



Development at 1 Marlborough Avenue, Falmouth, TR11 2RW

Energy Statement

For

**Annie & Alastair Morrison**  
**6<sup>th</sup> November 2023**

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All information within this document is based on evidence provided in the form of drawings and specifications.

CPD (Continual Professional Development) records are kept and all technical staff are required to complete a minimum 20 hours per year in training activities.

Low Carbon Consultants have the expertise and necessary qualifications to offer advice in a professional capacity on matters relating to Part L of the Building Regulations and sustainability within the construction sector.

This document contains the following information:

- Energy Statement, SAP Calculations

**Project Ref:** 304422 **Report Date:** 06/11/2023

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## 1. Executive Summary

### 1.1 Overview

The Energy Statement provides a clear assessment of the proposed development's overall energy requirements and subsequent CO<sub>2</sub> emissions.

In formulating designed energy and carbon emissions Elmhurst's SAP10 software has been used to calculate the estimated CO<sub>2</sub> reductions.

The Energy Strategy provides information on proposed energy efficiency measures and other carbon reductions. It also provides a summary of proposed major fabric building materials, waste management and water management. It considers how the development maintains a balance of environmental, economic, and social issues. Steps taken to promote an effective energy hierarchy are detailed.

### 1.2 Key Findings

The Energy Statement concludes that a net zero in carbon emissions can be provided from on-site renewable energy and energy efficient measures. To demonstrate this an efficient ASHP has been proposed with low U values and 6.00 kWp of Solar PV. The SAP calculations suggest that this will be more than sufficient to meet the necessary requirements.

### Building Regulations England Part L (BREL) Compliance Report

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

Date: Thu 02 Nov 2023 16:26:38

Project Information			
Assessed By	Kyle Jones	Building Type	Bungalow, Detached
OCDEA Registration	EES/027281	Assessment Date	2023-11-02

Dwelling Details			
Assessment Type	As designed	Total Floor Area	86 m <sup>2</sup>
Site Reference	709936	Plot Reference	709936
Address	1 Marlborough Avenue, Falmouth, TR11 2RW		

Client Details	
Name	Annie & Alastair Morrison
Company	N/A
Address	1 Marlborough Avenue, Falmouth, TR11 2RW

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	11.1 kgCO <sub>2</sub> /m <sup>2</sup>	
Dwelling carbon dioxide emission rate	-0.44 kgCO <sub>2</sub> /m <sup>2</sup>	OK
1b Target primary energy rate and dwelling primary energy		
Target primary energy	58.84 kWh <sub>pe</sub> /m <sup>2</sup>	
Dwelling primary energy	-6.75 kWh <sub>pe</sub> /m <sup>2</sup>	OK
1c Target fabric energy efficiency and dwelling fabric energy efficiency		
Target fabric energy efficiency	46.9 kWh/m <sup>2</sup>	
Dwelling fabric energy efficiency	38.4 kWh/m <sup>2</sup>	OK

SAP Rating:	104 A	CO2 Emission:	-0.1 t/yr	DER:	-0.44 kgCO <sub>2</sub> /yr/m <sup>2</sup>	TER:	11.1 kgCO <sub>2</sub> /yr/m <sup>2</sup>
% DER-TER:	103.96%	Compliance Check:	See BREL	EJ Rating:	100 A	DPER:	-6.75 kWh/m <sup>2</sup> /yr
TPER:	58.84 kWh/m <sup>2</sup> /yr	DPER-TPER:	111.47 %	DFEE:	38.42 kWh/m <sup>2</sup> /yr	TTEE:	46.94 kWh/m <sup>2</sup> /yr
DFEE-TTEE:	18.15 %						

### 1.3 DER/TER Comparison

	Result (kgCO <sub>2</sub> /yr/m <sup>2</sup> )
TER (Target Emission Rate)	11.10
DER (Dwelling Emission Rate)	-0.44
% Reduction	103.96

## 2. Introduction

### 2.1 Background

This Statement has been prepared by Melin Consultants considering *Cornwall Council's Local Plan (2010 – 2030)*.

It is intended to provide a clear and straightforward assessment of the proposed development's energy requirements and subsequent CO<sub>2</sub> emissions.

The *Cornwall Council's Local Plan* requires developments to provide sufficient renewable energy generation and/or energy efficient measures to reduce the carbon emissions and energy usage.

This Statement assesses expected energy demand at the site, showing how carbon dioxide emissions will be reduced through designing for minimum energy use and installing on-site renewable energy.

## 2.2 Policy Requirements

In writing, this report the following policies and guidance have been adopted.

### 2.2.1 Cornwall Council's Local Plan (2010 - 2030)

1. To increase use and production of renewable and low carbon energy generation development proposals will be supported that:
  - a. maximise the use of the available resource by deploying installations with the greatest energy output practicable taking into account the provisions of this Plan;
  - b. make use, or offer genuine potential for use, of any waste heat produced; and
  - c. in the case of wind turbines, they are within an area allocated by Neighbourhood Plans for wind power and avoid, or adequately mitigate shadow flicker, noise and adverse impact on air traffic operations, radar, and air navigational installations; and
  - d. do not have an overshadowing or overbearing effect on nearby habitations.
  - e. in the case of solar development, noise, glint, and glare is mitigated adequately.
2. Support will be given to renewable and low carbon energy generation developments that:
  - a. are led by, or meet the needs of local communities; and

- b. create opportunities for co-location of energy producers with energy users, in particular heat, and facilitate renewable and low carbon energy innovation.
3. When considering such proposals, regard will be given to the wider benefits of providing energy from renewable sources, as well as the potential effects on the local environment, including any cumulative impact of these proposals.
4. In and within the setting of Areas of Outstanding Natural Beauty and undeveloped coast, developments will only be permitted in exceptional circumstances and should generally be very small scale in order that the natural beauty of these areas may be conserved.
5. When considering proposals for renewables that impact upon the Area of Outstanding Natural Beauty and its setting and / or the World Heritage Site or other historic assets and their settings, applicants should apply other relevant policies in the Plan.

## 2.2.2 Cornwall Council's Climate Emergency Development Plan (February 2023):

### Policies SEC1 – Sustainable Energy and Construction

Development proposals will be required to demonstrate how they have implemented the principles and requirements set out in the policy below.

### 1. The Energy Hierarchy

All proposals should embed the Energy Hierarchy within the design of buildings by prioritising fabric first, orientation and landscaping in order to minimise energy demand for heating, lighting, and cooling. All proposals should consider opportunities to provide solar PV and energy storage.

### 2. A) New Development – Major Non-Residential

Development proposals for major (a floor space of over 1,000m<sup>2</sup>) non-residential development should demonstrate how they achieve BREEAM 'Excellent' or an equivalent or better methodology.

### B) New Development – Residential

Residential development proposals will be required to achieve Net Zero Carbon and submit an 'Energy Statement' that demonstrates how the proposal will achieve:

- Space heating demand less than 30kWh/m<sup>2</sup>/annum;
- Total energy consumption less than 40kWh/m<sup>2</sup>/annum; and
- On-site renewable generation to match the total energy consumption, with a preference for roof mounted solar PV.

Where the use of onsite renewables to match total energy consumption is demonstrated to be not technically feasible (for example with apartments) or economically viable renewable energy generation should be maximised as much as possible; and/or connection made to an existing or proposed low carbon district energy network; or where this is not possible the residual energy (the amount by which total energy demand exceeds the renewable energy generation) is to be offset by a contribution to Cornwall Council's Offset Fund.

Where economic viability or technical constraints prevent policy compliance, proposals should first and foremost strive to meet the space heating and total energy consumption thresholds. Proposals must then benefit as much as possible from renewable energy generation and/or connection to an existing or proposed low carbon district energy network. As a last resort, any residual energy is to be offset by a contribution to Cornwall Council's Offset Fund, as far as economic viability allows.

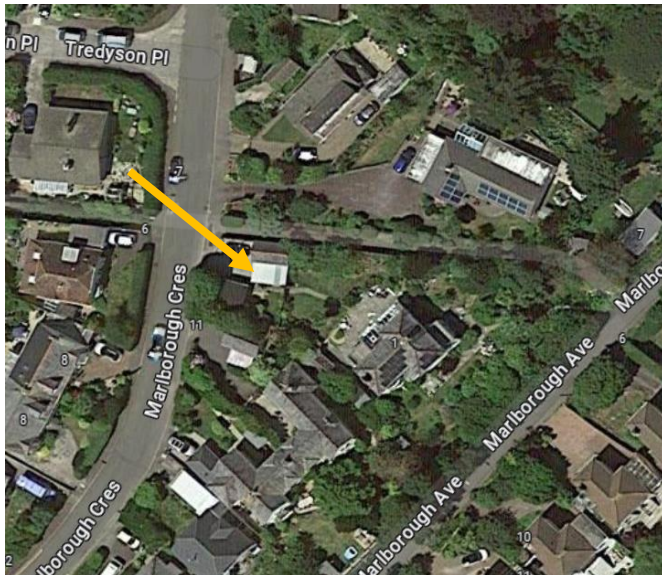
While this policy does not require the application of these standards to reserved matters applications that relate to outline planning permissions that predate the adoption of this climate Emergency DPD, developers are encouraged to apply these standards on a voluntary basis, where it is feasible to do so and not within breach of existing permissions.

## 3. Site Analysis

### 3.1 Location

The proposed development is located on the land to the rear of 1 Marlborough Avenue, Falmouth. Figure 1 below highlights the area of the development.

Figure 1 - Map highlighting the location of the site and its surroundings.



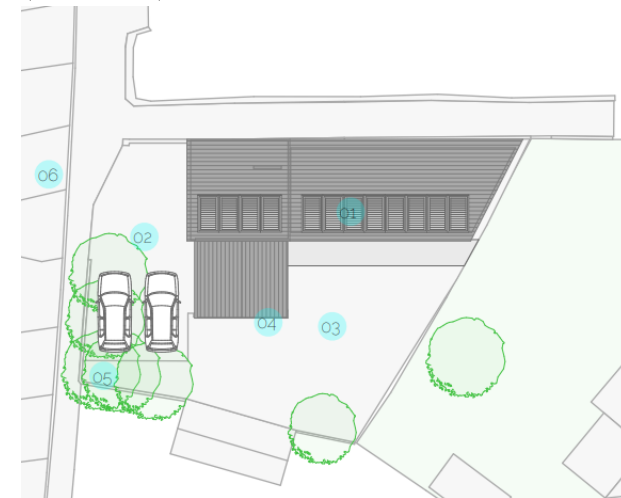
The closest train station is Penmere Station, which is approximately 0.3 miles from the development site by road. This train station provides services to Falmouth Docks & Truro. Additionally, Redruth train station is 10.4 miles from the site and provides services to Penzance, Cardiff Central, Plymouth & London Paddington.

There is a couple bus stops located at East Rise, approximately 0.4 miles from the development and provides further links nearby.

### 3.2 The Development

The proposed development will consist of the construction of a highly sustainable, low energy, low impact infill dwelling on the land to the rear of 1 Marlborough Avenue, Falmouth. The dwelling will replace the current garage and garden chalet occupying the site.

Figure 2: Proposed site plan





## 4. Energy Efficient Design Measures

To supplement Cornwall Council's requirements for sustainable construction the design team have considered the three issues that contribute to the proposed developments overall sustainability. These are environmental, economic, and social.

### 4.1 Solar/Daylighting

The proposed development will make good use of glazing to all elevations to help reduce internal lighting loads.

### 4.2 Lighting

It has been assumed within the calculations that all internal lighting will be low energy fittings. To be classified as a low energy light fitting under the Domestic Building Services Guide the fitting must have an efficacy of 75 lumens per circuit watt or higher.

In addition, all external security and safety lighting will be fitted with daylight and movement sensors.

