area)	14.8000	-0.0900	-1.3320
E24 Eaves (insulation at ceiling level - inverted)	1.5000	0.2400	0.3600

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 17.6362 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 117.8993 (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	90.7004	90.1539	89.6182	87.1021	86.6313	84.4398	84.4398	84.0340	85.2840	86.6313	87.5836	88.5793	(38)
Heat transfer coeff													
	208.5997	208.0532	207.5175	205.0014	204.5306	202.3392	202.3392	201.9333	203.1833	204.5306	205.4830	206.4786	(39)
Average = Sum(39)m / 12 =												204.9991	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1212	1.1183	1.1154	1.1019	1.0993	1.0876	1.0876	1.0854	1.0921	1.0993	1.1045	1.1098	(40)
HLP (average)												1.1018	
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 2.9837 (42)

Hot water usage for mixer showers

74.2473	73.1315	71.5056	68.3947	66.0989	63.5387	62.0834	63.6971	65.4659	68.2148	71.3926	73.9629	(42a)

Hot water usage for baths

32.0520	31.5760	30.9057	29.6697	28.7442	27.7180	27.1637	27.8293	28.5541	29.6522	30.9136	31.9436	(42b)

Hot water usage for other uses

45.1865	43.5433	41.9002	40.2570	38.6139	36.9707	36.9707	38.6139	40.2570	41.9002	43.5433	45.1865	(42c)

Average daily hot water use (litres/day) 139.2494 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	151.4858	148.2509	144.3114	138.3214	133.4570	128.2274	126.2179	130.1403	134.2770	139.7672	145.8495	151.0930	(44)
Energy conte	239.9165	211.1072	221.8013	189.3551	179.6588	157.6706	152.6496	161.1408	165.5770	189.6627	207.7893	236.5751	(45)
Energy content (annual)										Total = Sum(45)m =		2312.9040	
Distribution loss (46)m = 0.15 x (45)m													
	35.9875	31.6661	33.2702	28.4033	26.9488	23.6506	22.8974	24.1711	24.8365	28.4494	31.1684	35.4863	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7016	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9188	(55)
Total storage loss													
	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(56)
If cylinder contains dedicated solar storage													
	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(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													
	291.6631	257.8461	273.5479	239.4324	231.4054	207.7479	204.3962	212.8874	215.6543	241.4093	257.8667	288.3217	(62)
WWHRS	-33.9428	-30.0193	-31.4345	-26.0290	-24.2581	-20.7578	-19.4571	-20.6907	-21.4768	-25.3188	-28.6831	-33.3142	(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													
	257.7203	227.8268	242.1135	213.4035	207.1473	186.9901	184.9390	192.1967	194.1775	216.0905	229.1835	255.0075	(64)
										Total per year (kWh/year) = Sum(64)m =		2606.7962	(64)
12Total per year (kWh/year)												2607	(64)
Electric shower(s)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000	(64a)
Heat gains from water heating, kWh/month													
	121.1695	107.5842	115.1462	103.0224	101.1338	92.4873	92.1533	94.9766	95.1162	104.4601	109.1518	120.0585	(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	149.1869	149.1869	149.1869	149.1869	149.1869	149.1869	149.1869	149.1869	149.1869	149.1869	149.1869	149.1869	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	182.0126	201.5139	182.0126	188.0796	182.0126	188.0796	182.0126	182.0126	188.0796	182.0126	188.0796	182.0126	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	357.5865	361.2971	351.9465	332.0400	306.9117	283.2946	267.5169	263.8063	273.1570	293.0634	318.1917	341.8088	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.9187	37.9187	37.9187	37.9187	37.9187	37.9187	37.9187	37.9187	37.9187	37.9187	37.9187	37.9187	(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)													
	-119.3495	-119.3495	-119.3495	-119.3495	-119.3495	-119.3495	-119.3495	-119.3495	-119.3495	-119.3495	-119.3495	-119.3495	(71)
Water heating gains (Table 5)													
	162.8622	160.0956	154.7664	143.0867	135.9325	128.4546	123.8619	127.6567	132.1059	140.4034	151.5998	161.3689	(72)
Total internal gains													
	773.2174	793.6627	759.4815	733.9625	695.6129	667.5849	641.1475	641.2317	661.0985	686.2354	728.6272	755.9464	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	10.8400	11.2829	0.6300	0.7000	0.7700	37.3786	(75)
Southeast	10.2900	36.7938	0.6300	0.7000	0.7700	115.7077	(77)
Southwest	6.6100	36.7938	0.6300	0.7000	0.7700	74.3273	(79)
Northwest	8.7700	11.2829	0.6300	0.7000	0.7700	30.2408	(81)