### 4.3 Heating, cooling & DHW strategy

The proposed heating and domestic hot water strategy is likely to be from an efficient air source heat pump with an efficiency of at least 370% along with a 200L hot water cylinder and has therefore been used for the purposes of this report.

### 4.4 Ventilation strategy

A mechanical ventilation with heat recovery system has been specified to provide ventilation for the whole dwelling.

### 4.5 Water use

In order to meet Building Regulations requirements, water usage must not exceed 110 Litres/person/day in line with Enhanced Building Regulations Part G criteria. To achieve this the following fittings will be required:

- WCs – dual flush 4 (full flush), 2.6 (part flush)
- Kitchen taps – 6 litres per minute
- Basin taps – 6 litres per minute
- Baths – 180 litre capacity
- Showers – 8 litres per minute

### 4.6 Materials

Where possible, it is proposed that construction materials will be purchased from sources that minimise carbon emissions and/or come from sustainable sources. The environmental policy and sustainability policy for each manufacturer shall be carefully considered before orders are placed.

Where possible, timber should be sourced that has Forest Stewardship Council (FSC) or Programme for the Endorsement of

Forest Certification PEFC) certification. This is to ensure that the timber is legally and sustainably sourced.

## 4.7 Energy Efficiency Measures

To reduce the energy demand within the dwelling, low U values, independent psi values and low air permeability figures have been used. The U values we have used are as follows:

- Ground Floor – 0.11 W/m<sup>2</sup>K
- External Wall – 0.16 W/m<sup>2</sup>K
- Roof – 0.13 W/m<sup>2</sup>K
- Solid Door – 1.40 W/m<sup>2</sup>K
- Glazed/Sliding Doors - 1.20 W/m<sup>2</sup>K
- Windows – 1.20 W/m<sup>2</sup>K
- Thermal bridging: PSI values taken from R.O.I Acceptable Construction Details for a cavity wall has been used based on the u' values used.
- An air test figure of 2.00 m<sup>3</sup>/h/m<sup>2</sup> at 50Pa has been used.

## 4.8 Reducing surface water run-off

All development shall minimise the impact of surface water runoff from the development in the design of the drainage system, and where possible incorporate mitigation and resilience measures for any increases in river flooding levels as a result of climate change.

## 4.9 Renewable technologies

Several low carbon and renewable technologies have been considered for the proposed scheme.

A summary of the suitability of each technology is listed in the following table.

*Table 3 – Summary of renewable technology*

<b>Solar PV</b>
Solar PV lends itself to the proposed development with minimal obstruction and a significant available installation area. The electricity demand of the proposed building is not going to be significant during period of occupation and a reduction in carbon emissions is achievable by using this technology on its own.
<b>Solar thermal</b>
The proposed development would have low to medium hot water demand which, if sized correctly, lends itself too solar thermal. It is likely that a significant reduction in carbon emissions could be achieved with this system alone as a large area of solar thermal panels would be required to achieve this.
<b>Air source heat pumps</b>
Air source technology is a potential technology that could be used on the proposed development. It would require wall or roof mounted plant which may present visual issues. It is likely that a

significant reduction in carbon emissions could be achieved with this system alone

### **Biomass**

Biomass is a potential technology for the site however, space for fuel storage could be an issue within the development. Biomass boilers do not modulate as well as a conventional fuel boiler and would therefore require a constant heat demand to be sized correctly. It is unlikely that a significant reduction in carbon emissions could be achieved with this system alone

### **Ground source heat pumps**

The energy demand of the proposed development would be suitable for ground source technology. Further investigation would be required into the area required for the external works and whether the Geology of the site is suitable. It is likely that a significant reduction in carbon emissions could be achieved with this system alone

### **Water source heat pump**

The energy demand of the proposed development would be suitable for water source technology. Further investigation would be required into the area required for the external works and whether the Geology of the site is suitable. It is likely that a significant reduction in carbon emissions could be achieved with this system alone

### **Wind**

The estimated wind speed for the location and surrounding obstructions do not lend itself to this technology.

### **CHP**

Low to medium electricity demand makes CHP an unviable option for this development.

## 5. Baseline Energy Demand and CO<sub>2</sub> Emissions

### 5.1 Energy Benchmarks

Energy performance benchmarks for the proposed development are taken from 'Energy efficiency in buildings' CIBSE Guide F (2012) and where appropriate data from relevant design team members and thermal modelling calculations.

To demonstrate how the development has reduced carbon emissions by a prescribed amount, technical calculations (SAP10) provide target CO<sub>2</sub> emissions (TER) for a building that is compliant with Part L 2021 (baseline buildings with conventional gas boiler), followed by a final set of calculations that provide the dwelling CO<sub>2</sub> emissions (DER) for a building with renewable technologies.

### 5.2 Reduction in energy usage through on-site renewable technology and energy efficient measures

Several renewable technologies have been considered for the proposed development (Solar Thermal, Solar PV, Wind, ASHP, GSHP, WSHP, CHP and Biomass). An ASHP has been considered the most appropriate method along with Solar PV.

## 5.3 Regulated Energy

All our calculations have been based on regulated energy, which includes all energy used for space and water heating, electricity for lighting and all other fixed items such as pumps and fans.

## 6. Energy Statement for the Chosen Technology

Based on the information provided in the above report, below is a summary of the savings:

	CO <sub>2</sub> emissions (kg/m <sup>2</sup> pa)
TER (Target Emission Rate)	11.10
DER (Dwelling Emission Rate)	-0.44
Reduction in emissions from the use of renewable sources	11.54
Percentage reduction from the use of renewable sources	103.96%
CO <sub>2</sub> emissions	-0.10 tonnes pa

## 7. Energy Efficiency Measures included in Calculations per dwelling.

Element or System	Part L 2021	Proposed
Wall	0.26	0.16
Roof	0.16	0.13
Floor	0.18	0.11
Windows	1.60	1.20
Doors	1.60	1.20/1.40
Permeability	8.00	2.00
Ventilation		MVHR: Vent Axia Sentinel Kinetic Plus BS
Heating System		ASHP feeding underfloor heating: E.g. Ideal Heating Logic Air 5kW
Water Heating		From main system, 200L cylinder
Secondary Heating		None
Energy efficient lighting	Efficacy = 75lm/W	Power = 10W, Efficacy = 75lm/W
Renewables		Solar PV: 12 Panels at 500W each = 6.00 kWp total. Battery Storage > 5.00 kWh

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## 8. Conclusion

With the inclusion of energy efficient measures including low U values, air test figure in addition to an efficient air source heat pump and 6.00 kWp of Solar Photovoltaic panels., the proposed development can demonstrate a potential to achieve net zero carbon emissions over a Part L Building Regulations 2021 target emissions rate as outlined in the table above.

# Appendix A: Software Outputs



# Full SAP Calculation Printout



Property Reference	709936		Issued on Date	06/11/2023	
Assessment Reference	709936	Prop Type Ref	709936		
Property	1 Marlborough Avenue, Falmouth, Cornwall, TR11 2RW				
SAP Rating	104 A	DER	-0.44	TER	11.10
Environmental	100 A	% DER < TER			103.96
CO <sub>2</sub> Emissions (t/year)	-0.1	DFEE	38.42	TFEE	46.94
Compliance Check	See BREEL	% DFEE < TFEE			18.15
% DPER < TPER	111.47	DPER	-6.75	TPER	58.84
Assessor Details	Mr. Kyle Jones			Assessor ID	AV53-0001
Client	709936, Annie & Alastair Morrison				

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 (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	73.0700 (1b)	x 2.8500 (2b)	= 208.2495 (1b) - (3b)
First floor	13.4100 (1c)	x 1.8500 (2c)	= 24.8085 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	86.4800		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	233.0580 (5)

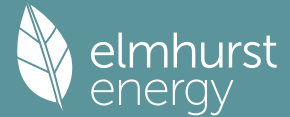
### 2. Ventilation rate

	m3 per hour											
Number of open chimneys	0 * 80 =											0.0000 (6a)
Number of open flues	0 * 20 =											0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =											0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =											0.0000 (6d)
Number of flues attached to other heater	0 * 35 =											0.0000 (6e)
Number of blocked chimneys	0 * 20 =											0.0000 (6f)
Number of intermittent extract fans	0 * 10 =											0.0000 (7a)
Number of passive vents	0 * 10 =											0.0000 (7b)
Number of flueless gas fires	0 * 40 =											0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =											0.0000 (8)
Pressure test												Yes
Pressure Test Method												Blower Door
Measured/design AP50												2.0000 (17)
Infiltration rate												0.1000 (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) =											0.1000 (21)
Wind speed	Jan 5.1000	Feb 5.0000	Mar 4.9000	Apr 4.4000	May 4.3000	Jun 3.8000	Jul 3.8000	Aug 3.7000	Sep 4.0000	Oct 4.3000	Nov 4.5000	Dec 4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.1275	0.1250	0.1225	0.1100	0.1075	0.0950	0.0950	0.0925	0.1000	0.1075	0.1125	0.1175 (22b)
Balanced mechanical ventilation with heat recovery												
If mechanical ventilation												0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												81.0000 (23c)
Effective ac	0.2225	0.2200	0.2175	0.2050	0.2025	0.1900	0.1900	0.1875	0.1950	0.2025	0.2075	0.2125 (25)

### 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
Window (Uw = 1.20)			8.8200	1.1450	10.0992		(27)
Glazed door (Uw = 1.20)			4.0100	1.1450	4.5916		(27)
Sliding door (Uw = 1.20)			6.7200	1.1450	7.6947		(27)
Solid door			1.9500	1.4000	2.7300		(26)
Ground floor			73.0700	0.1100	8.0377	110.0000	8037.7000 (28a)
Rendered external wall	70.1400	7.3500	62.7900	0.1600	10.0464	190.0000	11930.1000 (29a)
Timber clad external wall	52.2000	14.1500	38.0500	0.1600	6.0880	190.0000	7229.5000 (29a)
Sloped roof	81.3000		81.3000	0.1300	10.5690	9.0000	731.7000 (30)
Total net area of external elements Aum(A, m <sup>2</sup> )			276.7100				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	59.8566		(33)
Internal block wall			131.2400			75.0000	9843.0000 (32c)
First floor			13.4100			18.0000	241.3800 (32d)
Ground floor ceiling			13.4100			0.0000	0.0000 (32e)

# Full SAP Calculation Printout



Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 38013.3800 (34)  
 Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 439.5627 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	14.0200	0.0050	0.0701
E3 Sill	7.9700	0.0150	0.1195
E4 Jamb	35.0000	0.0260	0.9100
E5 Ground floor (normal)	46.1800	0.0720	3.3250
E6 Intermediate floor within a dwelling	15.5200	0.0390	0.6053
E11 Eaves (insulation at rafter level)	32.1100	0.0200	0.6422
E13 Gable (insulation at rafter level)	15.6500	0.0410	0.6417
E16 Corner (normal)	16.4300	0.0320	0.5258
E17 Corner (inverted - internal area greater than external area)	7.1500	-0.0530	-0.3790

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 6.4605 (36)  
 Point Thermal bridges 0.0000 (36a) =  
 Total fabric heat loss (33) + (36) + (36a) = 66.3171 (37)

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

(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	17.1123	16.9200	16.7277	15.7664	15.5741	14.6127	14.6127	14.4205	14.9973	15.5741	15.9586	16.3432 (38)
Average = Sum(39)m / 12 =	83.4294	83.2372	83.0449	82.0835	81.8912	80.9299	80.9299	80.7376	81.3144	81.8912	82.2758	82.6603 (39)

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	0.9647	0.9625	0.9603	0.9492	0.9469	0.9358	0.9358	0.9336	0.9403	0.9469	0.9514	0.9558 (40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

#### 4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.5744 (42)

Hot water usage for mixer showers 101.0762 99.5572 97.3438 93.1087 89.9834 86.4980 84.5170 86.7136 89.1216 92.8639 97.1899 100.6890 (42a)

Hot water usage for baths 29.1006 28.6684 28.0598 26.9377 26.0974 25.1657 24.6624 25.2668 25.9248 26.9218 28.0670 29.0022 (42b)

Hot water usage for other uses 40.9945 39.5038 38.0131 36.5224 35.0317 33.5410 33.5410 35.0317 36.5224 38.0131 39.5038 40.9945 (42c)

Average daily hot water use (litres/day) 157.4375 (43)

Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	171.1714	167.7295	163.4167	156.5688	151.1125	145.2047	142.7204	147.0121	151.5688	157.7987	164.7607	170.6857 (44)
Energy content (annual)	271.0936	238.8446	251.1654	214.3349	203.4265	178.5461	172.6079	182.0317	186.8995	214.1314	234.7319	267.2526 (45)
Distribution loss (46)m = 0.15 x (45)m	40.6640	35.8267	37.6748	32.1502	30.5140	26.7819	25.8912	27.3048	28.0349	32.1197	35.2098	40.0879 (46)

Water storage loss:  
 Store volume 200.0000 (47)  
 a) If manufacturer declared loss factor is known (kWh/day):  
 Temperature factor from Table 2b 2.1000 (48)  
 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 22.5120 22.5120 23.2624 23.2624 23.2624 23.2624 22.5120 22.5120 (58)

Combi loss 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (61)

Total heat required for water heating calculated for each month 329.5100 291.6078 309.5818 270.8669 261.8429 235.0781 231.0243 240.4481 243.4315 272.5478 291.2639 325.6690 (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 329.5100 291.6078 309.5818 270.8669 261.8429 235.0781 231.0243 240.4481 243.4315 272.5478 291.2639 325.6690 (64)

Total per year (kWh/year) = Sum(64)m = 3302.8720 (64)  
 3303 (64)

12Total per year (kWh/year)  
 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 136.8717 121.6264 130.2456 116.4919 114.3724 104.5922 104.1252 107.2587 107.3697 117.9318 123.2739 135.5946 (65)

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

Metabolic gains (Table 5), Watts

(66)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	117.2233	129.7829	117.2233	121.1307	117.2233	121.1307	117.2233	117.2233	121.1307	117.2233	121.1307	117.2233 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	232.4508	234.8629	228.7845	215.8442	199.5094	184.1570	173.9006	171.4885	177.5670	190.5073	206.8421	222.1945 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.8721	35.8721	35.8721	35.8721	35.8721	35.8721	35.8721	35.8721	35.8721	35.8721	35.8721	35.8721 (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)	-102.9764	-102.9764	-102.9764	-102.9764	-102.9764	-102.9764	-102.9764	-102.9764	-102.9764	-102.9764	-102.9764	-102.9764 (71)
Water heating gains (Table 5)	183.9674	180.9916	175.0613	161.7944	153.7264	145.2669	139.9533	144.1649	149.1246	158.5105	171.2138	182.2508 (72)
Total internal gains	595.2576	607.2536	582.6852	560.3854	532.0752	512.1708	492.6934	494.4928	509.4384	527.8572	560.8027	583.2847 (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	1.1000	10.6334	0.6300	0.7000	0.7700	3.5747 (74)
South	4.8100	46.7521	0.6300	0.7000	0.7700	68.7255 (78)

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West			2.9100		19.6403		0.6300		0.7000		0.7700		17.4668 (80)
East			2.0800		19.6403		0.6300		0.7000		0.7700		12.4848 (76)
South			1.9300		46.7521		0.6300		0.7000		0.7700		27.5759 (78)
South			6.7200		46.7521		0.6300		0.7000		0.7700		96.0156 (78)

Solar gains	225.8433	380.3887	509.3107	612.8286	670.1129	658.1840	637.5007	595.7876	545.2927	417.3758	269.7171	193.7903	(83)
Total gains	821.1009	987.6423	1091.9959	1173.2140	1202.1881	1170.3548	1130.1940	1090.2804	1054.7312	945.2330	830.5199	777.0750	(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	126.5653	126.8577	127.1514	128.6406	128.9426	130.4743	130.4743	130.7850	129.8573	128.9426	128.3400	127.7429	
alpha	9.4377	9.4572	9.4768	9.5760	9.5962	9.6983	9.6983	9.7190	9.6572	9.5962	9.5560	9.5162	
util living area	0.9972	0.9847	0.9425	0.8148	0.6306	0.4425	0.3151	0.3406	0.5314	0.8520	0.9867	0.9982	(86)
Living	20.6259	20.7487	20.8632	20.9452	20.9654	20.9678	20.9679	20.9679	20.9674	20.9399	20.7746	20.6029	
Non living	19.6882	19.8429	19.9778	20.0679	20.0850	20.0959	20.0959	20.0979	20.0919	20.0671	19.8848	19.6656	
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	20.8086	20.7487	20.8632	20.9452	20.9654	20.9678	20.9679	20.9679	20.9674	20.9399	20.7746	20.6584	(87)
Th 2	20.1128	20.1147	20.1166	20.1259	20.1278	20.1372	20.1372	20.1390	20.1334	20.1278	20.1240	20.1203	(88)
util rest of house	0.9957	0.9774	0.9195	0.7673	0.5729	0.3829	0.2533	0.2769	0.4650	0.7991	0.9789	0.9973	(89)
MIT 2	19.9435	19.8429	19.9778	20.0679	20.0850	20.0959	20.0959	20.0979	20.0919	20.0671	19.8848	19.7476	(90)
Living area fraction									fLA = Living area / (4) =			0.3498	(91)
MIT	20.2461	20.1597	20.2875	20.3748	20.3930	20.4009	20.4009	20.4022	20.3981	20.3724	20.1961	20.0662	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.2461	20.1597	20.2875	20.3748	20.3930	20.4009	20.4009	20.4022	20.3981	20.3724	20.1961	20.0662	(93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9959	0.9778	0.9245	0.7814	0.5906	0.4011	0.2722	0.2964	0.4853	0.8149	0.9797	0.9972	(94)
Useful gains	817.7722	965.7179	1009.5667	916.7559	709.9690	469.4242	307.6064	323.1271	511.8809	770.2992	813.6195	774.8910	(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	1330.3768	1270.1775	1144.9814	941.8934	711.8781	469.4642	307.6071	323.1288	512.1269	800.2753	1077.4895	1311.5033	(97)
Space heating kWh	381.3778	204.5969	100.7485	18.0990	1.4203	0.0000	0.0000	0.0000	0.0000	22.3023	189.9864	399.2395	(98a)
Space heating requirement - total per year (kWh/year)												1317.7708	
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	381.3778	204.5969	100.7485	18.0990	1.4203	0.0000	0.0000	0.0000	0.0000	22.3023	189.9864	399.2395	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1317.7708	
Space heating per m2										(98c) / (4) =		15.2379	(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 %)													379.6158 (206)
Efficiency of main space heating system 2 (in %)													0.0000 (207)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement	381.3778	204.5969	100.7485	18.0990	1.4203	0.0000	0.0000	0.0000	0.0000	22.3023	189.9864	399.2395	(98)
Space heating efficiency (main heating system 1)	379.6158	379.6158	379.6158	379.6158	379.6158	0.0000	0.0000	0.0000	0.0000	379.6158	379.6158	379.6158	(210)
Space heating fuel (main heating system)	100.4642	53.8958	26.5396	4.7677	0.3742	0.0000	0.0000	0.0000	0.0000	5.8750	50.0470	105.1694	(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	329.5100	291.6078	309.5818	270.8669	261.8429	235.0781	231.0243	240.4481	243.4315	272.5478	291.2639	325.6690	(64)
Efficiency of water heater (217)m	193.6116	193.6116	193.6116	193.6116	193.6116	193.6116	193.6116	193.6116	193.6116	193.6116	193.6116	193.6116	(216)
Fuel for water heating, kWh/month	170.1912	150.6148	159.8984	139.9022	135.2413	121.4174	119.3236	124.1910	125.7319	140.7704	150.4372	168.2074	(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	17.5802	15.8789	17.5802	17.0131	17.5802	17.0131	17.5802	17.5802	17.0131	17.5802	17.0131	17.5802	(231)
Lighting	27.1628	21.7910	19.6204	14.3747	11.1035	9.0716	10.1290	13.1660	17.1013	22.4379	25.3435	27.9177	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-132.9378	-198.1412	-289.7218	-316.9665	-331.3980	-304.6044	-300.6486	-292.8042	-267.6269	-226.1023	-149.7044	-113.2252	(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)

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Annual totals kWh/year		
Space heating fuel - main system 1	347.1328	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	193.6116	
Water heating fuel used	1705.9266	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.7280)		
mechanical ventilation fans (SFP = 0.7280)	206.9928	(230a)
Total electricity for the above, kWh/year	206.9928	(231)
Electricity for lighting (calculated in Appendix L)	219.2194	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-2923.8814	(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	-444.6097	(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	347.1328	0.1593	55.2894 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1705.9266	0.1410	240.5041 (264)
Space and water heating			295.7935 (265)
Pumps, fans and electric keep-hot	206.9928	0.1387	28.7125 (267)
Energy for lighting	219.2194	0.1443	31.6401 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-2923.8814	0.1347	-393.9497
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-393.9497 (269)
Total CO2, kg/year			-37.8036 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			-0.4400 (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	347.1328	1.5895	551.7655 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1705.9266	1.5213	2595.2309 (278)
Space and water heating			3146.9965 (279)
Pumps, fans and electric keep-hot	206.9928	1.5128	313.1387 (281)
Energy for lighting	219.2194	1.5338	336.2461 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-2923.8814	1.4980	-4379.9204
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-4379.9204 (283)
Total Primary energy kWh/year			-583.5392 (286)
Dwelling Primary energy Rate (DPER)			-6.7500 (287)

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

### 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	73.0700 (1b)	x 2.8500 (2b)	= 208.2495 (1b) - (3b)
First floor	13.4100 (1c)	x 1.8500 (2c)	= 24.8085 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	86.4800		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 233.0580 (5)

### 2. Ventilation rate

	m <sup>3</sup> 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)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) = 0.1287 (8)
Pressure test	Yes
Pressure Test Method	Blower Door

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Measured/design AP50 5.0000 (17)  
 Infiltration rate 0.3787 (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) = 0.3787 (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												
Effective ac	0.4829	0.4734	0.4639	0.4166	0.4071	0.3598	0.3598	0.3503	0.3787	0.4071	0.4261	0.4450 (22b)
	0.6166	0.6121	0.6076	0.5868	0.5829	0.5647	0.5647	0.5614	0.5717	0.5829	0.5908	0.5990 (25)

### 3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
TER Opaque door			1.9500	1.0000	1.9500		(26)
TER Opening Type (Uw = 1.20)			19.5500	1.1450	22.3855		(27)
Ground floor			73.0700	0.1300	9.4991		(28a)
Rendered external wall	70.1400	7.3500	62.7900	0.1800	11.3022		(29a)
Timber clad external wall	52.2000	14.1500	38.0500	0.1800	6.8490		(29a)
Sloped roof	81.3000		81.3000	0.1100	8.9430		(30)
Total net area of external elements Aum(A, m2)			276.7100				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 60.9288		(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 439.5627 (35)

#### List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	14.0200	0.0500	0.7010
E3 Sill	7.9700	0.0500	0.3985
E4 Jamb	35.0000	0.0500	1.7500
E5 Ground floor (normal)	46.1800	0.1600	7.3888
E6 Intermediate floor within a dwelling	15.5200	0.0000	0.0000
E11 Eaves (insulation at rafter level)	32.1100	0.0400	1.2844
E13 Gable (insulation at rafter level)	15.6500	0.0800	1.2520
E16 Corner (normal)	16.4300	0.0900	1.4787
E17 Corner (inverted - internal area greater than external area)	7.1500	-0.0900	-0.6435

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 13.6099 (36)