Solar gains	257.6545	461.3413	690.8863	956.0392	1162.1167	1193.8609	1134.3015	974.4205	781.7422	525.9660	312.7009	217.8518	(83)
Total gains	1030.8718	1255.0040	1450.3678	1690.0016	1857.7296	1861.4458	1775.4490	1615.6522	1442.8407	1212.2015	1041.3281	973.7982	(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	45.2615	45.3804	45.4975	46.0559	46.1620	46.6619	46.6619	46.7557	46.4681	46.1620	45.9480	45.7264	
alpha	4.0174	4.0254	4.0332	4.0704	4.0775	4.1108	4.1108	4.1170	4.0979	4.0775	4.0632	4.0484	
util living area													
	0.9947	0.9879	0.9720	0.9220	0.8124	0.6392	0.4864	0.5483	0.7921	0.9539	0.9894	0.9958	(86)
MIT	19.1886	19.4442	19.8199	20.3173	20.7090	20.9219	20.9801	20.9681	20.8078	20.2810	19.6492	19.1535	(87)
Th 2	19.9836	19.9859	19.9883	19.9993	20.0014	20.0110	20.0110	20.0128	20.0073	20.0014	19.9972	19.9928	(88)
util rest of house													
	0.9934	0.9849	0.9647	0.9015	0.7654	0.5589	0.3838	0.4420	0.7238	0.9377	0.9862	0.9947	(89)
MIT 2	17.8584	18.1856	18.6629	19.2853	19.7390	19.9591	20.0027	19.9981	19.8589	19.2542	18.4564	17.8197	(90)
Living area fraction										fLA = Living area / (4) =		0.1247	(91)
MIT	18.0243	18.3426	18.8071	19.4139	19.8600	20.0791	20.1246	20.1190	19.9772	19.3822	18.6052	17.9860	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.0243	18.3426	18.8071	19.4139	19.8600	20.0791	20.1246	20.1190	19.9772	19.3822	18.6052	17.9860	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9894	0.9777	0.9532	0.8868	0.7578	0.5648	0.3960	0.4540	0.7215	0.9243	0.9797	0.9914	(94)
Useful gains	1019.9122	1227.0176	1382.4604	1498.6891	1407.8747	1051.3217	703.0205	733.4990	1040.9428	1120.4438	1020.1702	965.4301	(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													
	2862.8748	2796.7715	2553.9486	2155.3732	1668.9667	1108.6443	713.1564	751.0000	1194.1481	1796.2328	2364.1126	2846.5107	(97)
Space heating kWh													
	1371.1641	1054.8746	871.5872	472.8126	194.2525	0.0000	0.0000	0.0000	0.0000	502.7870	967.6386	1399.5240	(98a)
Space heating requirement - total per year (kWh/year)												6834.6406	
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													
	1371.1641	1054.8746	871.5872	472.8126	194.2525	0.0000	0.0000	0.0000	0.0000	502.7870	967.6386	1399.5240	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												6834.6406	
Space heating per m2											(98c) / (4) =	36.7355	(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													
	1371.1641	1054.8746	871.5872	472.8126	194.2525	0.0000	0.0000	0.0000	0.0000	502.7870	967.6386	1399.5240	(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)													
	1485.5516	1142.8761	944.2982	512.2563	210.4577	0.0000	0.0000	0.0000	0.0000	544.7313	1048.3625	1516.2773	(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													
	257.7203	227.8268	242.1135	213.4035	207.1473	186.9901	184.9390	192.1967	194.1775	216.0905	229.1835	255.0075	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.2432	87.0561	86.6749	85.7910	83.9159	79.8000	79.8000	79.8000	79.8000	85.8882	86.9227	87.2828	(217)
Fuel for water heating, kWh/month													
	295.4044	261.7011	279.3352	248.7481	246.8511	234.3234	231.7532	240.8480	243.3302	251.5950	263.6635	292.1624	(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	37.8186	30.3395	27.3174	20.0139	15.4593	12.6304	14.1025	18.3309	23.8101	31.2401	35.2856	38.8697	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													

(233a)m	-80.6867	-109.1270	-150.4932	-162.0137	-168.7139	-155.1752	-153.0049	-147.1428	-136.2497	-121.0132	-86.9332	-70.2911	(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	-60.8133	-125.8092	-246.3484	-364.8705	-477.7444	-478.5254	-473.1148	-402.9109	-298.3003	-178.4428	-80.6750	-48.2746	(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	7404.8110	(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	3089.7156	(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)	305.2179	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-4776.6741	(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	6109.0705	(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	7404.8110	0.2100	1555.0103	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3089.7156	0.2100	648.8403	(264)
Space and water heating			2203.8506	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	305.2179	0.1443	44.0524	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1540.8446	0.1355	-208.8251	
PV Unit electricity exported	-3235.8295	0.1263	-408.6916	
Total			-617.5167	(269)
Total CO2, kg/year			1642.3155	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			8.8300	(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	7404.8110	1.1300	8367.4365	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3089.7156	1.1300	3491.3787	(278)
Space and water heating			11858.8151	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	305.2179	1.5338	468.1534	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1540.8446	1.5009	-2312.7069	
PV Unit electricity exported	-3235.8295	0.4636	-1500.2354	
Total			-3812.9423	(283)
Total Primary energy kWh/year			8644.1271	(286)
Target Primary Energy Rate (TPER)			46.4600	(287)

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