#### Point Thermal bridges

Total fabric heat loss (33) + (36) + (36a) = 74.5387 (37)

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

(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	47.4209	47.0727	46.7314	45.1284	44.8285	43.4324	43.4324	43.1738	43.9702	44.8285	45.4352	46.0695 (38)
Average = Sum(39)m / 12 =	121.9595	121.6114	121.2701	119.6671	119.3672	117.9711	117.9711	117.7125	118.5089	119.3672	119.9739	120.6082 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.4103	1.4062	1.4023	1.3838	1.3803	1.3641	1.3641	1.3612	1.3704	1.3803	1.3873	1.3946 (40)
HLP (average)												1.3837
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

### 4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.5744 (42)

Hot water usage for mixer showers	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hot water usage for baths	67.3841	66.3715	64.8959	62.0725	59.9889	57.6654	56.3446	57.8091	59.4144	61.9092	64.7932	67.1260 (42a)
Hot water usage for other uses	29.1006	28.6684	28.0598	26.9377	26.0974	25.1657	24.6624	25.2668	25.9248	26.9218	28.0670	29.0022 (42b)
Average daily hot water use (litres/day)	40.9945	39.5038	38.0131	36.5224	35.0317	33.5410	33.5410	35.0317	36.5224	38.0131	39.5038	40.9945 (42c)

Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy content (annual)	137.4793	134.5437	130.9688	125.5326	121.1180	116.3720	114.5480	118.1076	121.8616	126.8441	132.3641	137.1227 (44)
Distribution loss (46)m = 0.15 x (45)m	217.7336	191.5885	201.2942	171.8478	163.0481	143.0930	138.5359	146.2418	150.2676	172.1263	188.5769	214.7011 (45)
Total = Sum(45)m =	32.6600	28.7383	30.1941	25.7772	24.4572	21.4639	20.7804	21.9363	22.5401	25.8189	28.2865	32.2052 (46)

Water storage loss: 200.0000 (47)

Store volume 1.6525 (48)

a) If manufacturer declared loss factor is known (kWh/day): 0.5400 (49)

Temperature factor from Table 2b 0.8924 (55)

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

Total storage loss 27.6637 24.9865 27.6637 26.7713 27.6637 26.7713 27.6637 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 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 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 0.0000 (61)

Total heat required for water heating calculated for each month 268.6597 237.5862 252.2202 221.1311 213.9742 192.3763 189.4620 197.1679 199.5509 223.0523 237.8602 265.6271 (62)

WWHRS -30.8052 -27.2444 -28.5288 -23.6229 -22.0157 -18.8390 -17.6586 -18.7781 -19.4916 -22.9784 -26.0317 -30.2347 (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 -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 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 0.0000 (63d)

Output from w/h 237.8545 210.3419 223.6915 197.5082 191.9585 173.5373 171.8034 178.3898 180.0593 200.0739 211.8285 235.3924 (64)

Total per year (kWh/year) = Sum(64a)m = 2412.4390 (64a)

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 0.0000 (64a)

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

Heat gains from water heating, kWh/month 113.1373 100.5014 107.6712 96.5660 94.9544 87.0051 86.8041 89.3663 89.3906 97.9728 102.1285 112.1290 (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	128.7205	128.7205	128.7205	128.7205	128.7205	128.7205	128.7205	128.7205	128.7205	128.7205	128.7205	128.7205	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	117.2233	129.7829	117.2233	121.1307	117.2233	121.1307	117.2233	117.2233	121.1307	117.2233	121.1307	117.2233	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	232.4508	234.8629	228.7845	215.8442	199.5094	184.1570	173.9006	171.4885	177.5670	190.5073	206.8421	222.1945	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.8721	35.8721	35.8721	35.8721	35.8721	35.8721	35.8721	35.8721	35.8721	35.8721	35.8721	35.8721	(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)	-102.9764	-102.9764	-102.9764	-102.9764	-102.9764	-102.9764	-102.9764	-102.9764	-102.9764	-102.9764	-102.9764	-102.9764	(71)
Water heating gains (Table 5)	152.0662	149.5556	144.7193	134.1195	127.6268	120.8403	116.6721	120.1159	124.1536	131.6839	141.8451	150.7110	(72)
Total internal gains	566.3565	578.8176	555.3432	535.7106	508.9757	487.7442	469.4122	470.4439	484.4675	504.0306	534.4340	554.7449	(73)

## 6. Solar gains

[Jan]	Area m <sup>2</sup>	Solar flux Table 6a W/m <sup>2</sup>	Specific data or Table 6b	Specific data or Table 6c	FF	Access factor Table 6d	Gains W						
North	1.1000	10.6334	0.6300	0.7000	0.7700	3.5747	(74)						
East	2.0800	19.6403	0.6300	0.7000	0.7700	12.4848	(76)						
South	13.4600	46.7521	0.6300	0.7000	0.7700	192.3170	(78)						
West	2.9100	19.6403	0.6300	0.7000	0.7700	17.4668	(80)						
Solar gains	225.8433	380.3887	509.3107	612.8286	670.1129	658.1840	637.5007	595.7876	545.2927	417.3758	269.7171	193.7903	(83)
Total gains	792.1997	959.2063	1064.6539	1148.5391	1179.0886	1145.9283	1106.9129	1066.2315	1029.7602	921.4065	804.1512	748.5352	(84)

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisation factor for gains for living area, nil,m (see Table 9a)	86.5801	86.8280	87.0723	88.2387	88.4604	89.5073	89.5073	89.7039	89.1011	88.4604	88.0131	87.5502	21.0000	(85)
tau	6.7720	6.7885	6.8048	6.8826	6.8974	6.9672	6.9672	6.9803	6.9401	6.8974	6.8675	6.8367		
util living area	0.9990	0.9960	0.9868	0.9500	0.8456	0.6461	0.4677	0.5056	0.7548	0.9636	0.9965	0.9993	(86)	
MIT	20.0626	20.2450	20.4667	20.7306	20.9146	20.9890	20.9989	20.9982	20.9694	20.7330	20.3463	20.0362	(87)	
Th 2	19.7555	19.7586	19.7616	19.7758	19.7785	19.7909	19.7909	19.7932	19.7861	19.7785	19.7731	19.7674	(88)	
util rest of house	0.9984	0.9936	0.9787	0.9207	0.7711	0.5312	0.3400	0.3744	0.6420	0.9354	0.9940	0.9989	(89)	
MIT 2	18.6988	18.9334	19.2142	19.5394	19.7250	19.7874	19.7908	19.7930	19.7738	19.5520	19.0748	18.6743	(90)	
Living area fraction	19.1759	19.3922	19.6523	19.9561	20.1411	20.2077	20.2134	20.2146	20.1920	19.9651	19.5196	19.1507	(91)	
MIT	19.1759	19.3922	19.6523	19.9561	20.1411	20.2077	20.2134	20.2146	20.1920	19.9651	19.5196	19.1507	(92)	
Temperature adjustment												0.0000		
adjusted MIT	19.1759	19.3922	19.6523	19.9561	20.1411	20.2077	20.2134	20.2146	20.1920	19.9651	19.5196	19.1507	(93)	

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9979	0.9926	0.9778	0.9259	0.7954	0.5719	0.3848	0.4205	0.6821	0.9408	0.9933	0.9986	(94)
Useful gains	790.5655	952.1115	1041.0300	1063.3913	937.8812	655.3828	425.9361	448.4002	702.4397	866.8595	798.7526	747.4605	(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	1814.2534	1762.4179	1594.9850	1323.0486	1007.5932	661.5450	426.2760	449.0220	721.9568	1117.8826	1490.0270	1803.1755	(97)
Space heating kWh	761.6238	544.5259	412.1425	186.9533	51.8657	0.0000	0.0000	0.0000	0.0000	186.7611	497.7176	785.4520	(98a)
Space heating requirement - total per year (kWh/year)												3427.0418	
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	761.6238	544.5259	412.1425	186.9533	51.8657	0.0000	0.0000	0.0000	0.0000	186.7611	497.7176	785.4520	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3427.0418	
Space heating per m <sup>2</sup>										(98c) / (4) =		39.6281	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Fraction of space heat from main system(s)													0.0000	(201)
Efficiency of main space heating system 1 (in %)													1.0000	(202)
Efficiency of main space heating system 2 (in %)													92.3000	(206)
Efficiency of secondary/supplementary heating system, %													0.0000	(207)
													0.0000	(208)
Space heating requirement	761.6238	544.5259	412.1425	186.9533	51.8657	0.0000	0.0000	0.0000	0.0000	186.7611	497.7176	785.4520	(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)	825.1612	589.9522	446.5250	202.5496	56.1925	0.0000	0.0000	0.0000	0.0000	202.3414	539.2390	850.9772	(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	237.8545	210.3419	223.6915	197.5082	191.9585	173.5373	171.8034	178.3898	180.0593	200.0739	211.8285	235.3924	(64)	

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Efficiency of water heater (217)m	86.4789	86.0944	85.4111	83.9368	81.5583	79.8000	79.8000	79.8000	79.8000	83.9056	85.9075	79.8000 (216)
Fuel for water heating, kWh/month (233a)m	275.0432	244.3155	261.8998	235.3059	235.3634	217.4652	215.2925	223.5461	225.6382	238.4511	246.5774	271.9752 (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 (235a)m	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 (234a)m	24.3567	19.5398	17.5935	12.8897	9.9564	8.1345	9.0826	11.8058	15.3346	20.1199	22.7253	25.0336 (232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-58.7891	-78.4457	-106.8074	-113.5662	-117.2484	-107.6229	-106.2365	-102.7177	-95.9221	-86.4220	-63.0093	-51.3599 (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	-48.1998	-99.1907	-193.2466	-284.8137	-371.5421	-371.5214	-367.1758	-313.1807	-232.6433	-139.9983	-63.7202	-38.2882 (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												3712.9380 (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												2890.8736 (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)												196.5724 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-3611.6678 (233)
Wind generation												0.0000 (234)
Hydro-electric generation (Appendix N)												0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)												0.0000 (235)
Appendix Q - special features												
Energy saved or generated												-0.0000 (236)
Energy used												0.0000 (237)
Total delivered energy for all uses												3274.7162 (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	3712.9380	0.2100	779.7170 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2890.8736	0.2100	607.0835 (264)
Space and water heating			1386.8004 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	196.5724	0.1443	28.3715 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1088.1472	0.1358	-147.7456
PV Unit electricity exported	-2523.5207	0.1265	-319.1262
Total			-466.8718 (269)
Total CO2, kg/year			960.2294 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			11.1000 (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	3712.9380	1.1300	4195.6200 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2890.8736	1.1300	3266.6872 (278)
Space and water heating			7462.3071 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	196.5724	1.5338	301.5093 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1088.1472	1.5019	-1634.2605
PV Unit electricity exported	-2523.5207	0.4642	-1171.4761
Total			-2805.7366 (283)
Total Primary energy kWh/year			5088.1807 (286)
Target Primary Energy Rate (TPER)			58.8400 (287)

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

### 1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	73.0700 (1b)	x 2.8500 (2b)	= 208.2495 (1b) - (3b)
First floor	13.4100 (1c)	x 1.8500 (2c)	= 24.8085 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	86.4800		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 233.0580 (5)





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Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Total heat required for water heating calculated for each month													
WWHRS	94.3615	82.5149	86.3189	73.8426	69.9478	61.3587	59.8332	63.4628	65.4531	74.8986	81.8270	93.1583	(62)
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	(63a)
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	(63b)
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	(63c)
Output from w/h													
	94.3615	82.5149	86.3189	73.8426	69.9478	61.3587	59.8332	63.4628	65.4531	74.8986	81.8270	93.1583	(64)
12Total per year (kWh/year)													
Electric shower(s)													
	53.9635	48.0819	52.5036	50.1035	51.0437	48.6907	50.3138	51.0437	50.1035	52.5036	51.5163	53.9635	(64a)
Heat gains from water heating, kWh/month													
	37.0813	32.6492	34.7056	30.9865	30.2479	27.5124	27.5367	28.6266	28.8892	31.8505	33.3358	36.7804	(65)

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

Metabolic gains (Table 5), Watts													
(66)m	128.7205	128.7205	128.7205	128.7205	128.7205	128.7205	128.7205	128.7205	128.7205	128.7205	128.7205	128.7205	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	117.2233	129.7829	117.2233	121.1307	117.2233	121.1307	117.2233	117.2233	121.1307	117.2233	121.1307	117.2233	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	232.4508	234.8629	228.7845	215.8442	199.5094	184.1570	173.9006	171.4885	177.5670	190.5073	206.8421	222.1945	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.8721	35.8721	35.8721	35.8721	35.8721	35.8721	35.8721	35.8721	35.8721	35.8721	35.8721	35.8721	(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)													
	-102.9764	-102.9764	-102.9764	-102.9764	-102.9764	-102.9764	-102.9764	-102.9764	-102.9764	-102.9764	-102.9764	-102.9764	(71)
Water heating gains (Table 5)													
	49.8404	48.5851	46.6473	43.0369	40.6557	38.2116	37.0117	38.4766	40.1238	42.8099	46.2998	49.4361	(72)
Total internal gains	461.1306	474.8471	454.2712	441.6279	419.0046	405.1155	389.7518	388.8046	400.4377	412.1566	435.8887	450.4700	(73)

## 6. Solar gains

[Jan]													
		Area	Solar flux	g	FF	Access	Gains						
		m2	Table 6a	Specific data	Specific data	factor	W						
			W/m2	or Table 6b	or Table 6c	Table 6d							
North		1.1000	10.6334	0.6300	0.7000	0.7700	3.5747						(74)
South		4.8100	46.7521	0.6300	0.7000	0.7700	68.7255						(78)
West		2.9100	19.6403	0.6300	0.7000	0.7700	17.4668						(80)
East		2.0800	19.6403	0.6300	0.7000	0.7700	12.4848						(76)
South		1.9300	46.7521	0.6300	0.7000	0.7700	27.5759						(78)
South		6.7200	46.7521	0.6300	0.7000	0.7700	96.0156						(78)
Solar gains	225.8433	380.3887	509.3107	612.8286	670.1129	658.1840	637.5007	595.7876	545.2927	417.3758	269.7171	193.7903	(83)
Total gains	686.9739	855.2358	963.5819	1054.4565	1089.1175	1063.2995	1027.2525	984.5922	945.7304	829.5324	705.6059	644.2603	(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	97.7330	97.8480	97.9610	98.4952	98.5959	99.0669	99.0669	99.1546	98.8849	98.5959	98.3925	98.1809		
alpha	7.5155	7.5232	7.5307	7.5663	7.5731	7.6045	7.6045	7.6103	7.5923	7.5731	7.5595	7.5454		
util living area	0.9996	0.9975	0.9898	0.9530	0.8403	0.6335	0.4559	0.4963	0.7498	0.9702	0.9982	0.9997		(86)
MIT	20.1435	20.3222	20.5330	20.7758	20.9380	20.9934	20.9995	20.9991	20.9787	20.7629	20.3960	20.1084		(87)
Th 2	19.8807	19.8819	19.8830	19.8884	19.8894	19.8941	19.8941	19.8949	19.8923	19.8894	19.8874	19.8853		(88)
util rest of house	0.9993	0.9961	0.9836	0.9260	0.7692	0.5287	0.3417	0.3779	0.6448	0.9468	0.9968	0.9996		(89)
MIT 2	19.1168	19.2956	19.5037	19.7338	19.8593	19.8924	19.8940	19.8948	19.8856	19.7287	19.3742	19.0855		(90)
Living area fraction														
MIT	19.4759	19.6547	19.8638	20.0982	20.2366	20.2776	20.2807	20.2811	20.2679	20.0905	19.7317	19.4433		(92)
Temperature adjustment														
adjusted MIT	19.4759	19.6547	19.8638	20.0982	20.2366	20.2776	20.2807	20.2811	20.2679	20.0905	19.7317	19.4433		(93)

## 8. Space heating requirement

Utilisation	0.9992	0.9957	0.9834	0.9320	0.7933	0.5657	0.3818	0.4194	0.6822	0.9521	0.9965	0.9995		(94)
Useful gains	686.3958	851.5289	947.6199	982.7973	864.0469	601.5398	392.1567	412.9844	645.2127	789.8324	703.1662	643.9201		(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	1639.6388	1592.2570	1440.4864	1200.5175	914.2396	605.1550	392.3173	413.3088	658.6348	1016.3972	1355.6011	1639.4029		(97)
Space heating kWh	709.2128	497.7693	366.6926	156.7586	37.3433	0.0000	0.0000	0.0000	0.0000	168.5642	469.7531	740.6392		(98a)
Space heating requirement - total per year (kWh/year)														3146.7332
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	709.2128	497.7693	366.6926	156.7586	37.3433	0.0000	0.0000	0.0000	0.0000	168.5642	469.7531	740.6392		(98c)
Space heating requirement after solar contribution - total per year (kWh/year)														3146.7332
Space heating per m2														(98c) / (4) = 36.3868 (99)

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## 8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	1001.9206	788.7460	809.3468	0.0000	0.0000	0.0000	0.0000 (100)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.9463	0.9821	0.9738	0.0000	0.0000	0.0000	0.0000 (101)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	948.0858	774.6158	788.1125	0.0000	0.0000	0.0000	0.0000 (102)
Space cooling kWh												
Cooled fraction	0.0000	0.0000	0.0000	0.0000	0.0000	179.3222	284.7076	239.2755	0.0000	0.0000	0.0000	0.0000 (104)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500 (105)
Space cooling kWh												
Space cooling requirement	0.0000	0.0000	0.0000	0.0000	0.0000	44.8306	71.1769	59.8189	0.0000	0.0000	0.0000	0.0000 (107)
Energy for space heating												175.8263 (107)
Energy for space cooling												36.3868 (99)
Total												2.0331 (108)
Fabric Energy Efficiency (DFEE)												38.4200 (109)
												38.4 (109)

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

### 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	73.0700 (1b)	x 2.8500 (2b)	= 208.2495 (1b) - (3b)
First floor	13.4100 (1c)	x 1.8500 (2c)	= 24.8085 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	86.4800		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	233.0580 (5)

### 2. Ventilation rate

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

Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1287 (8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000 (17)	
Infiltration rate		0.3787 (18)	
Number of sides sheltered		0 (19)	
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3787 (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	0.4829	0.4734	0.4639	0.4166	0.4071	0.3598	0.3598	0.3503	0.3787	0.4071	0.4261	0.4450 (22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.0000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												0.0000 (23c)
Effective ac	0.6166	0.6121	0.6076	0.5868	0.5829	0.5647	0.5647	0.5614	0.5717	0.5829	0.5908	0.5990 (25)

### 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
TER Opaque door			1.9500	1.0000	1.9500		(26)
TER Opening Type (Uw = 1.20)			19.5500	1.1450	22.3855		(27)
Ground floor			73.0700	0.1300	9.4991		(28a)
Rendered external wall	70.1400	7.3500	62.7900	0.1800	11.3022		(29a)
Timber clad external wall	52.2000	14.1500	38.0500	0.1800	6.8490		(29a)
Sloped roof	81.3000		81.3000	0.1100	8.9430		(30)
Total net area of external elements Aum (A, m <sup>2</sup> )			276.7100				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	60.9288		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							439.5627 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)				14.0200	0.0500	0.7010	
E3 Sill				7.9700	0.0500	0.3985	
E4 Jamb				35.0000	0.0500	1.7500	



# Full SAP Calculation Printout



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	86.5801	86.8280	87.0723	88.2387	88.4604	89.5073	89.5073	89.7039	89.1011	88.4604	88.0131	87.5502
alpha	6.7720	6.7885	6.8048	6.8826	6.8974	6.9672	6.9672	6.9803	6.9401	6.8974	6.8675	6.8367
util living area	0.9996	0.9980	0.9924	0.9666	0.8816	0.6898	0.5031	0.5461	0.8024	0.9785	0.9984	0.9997 (86)
MIT	19.9838	20.1683	20.3957	20.6764	20.8867	20.9837	20.9983	20.9971	20.9555	20.6755	20.2732	19.9579 (87)
Th 2	19.7555	19.7586	19.7616	19.7758	19.7785	19.7909	19.7909	19.7932	19.7861	19.7785	19.7731	19.7674 (88)
util rest of house	0.9993	0.9967	0.9875	0.9449	0.8144	0.5706	0.3662	0.4052	0.6916	0.9599	0.9972	0.9996 (89)
MIT 2	18.8534	19.0398	19.2668	19.5455	19.7201	19.7867	19.7908	19.7929	19.7712	19.5524	19.1567	18.8373 (90)
Living area fraction									fLA = Living area / (4) =			
MIT	19.2488	19.4345	19.6617	19.9411	20.1282	20.2054	20.2132	20.2141	20.1854	19.9453	19.5473	19.2293 (92)
Temperature adjustment												0.0000
adjusted MIT	19.2488	19.4345	19.6617	19.9411	20.1282	20.2054	20.2132	20.2141	20.1854	19.9453	19.5473	19.2293 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9992	0.9963	0.9870	0.9486	0.8362	0.6131	0.4144	0.4550	0.7313	0.9632	0.9969	0.9995 (94)
Useful gains	686.3968	852.0293	951.0220	1000.2047	910.6937	651.9228	425.7041	447.9531	691.6506	799.0237	703.4386	643.9079 (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	1823.1523	1767.5623	1596.1209	1321.2529	1006.0487	661.2728	426.2483	448.9720	721.1781	1115.5180	1493.3474	1812.6557 (97)
Space heating kWh	845.7461	615.2382	479.9536	231.1547	70.9441	0.0000	0.0000	0.0000	0.0000	235.4718	568.7343	869.5484 (98a)
Space heating requirement - total per year (kWh/year)												3916.7912
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	845.7461	615.2382	479.9536	231.1547	70.9441	0.0000	0.0000	0.0000	0.0000	235.4718	568.7343	869.5484 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3916.7912
Space heating per m2												(98c) / (4) = 45.2913 (99)

## 8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	1108.9282	872.9860	894.6153	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9053	0.9615	0.9475	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1003.9275	839.3424	847.6669	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1197.1445	1157.2873	1109.7194	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	139.1162	236.5509	194.9671	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction									fc = cooled area / (4) =			
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500 (105)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	34.7790	59.1377	48.7418	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement												142.6585 (107)
Energy for space heating												45.2913 (99)
Energy for space cooling												1.6496 (108)
Total												46.9409 (109)
Fabric Energy Efficiency (TFEE)												46.9 (109)

## SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)

### CALCULATION OF ENERGY RATING

#### 1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	73.0700 (1b)	x	2.8500 (2b)
First floor	13.4100 (1c)	x	1.8500 (2c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	86.4800		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	233.0580 (5)

#### 2. Ventilation rate

	m3 per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	0 * 10 = 0.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
	Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) = 0.0000 (8)

# Full SAP Calculation Printout



Pressure test													Yes
Pressure Test Method													Blower Door
Measured/design AP50													2.0000 (17)
Infiltration rate													0.1000 (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) = 0.1000 (21)

Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	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	0.1275	0.1250	0.1225	0.1100	0.1075	0.0950	0.0950	0.0925	0.1000	0.1075	0.1125	0.1175	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation 0.5000 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) 0.5000 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 81.0000 (23c)

Effective ac	0.2225	0.2200	0.2175	0.2050	0.2025	0.1900	0.1900	0.1875	0.1950	0.2025	0.2075	0.2125	(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
Window (Uw = 1.20)			8.8200	1.1450	10.0992		(27)
Glazed door (Uw = 1.20)			4.0100	1.1450	4.5916		(27)
Sliding door (Uw = 1.20)			6.7200	1.1450	7.6947		(27)
Solid door			1.9500	1.4000	2.7300		(26)
Ground floor			73.0700	0.1100	8.0377	110.0000	8037.7000 (28a)
Rendered external wall	70.1400	7.3500	62.7900	0.1600	10.0464	190.0000	11930.1000 (29a)
Timber clad external wall	52.2000	14.1500	38.0500	0.1600	6.0880	190.0000	7229.5000 (29a)
Sloped roof	81.3000		81.3000	0.1300	10.5690	9.0000	731.7000 (30)
Total net area of external elements Aum(A, m2)			276.7100				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 59.8566		(33)
Internal block wall			131.2400			75.0000	9843.0000 (32c)
First floor			13.4100			18.0000	241.3800 (32d)
Ground floor ceiling			13.4100			0.0000	0.0000 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 38013.3800 (34)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 439.5627 (35)

#### List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	14.0200	0.0050	0.0701
E3 Sill	7.9700	0.0150	0.1195
E4 Jamb	35.0000	0.0260	0.9100
E5 Ground floor (normal)	46.1800	0.0720	3.3250
E6 Intermediate floor within a dwelling	15.5200	0.0390	0.6053
E11 Eaves (insulation at rafter level)	32.1100	0.0200	0.6422
E13 Gable (insulation at rafter level)	15.6500	0.0410	0.6417
E16 Corner (normal)	16.4300	0.0320	0.5258
E17 Corner (inverted - internal area greater than external area)	7.1500	-0.0530	-0.3790

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 6.4605 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 66.3171 (37)

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

(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	17.1123	16.9200	16.7277	15.7664	15.5741	14.6127	14.6127	14.4205	14.9973	15.5741	15.9586	16.3432	(38)
Heat transfer coeff	83.4294	83.2372	83.0449	82.0835	81.8912	80.9299	80.9299	80.7376	81.3144	81.8912	82.2758	82.6603	(39)
Average = Sum(39)m / 12 =													82.0355

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.9647	0.9625	0.9603	0.9492	0.9469	0.9358	0.9358	0.9336	0.9403	0.9469	0.9514	0.9558	(40)
HLP (average)													0.9486
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

### 4. Water heating energy requirements (kWh/year)

Assumed occupancy													2.5744 (42)
Hot water usage for mixer showers													
	101.0762	99.5572	97.3438	93.1087	89.9834	86.4980	84.5170	86.7136	89.1216	92.8639	97.1899	100.6890	(42a)
Hot water usage for baths													
	29.1006	28.6684	28.0598	26.9377	26.0974	25.1657	24.6624	25.2668	25.9248	26.9218	28.0670	29.0022	(42b)
Hot water usage for other uses													
	40.9945	39.5038	38.0131	36.5224	35.0317	33.5410	33.5410	35.0317	36.5224	38.0131	39.5038	40.9945	(42c)
Average daily hot water use (litres/day)													157.4375 (43)

Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	171.1714	167.7295	163.4167	156.5688	151.1125	145.2047	142.7204	147.0121	151.5688	157.7987	164.7607	170.6857	(44)
Energy conte	271.0936	238.8446	251.1654	214.3349	203.4265	178.5461	172.6079	182.0317	186.8995	214.1314	234.7319	267.2526	(45)
Energy content (annual)													Total = Sum(45)m = 2615.0660

Distribution loss (46)m = 0.15 x (45)m 40.6640 35.8267 37.6748 32.1502 30.5140 26.7819 25.8912 27.3048 28.0349 32.1197 35.2098 40.0879 (46)

Water storage loss: Store volume 200.0000 (47)

a) If manufacturer declared loss factor is known (kWh/day): Temperature factor from Table 2b 2.1000 (48)

Enter (49) or (54) in (55) 0.5400 (49)

Total storage loss 1.1340 (55)

35.1540 31.7520 35.1540 34.0200 35.1540 34.0200 35.1540 35.1540 34.0200 35.1540 34.0200 35.1540 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 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 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 0.0000 (61)

Total heat required for water heating calculated for each month 329.5100 291.6078 309.5818 270.8669 261.8429 235.0781 231.0243 240.4481 243.4315 272.5478 291.2639 325.6690 (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 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 -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 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 0.0000 (63d)

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Output from w/h	329.5100	291.6078	309.5818	270.8669	261.8429	235.0781	231.0243	240.4481	243.4315	272.5478	291.2639	325.6690 (64)
	Total per year (kWh/year) = Sum(64)m = 3302.8720 (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	136.8717	121.6264	130.2456	116.4919	114.3724	104.5922	104.1252	107.2587	107.3697	117.9318	123.2739	135.5946 (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	154.4646	154.4646	154.4646	154.4646	154.4646	154.4646	154.4646	154.4646	154.4646	154.4646	154.4646	154.4646 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	31.0328	27.5630	22.4158	16.9702	12.6854	10.7096	11.5721	15.0418	20.1891	25.6347	29.9194	31.8953 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	346.9415	350.5417	341.4694	322.1555	297.7752	274.8612	259.5532	255.9530	265.0253	284.3392	308.7195	331.6335 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.0209	53.0209	53.0209	53.0209	53.0209	53.0209	53.0209	53.0209	53.0209	53.0209	53.0209	53.0209 (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)	-102.9764	-102.9764	-102.9764	-102.9764	-102.9764	-102.9764	-102.9764	-102.9764	-102.9764	-102.9764	-102.9764	-102.9764 (71)
Water heating gains (Table 5)	183.9674	180.9916	175.0613	161.7944	153.7264	145.2669	139.9533	144.1649	149.1246	158.5105	171.2138	182.2508 (72)
Total internal gains	666.4508	663.6054	643.4555	605.4291	568.6961	535.3468	515.5876	519.6688	538.8481	572.9934	614.3618	650.2887 (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	1.1000	10.6334	0.6300	0.7000	0.7700	3.5747 (74)						
South	4.8100	46.7521	0.6300	0.7000	0.7700	68.7255 (78)						
West	2.9100	19.6403	0.6300	0.7000	0.7700	17.4668 (80)						
East	2.0800	19.6403	0.6300	0.7000	0.7700	12.4848 (76)						
South	1.9300	46.7521	0.6300	0.7000	0.7700	27.5759 (78)						
South	6.7200	46.7521	0.6300	0.7000	0.7700	96.0156 (78)						
Solar gains	225.8433	380.3887	509.3107	612.8286	670.1129	658.1840	637.5007	595.7876	545.2927	417.3758	269.7171	193.7903 (83)
Total gains	892.2940	1043.9941	1152.7662	1218.2577	1238.8090	1193.5308	1153.0883	1115.4564	1084.1408	990.3693	884.0790	844.0790 (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	126.5653	126.8577	127.1514	128.6406	128.9426	130.4743	130.4743	130.7850	129.8573	128.9426	128.3400	127.7429
alpha	9.4377	9.4572	9.4768	9.5760	9.5962	9.6983	9.6983	9.7190	9.6572	9.5962	9.5560	9.5162
util living area	0.9946	0.9775	0.9230	0.7912	0.6125	0.4339	0.3088	0.3329	0.5171	0.8245	0.9792	0.9965 (86)
Living	20.6666	20.7772	20.8839	20.9500	20.9659	20.9678	20.9679	20.9679	20.9674	20.9466	20.8021	20.6418
Non living	19.7396	19.8769	19.9994	20.0717	20.0852	20.0959	20.0959	20.0979	20.0919	20.0722	19.9175	19.7149
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	20.8295	20.7772	20.8839	20.9500	20.9659	20.9678	20.9679	20.9679	20.9674	20.9466	20.8021	20.6919 (87)
Th 2	20.1128	20.1147	20.1166	20.1259	20.1278	20.1372	20.1372	20.1390	20.1334	20.1278	20.1240	20.1203 (88)
util rest of house	0.9918	0.9674	0.8956	0.7430	0.5562	0.3754	0.2483	0.2706	0.4524	0.7694	0.9679	0.9947 (89)
MIT 2	19.9640	19.8769	19.9994	20.0717	20.0852	20.0959	20.0959	20.0979	20.0919	20.0722	19.9175	19.7880 (90)
Living area fraction	fLA = Living area / (4) =											
MIT	20.2667	20.1919	20.3088	20.3789	20.3933	20.4009	20.4009	20.4022	20.3981	20.3780	20.2269	20.1042 (92)
Temperature adjustment												0.0000
adjusted MIT	20.2667	20.1919	20.3088	20.3789	20.3933	20.4009	20.4009	20.4022	20.3981	20.3780	20.2269	20.1042 (93)

## 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	885.4786	1011.0461	1039.9861	922.7065	710.4120	469.4312	307.6065	323.1275	511.9370	778.4483	857.1452	839.5794 (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	1332.0964	1272.8508	1146.7476	942.2287	711.9038	469.4646	307.6072	323.1288	512.1304	800.7359	1080.0277	1314.6440 (97)
Space heating kWh	332.2836	175.9327	79.4306	14.0560	1.1099	0.0000	0.0000	0.0000	0.0000	16.5820	160.4754	353.4480 (98a)
Space heating requirement - total per year (kWh/year)												1133.3182
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	332.2836	175.9327	79.4306	14.0560	1.1099	0.0000	0.0000	0.0000	0.0000	16.5820	160.4754	353.4480 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1133.3182
Space heating per m2												(98c) / (4) = 13.1050 (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 %)	379.6158 (206)
Efficiency of main space heating system 2 (in %)	0.0000 (207)

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement	332.2836	175.9327	79.4306	14.0560	1.1099	0.0000	0.0000	0.0000	0.0000	16.5820	160.4754	353.4480	(98)
Space heating efficiency (main heating system 1)	379.6158	379.6158	379.6158	379.6158	379.6158	0.0000	0.0000	0.0000	0.0000	379.6158	379.6158	379.6158	(210)
Space heating fuel (main heating system)	87.5316	46.3450	20.9239	3.7027	0.2924	0.0000	0.0000	0.0000	0.0000	4.3681	42.2731	93.1068	(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 requirement	329.5100	291.6078	309.5818	270.8669	261.8429	235.0781	231.0243	240.4481	243.4315	272.5478	291.2639	325.6690	(64)
Efficiency of water heater (217)m	193.6116	193.6116	193.6116	193.6116	193.6116	193.6116	193.6116	193.6116	193.6116	193.6116	193.6116	193.6116	(216)
Fuel for water heating, kWh/month	170.1912	150.6148	159.8984	139.9022	135.2413	121.4174	119.3236	124.1910	125.7319	140.7704	150.4372	168.2074	(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	17.5802	15.8789	17.5802	17.0131	17.5802	17.0131	17.5802	17.5802	17.0131	17.5802	17.0131	17.5802	(231)
Lighting	27.1628	21.7910	19.6204	14.3747	11.1035	9.0716	10.1290	13.1660	17.1013	22.4379	25.3435	27.9177	(232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-132.5948	-197.4590	-288.5085	-316.5229	-331.3500	-304.6044	-300.6486	-292.8042	-267.6269	-225.8317	-149.3014	-112.9890	(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													298.5435 (211)
Space heating fuel - main system 2													0.0000 (213)
Space heating fuel - secondary													0.0000 (215)
Efficiency of water heater													193.6116 (216)
Water heating fuel used													1705.9266 (219)
Space cooling fuel													0.0000 (221)
Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.7280)													
mechanical ventilation fans (SFP = 0.7280)													206.9928 (230a)
Total electricity for the above, kWh/year													206.9928 (231)
Electricity for lighting (calculated in Appendix L)													219.2194 (232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation													-2920.2414 (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													-489.5591 (238)

## 10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	298.5435	16.4900	49.2298	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1705.9266	16.4900	281.3073	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	206.9928	16.4900	34.1331	(249)
Energy for lighting	219.2194	16.4900	36.1493	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-2920.2414	16.4900	-481.5478	
PV Unit electricity exported	0.0000	5.5900	0.0000	
Total			-481.5478	(252)
Total energy cost			-80.7283	(255)

## 11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600	(256)
Energy cost factor (ECF)		[(255) x (256)] / [(4) + 45.0] =	-0.2210 (257)
SAP value		103.5830	
SAP rating (Section 12)		104	(258)
SAP band		A	

## 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	298.5435	0.1595	47.6060	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1705.9266	0.1410	240.5041	(264)
Space and water heating			288.1101	(265)
Pumps, fans and electric keep-hot	206.9928	0.1387	28.7125	(267)

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Energy for lighting	219.2194	0.1443	31.6401 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-2920.2414	0.1347	-393.3931
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-393.3931 (269)
Total CO2, kg/year			-44.9304 (272)
CO2 emissions per m2			-0.5200 (273)
EI value			100.4579
EI rating			100 (274)
EI band			A

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)  
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY

## 1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	73.0700 (1b)	x 2.8500 (2b)	= 208.2495 (1b) - (3b)
First floor	13.4100 (1c)	x 1.8500 (2c)	= 24.8085 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	86.4800		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 233.0580 (5)

## 2. Ventilation rate

	m3 per hour												
Number of open chimneys	0 * 80 =											0.0000 (6a)	
Number of open flues	0 * 20 =											0.0000 (6b)	
Number of chimneys / flues attached to closed fire	0 * 10 =											0.0000 (6c)	
Number of flues attached to solid fuel boiler	0 * 20 =											0.0000 (6d)	
Number of flues attached to other heater	0 * 35 =											0.0000 (6e)	
Number of blocked chimneys	0 * 20 =											0.0000 (6f)	
Number of intermittent extract fans	0 * 10 =											0.0000 (7a)	
Number of passive vents	0 * 10 =											0.0000 (7b)	
Number of flueless gas fires	0 * 40 =											0.0000 (7c)	
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =											0.0000 / (5) =	0.0000 (8)
Pressure test												Yes	
Pressure Test Method												Blower Door	
Measured/design AP50												2.0000 (17)	
Infiltration rate												0.1000 (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) =											0.1000 (21)	
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind factor	7.0000	6.5000	6.4000	5.8000	5.7000	5.0000	4.9000	4.8000	5.5000	6.2000	6.3000	6.9000	(22)
Adj infilt rate	1.7500	1.6250	1.6000	1.4500	1.4250	1.2500	1.2250	1.2000	1.3750	1.5500	1.5750	1.7250	(22a)
Balanced mechanical ventilation with heat recovery	0.1750	0.1625	0.1600	0.1450	0.1425	0.1250	0.1225	0.1200	0.1375	0.1550	0.1575	0.1725	(22b)
If mechanical ventilation												0.5000 (23a)	
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.5000 (23b)	
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												81.0000 (23c)	
Effective ac	0.2700	0.2575	0.2550	0.2400	0.2375	0.2200	0.2175	0.2150	0.2325	0.2500	0.2525	0.2675	(25)

## 3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
Window (Uw = 1.20)			8.8200	1.1450	10.0992		(27)
Glazed door (Uw = 1.20)			4.0100	1.1450	4.5916		(27)
Sliding door (Uw = 1.20)			6.7200	1.1450	7.6947		(27)
Solid door			1.9500	1.4000	2.7300		(26)
Ground floor			73.0700	0.1100	8.0377	110.0000	8037.7000 (28a)
Rendered external wall	70.1400	7.3500	62.7900	0.1600	10.0464	190.0000	11930.1000 (29a)
Timber clad external wall	52.2000	14.1500	38.0500	0.1600	6.0880	190.0000	7229.5000 (29a)
Sloped roof	81.3000		81.3000	0.1300	10.5690	9.0000	731.7000 (30)
Total net area of external elements Aum(A, m2)			276.7100				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	59.8566		(33)
Internal block wall			131.2400			75.0000	9843.0000 (32c)
First floor			13.4100			18.0000	241.3800 (32d)
Ground floor ceiling			13.4100			0.0000	0.0000 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	38013.3800 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							439.5627 (35)
List of Thermal Bridges				Length	Psi-value	Total	
K1 Element				14.0200	0.0050	0.0701	
E2 Other lintels (including other steel lintels)				7.9700	0.0150	0.1195	
E3 Sill				35.0000	0.0260	0.9100	
E4 Jamb				46.1800	0.0720	3.3250	
E5 Ground floor (normal)				15.5200	0.0390	0.6053	
E6 Intermediate floor within a dwelling				32.1100	0.0200	0.6422	
E11 Eaves (insulation at rafter level)				15.6500	0.0410	0.6417	
E13 Gable (insulation at rafter level)				16.4300	0.0320	0.5258	
E16 Corner (normal)							



# Full SAP Calculation Printout



E17 Corner (inverted - internal area greater than external area)													7.1500	-0.0530	-0.3790	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)																6.4605 (36)
Point Thermal bridges																(36a) = 0.0000
Total fabric heat loss																(33) + (36) + (36a) = 66.3171 (37)
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)																
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec				
Heat transfer coeff	20.7655	19.8041	19.6118	18.4582	18.2659	16.9200	16.7277	16.5355	17.8814	19.2273	19.4196	20.5732	(38)			
Average = Sum(39)m / 12 =	87.0826	86.1212	85.9290	84.7753	84.5831	83.2372	83.0449	82.8526	84.1985	85.5444	85.7367	86.8903	(39)			
													84.9997			
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec				
HLP (average)	1.0070	0.9959	0.9936	0.9803	0.9781	0.9625	0.9603	0.9581	0.9736	0.9892	0.9914	1.0047	(40)			
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	0.9829			
													31			

## 4. Water heating energy requirements (kWh/year)

Assumed occupancy													2.5744 (42)
Hot water usage for mixer showers													100.6890 (42a)
Hot water usage for baths													29.0022 (42b)
Hot water usage for other uses													40.9945 (42c)
Average daily hot water use (litres/day)													157.4375 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy conte	171.1714	167.7295	163.4167	156.5688	151.1125	145.2047	142.7204	147.0121	151.5688	157.7987	164.7607	170.6857	(44)
Energy content (annual)	271.0936	238.8446	251.1654	214.3349	203.4265	178.5461	172.6079	182.0317	186.8995	214.1314	234.7319	267.2526	(45)
Distribution loss (46)m = 0.15 x (45)m													Total = Sum(45)m = 2615.0660
Water storage loss:	40.6640	35.8267	37.6748	32.1502	30.5140	26.7819	25.8912	27.3048	28.0349	32.1197	35.2098	40.0879	(46)
Store volume													200.0000 (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													
Primary 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	(57)
Combi 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)
Total heat required for water heating calculated for each month	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)
WWHRS	329.5100	291.6078	309.5818	270.8669	261.8429	235.0781	231.0243	240.4481	243.4315	272.5478	291.2639	325.6690	(62)
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	(63a)
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	(63b)
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	(63c)
Output from w/h	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)
Electric shower(s)	329.5100	291.6078	309.5818	270.8669	261.8429	235.0781	231.0243	240.4481	243.4315	272.5478	291.2639	325.6690	(64)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64)m =													3302.8720 (64)
Heat gains from water heating, kWh/month	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)
	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	136.8717	121.6264	130.2456	116.4919	114.3724	104.5922	104.1252	107.2587	107.3697	117.9318	123.2739	135.5946	(65)

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

Metabolic gains (Table 5), Watts													
(66)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	154.4646	154.4646	154.4646	154.4646	154.4646	154.4646	154.4646	154.4646	154.4646	154.4646	154.4646	154.4646	(66)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	31.0328	27.5630	22.4158	16.9702	12.6854	10.7096	11.5721	15.0418	20.1891	25.6347	29.9194	31.8953	(67)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	346.9415	350.5417	341.4694	322.1555	297.7752	274.8612	259.5532	255.9530	265.0253	284.3392	308.7195	331.6335	(68)
Pumps, fans	53.0209	53.0209	53.0209	53.0209	53.0209	53.0209	53.0209	53.0209	53.0209	53.0209	53.0209	53.0209	(69)
Losses e.g. evaporation (negative values) (Table 5)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Water heating gains (Table 5)	-102.9764	-102.9764	-102.9764	-102.9764	-102.9764	-102.9764	-102.9764	-102.9764	-102.9764	-102.9764	-102.9764	-102.9764	(71)
Total internal gains	183.9674	180.9916	175.0613	161.7944	153.7264	145.2669	139.9533	144.1649	149.1246	158.5105	171.2138	182.2508	(72)
	666.4508	663.6054	643.4555	605.4291	568.6961	535.3468	515.5876	519.6688	538.8481	572.9934	614.3618	650.2887	(73)

## 6. Solar gains

[Jan]		Area	Solar flux	g	FF	Access	Gains
		m2	Table 6a	Specific data	Specific data	factor	W
			W/m2	or Table 6b	or Table 6c	Table 6d	
North		1.1000	14.1336	0.6300	0.7000	0.7700	4.7513 (74)
South		4.8100	58.4943	0.6300	0.7000	0.7700	85.9865 (78)
West		2.9100	26.4917	0.6300	0.7000	0.7700	23.5600 (80)
East		2.0800	26.4917	0.6300	0.7000	0.7700	16.8401 (76)
South		1.9300	58.4943	0.6300	0.7000	0.7700	34.5018 (78)
South		6.7200	58.4943	0.6300	0.7000	0.7700	120.1308 (78)
Solar gains	285.7705	418.6410	552.2981	681.5871	709.0100	766.0014	675.5466
Total gains	952.2213	1082.2465	1195.7537	1287.0163	1277.7061	1301.3481	1191.1342
							673.5880
							623.9921
							474.9798
							336.0406
							244.6823 (83)
							894.9710 (84)

## 7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	121.2558	122.6094	122.8837	124.5559	124.8391	126.8577	127.1514	127.4465	125.4092	123.4361	123.1593	121.5241
alpha	9.0837	9.1740	9.1922	9.3037	9.3226	9.4572	9.4768	9.4964	9.3606	9.2291	9.2106	9.1016
util living area	0.9789	0.9473	0.8803	0.7593	0.6194	0.4348	0.3556	0.3402	0.4776	0.7299	0.9246	0.9831 (86)
Living	20.7755	20.8491	20.9127	20.9528	20.9644	20.9670	20.9671	20.9672	20.9665	20.9582	20.8925	20.7668
Non living	19.8424	19.9344	20.0012	20.0474	20.0576	20.0724	20.0744	20.0763	20.0626	20.0447	19.9865	19.8343
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	20.8852	20.8491	20.9127	20.9528	20.9644	20.9670	20.9671	20.9672	20.9665	20.9582	20.8925	20.7994 (87)
Th 2	20.0775	20.0868	20.0886	20.0998	20.1017	20.1147	20.1166	20.1184	20.1054	20.0924	20.0905	20.0794 (88)
util rest of house	0.9679	0.9249	0.8419	0.7084	0.5616	0.3783	0.2940	0.2790	0.4131	0.6632	0.8895	0.9735 (89)
MIT 2	19.9838	19.9344	20.0012	20.0474	20.0576	20.0724	20.0744	20.0763	20.0626	20.0447	19.9865	19.8785 (90)
Living area fraction									FLA = Living area / (4) =			0.3498 (91)
MIT	20.2991	20.2543	20.3201	20.3641	20.3748	20.3853	20.3866	20.3879	20.3788	20.3642	20.3034	20.2006 (92)
Temperature adjustment												0.0000
adjusted MIT	20.2991	20.2543	20.3201	20.3641	20.3748	20.3853	20.3866	20.3879	20.3788	20.3642	20.3034	20.2006 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9710	0.9295	0.8524	0.7237	0.5793	0.3956	0.3128	0.2977	0.4328	0.6837	0.8987	0.9750 (94)
Useful gains	924.5707	1005.9966	1019.2303	931.4636	740.2275	514.7986	372.5877	355.2636	503.2922	716.5168	854.1189	872.5890 (95)
Ext temp.	6.6000	6.8000	7.7000	9.2000	11.6000	14.2000	15.9000	16.1000	14.4000	11.9000	9.3000	7.0000 (96)
Heat loss rate W	1192.9528	1158.7046	1084.4282	946.4417	742.2007	514.8470	372.5919	355.2661	503.4049	724.0665	943.3961	1147.0043 (97)
Space heating kWh	199.6763	102.6197	48.5073	10.7843	1.4680	0.0000	0.0000	0.0000	0.0000	5.6169	64.2796	204.1650 (98a)
Space heating requirement - total per year (kWh/year)												637.1171
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	199.6763	102.6197	48.5073	10.7843	1.4680	0.0000	0.0000	0.0000	0.0000	5.6169	64.2796	204.1650 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												637.1171
Space heating per m2												(98c) / (4) = 7.3672 (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 %) 378.5900 (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	199.6763	102.6197	48.5073	10.7843	1.4680	0.0000	0.0000	0.0000	0.0000	5.6169	64.2796	204.1650 (98)
Space heating efficiency (main heating system 1)	378.5900	378.5900	378.5900	378.5900	378.5900	0.0000	0.0000	0.0000	0.0000	378.5900	378.5900	378.5900 (210)
Space heating fuel (main heating system)	52.7421	27.1058	12.8126	2.8485	0.3878	0.0000	0.0000	0.0000	0.0000	1.4836	16.9787	53.9277 (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	329.5100	291.6078	309.5818	270.8669	261.8429	235.0781	231.0243	240.4481	243.4315	272.5478	291.2639	325.6690 (64)
Efficiency of water heater	193.3186	193.3186	193.3186	193.3186	193.3186	193.3186	193.3186	193.3186	193.3186	193.3186	193.3186	193.3186 (216)
Fuel for water heating, kWh/month	170.4492	150.8431	160.1407	140.1142	135.4463	121.6014	119.5044	124.3792	125.9224	140.9837	150.6652	168.4623 (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	17.5802	15.8789	17.5802	17.0131	17.5802	17.0131	17.5802	17.5802	17.0131	17.5802	17.0131	17.5802 (231)
Lighting	27.1628	21.7910	19.6204	14.3747	11.1035	9.0716	10.1290	13.1660	17.1013	22.4379	25.3435	27.9177 (232)
Electricity generated by PVs (Appendix M) (negative quantity)	-166.4528	-216.9933	-308.9596	-334.8680	-338.7019	-312.9957	-305.5314	-305.5593	-288.4091	-251.5905	-182.1078	-142.1992 (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)
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)
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)
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)
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)
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)
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)
Annual totals kWh/year												
Space heating fuel - main system 1												168.2868 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												193.3186
Water heating fuel used												1708.5120 (219)
Space cooling fuel												0.0000 (221)
Electricity for pumps and fans:												
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.7280)												
mechanical ventilation fans (SFP = 0.7280)												206.9928 (230a)
Total electricity for the above, kWh/year												206.9928 (231)
Electricity for lighting (calculated in Appendix L)												219.2194 (232)

# Full SAP Calculation Printout



Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-3154.3687 (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	-851.3576 (238)

## 10a. Fuel costs - using BEDF prices (531)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	168.2868	21.5100	36.1985 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1708.5120	21.5100	367.5009 (247)
Energy for instantaneous electric shower(s)	0.0000	21.5100	0.0000 (247a)
Pumps, fans and electric keep-hot	206.9928	21.5100	44.5241 (249)
Energy for lighting	219.2194	21.5100	47.1541 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-3154.3687	21.5100	-678.5047
PV Unit electricity exported	0.0000	5.5900	0.0000
Total			-678.5047 (252)
Total energy cost			-183.1270 (255)

## 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	168.2868	0.1599	26.9085 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1708.5120	0.1410	240.8686 (264)
Space and water heating			267.7771 (265)
Pumps, fans and electric keep-hot	206.9928	0.1387	28.7125 (267)
Energy for lighting	219.2194	0.1443	31.6401 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-3154.3687	0.1355	-427.4914
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-427.4914 (269)
Total CO2, kg/year			-99.3617 (272)

## 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	168.2868	1.5918	267.8817 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1708.5120	1.5213	2599.1642 (278)
Space and water heating			2867.0458 (279)
Pumps, fans and electric keep-hot	206.9928	1.5128	313.1387 (281)
Energy for lighting	219.2194	1.5338	336.2461 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-3154.3687	1.5009	-4734.4640
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-4734.4640 (283)
Total Primary energy kWh/year			-1218.0334 (286)

## SAP 10 EPC IMPROVEMENTS

709936

Current energy efficiency rating: A 104  
Current environmental impact rating: A 100

N Solar water heating SAP increase too small  
U Solar photovoltaic panels Already installed  
V2 Wind turbine Not applicable

Recommended measures: SAP change Cost change CO2 change  
(none)

Measures omitted - SAP change or cost saving too small:  
N Solar water heating + 0.8 -£ 27 -16 kg (16.6%)

Recommended measures Typical annual savings Energy Environmental  
(none) Total Savings £0 0.00 kg/m<sup>2</sup> efficiency impact

Potential energy efficiency rating: A 104  
Potential environmental impact rating: A 100

Fuel prices for cost data on this page from database revision number 531 TEST (31 Oct 2023)  
Recommendation texts revision number 6.1 (11 Jun 2019)

Typical heating and lighting costs of this home (per year, South West England):  
Current Potential Saving

# Full SAP Calculation Printout



Electricity	£495	£495	£0
Space heating	£81	£81	£0
Water heating	£368	£368	£0
Lighting	£47	£47	£0
Generated (PV)	-£679	-£679	£0
Total cost of fuels	-£184	-£184	£0
Total cost of uses	-£183	-£183	£0
Delivered energy	-10 kWh/m <sup>2</sup>	-10 kWh/m <sup>2</sup>	0 kWh/m <sup>2</sup>
Carbon dioxide emissions	-0.1 tonnes	-0.1 tonnes	0.0 tonnes
CO2 emissions per m <sup>2</sup>	-1 kg/m <sup>2</sup>	-1 kg/m <sup>2</sup>	0 kg/m <sup>2</sup>
Primary energy	-14 kWh/m <sup>2</sup>	-14 kWh/m <sup>2</sup>	0 kWh/m <sup>2</sup>

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)  
CALCULATION OF ENERGY RATING FOR IMPROVED DWELLING

## 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	73.0700 (1b)	x 2.8500 (2b)	= 208.2495 (1b) - (3b)
First floor	13.4100 (1c)	x 1.8500 (2c)	= 24.8085 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	86.4800		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 233.0580 (5)

## 2. Ventilation rate

	m <sup>3</sup> per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	0 * 10 = 0.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c)	0.0000 / (5) = 0.0000 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	2.0000 (17)
Infiltration rate	0.1000 (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) = 0.1000 (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	0.1275	0.1250	0.1225	0.1100	0.1075	0.0950	0.0950	0.0925	0.1000	0.1075	0.1125	0.1175 (22b)
Balanced mechanical ventilation with heat recovery												
If mechanical ventilation												0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												81.0000 (23c)
Effective ac	0.2225	0.2200	0.2175	0.2050	0.2025	0.1900	0.1900	0.1875	0.1950	0.2025	0.2075	0.2125 (25)

## 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
Window (Uw = 1.20)			8.8200	1.1450	10.0992		(27)
Glazed door (Uw = 1.20)			4.0100	1.1450	4.5916		(27)
Sliding door (Uw = 1.20)			6.7200	1.1450	7.6947		(27)
Solid door			1.9500	1.4000	2.7300		(26)
Ground floor			73.0700	0.1100	8.0377	110.0000	8037.7000 (28a)
Rendered external wall	70.1400	7.3500	62.7900	0.1600	10.0464	190.0000	11930.1000 (29a)
Timber clad external wall	52.2000	14.1500	38.0500	0.1600	6.0880	190.0000	7229.5000 (29a)
Sloped roof	81.3000		81.3000	0.1300	10.5690	9.0000	731.7000 (30)
Total net area of external elements Aum(A, m <sup>2</sup> )			276.7100				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	59.8566		(33)
Internal block wall			131.2400			75.0000	9843.0000 (32c)
First floor			13.4100			18.0000	241.3800 (32d)
Ground floor ceiling			13.4100			0.0000	0.0000 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	38013.3800 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							439.5627 (35)

### List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	14.0200	0.0050	0.0701
E3 Sill	7.9700	0.0150	0.1195
E4 Jamb	35.0000	0.0260	0.9100
E5 Ground floor (normal)	46.1800	0.0720	3.3250
E6 Intermediate floor within a dwelling	15.5200	0.0390	0.6053



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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	126.5653	126.8577	127.1514	128.6406	128.9426	130.4743	130.4743	130.7850	129.8573	128.9426	128.3400	127.7429
alpha	9.4377	9.4572	9.4768	9.5760	9.5962	9.6983	9.6983	9.7190	9.6572	9.5962	9.5560	9.5162
util living area	0.9946	0.9775	0.9230	0.7912	0.6125	0.4339	0.3088	0.3329	0.5171	0.8245	0.9792	0.9965 (86)
Living	20.6666	20.7772	20.8839	20.9500	20.9659	20.9678	20.9679	20.9679	20.9674	20.9466	20.8021	20.6418
Non living	19.7396	19.8769	19.9994	20.0717	20.0852	20.0959	20.0959	20.0979	20.0919	20.0722	19.9175	19.7149
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	20.8295	20.7772	20.8839	20.9500	20.9659	20.9678	20.9679	20.9679	20.9674	20.9466	20.8021	20.6919 (87)
Th 2	20.1128	20.1147	20.1166	20.1259	20.1278	20.1372	20.1372	20.1390	20.1334	20.1278	20.1240	20.1203 (88)
util rest of house	0.9918	0.9674	0.8956	0.7430	0.5562	0.3754	0.2483	0.2706	0.4524	0.7694	0.9679	0.9947 (89)
MIT 2	19.9640	19.8769	19.9994	20.0717	20.0852	20.0959	20.0959	20.0979	20.0919	20.0722	19.9175	19.7880 (90)
Living area fraction									fLA = Living area / (4) =			0.3498 (91)
MIT	20.2667	20.1919	20.3088	20.3789	20.3933	20.4009	20.4009	20.4022	20.3981	20.3780	20.2269	20.1042 (92)
Temperature adjustment												0.0000
adjusted MIT	20.2667	20.1919	20.3088	20.3789	20.3933	20.4009	20.4009	20.4022	20.3981	20.3780	20.2269	20.1042 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9924	0.9684	0.9022	0.7574	0.5735	0.3933	0.2668	0.2897	0.4722	0.7860	0.9695	0.9947 (94)
Useful gains	885.4786	1011.0461	1039.9861	922.7065	710.4120	469.4312	307.6065	323.1275	511.9370	778.4483	857.1452	839.5794 (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	1332.0964	1272.8508	1146.7476	942.2287	711.9038	469.4646	307.6072	323.1288	512.1304	800.7359	1080.0277	1314.6440 (97)
Space heating kWh	332.2836	175.9327	79.4306	14.0560	1.1099	0.0000	0.0000	0.0000	0.0000	16.5820	160.4754	353.4480 (98a)
Space heating requirement - total per year (kWh/year)												1133.3182
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	332.2836	175.9327	79.4306	14.0560	1.1099	0.0000	0.0000	0.0000	0.0000	16.5820	160.4754	353.4480 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1133.3182
Space heating per m2										(98c) / (4) =		13.1050 (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 %)												379.6158 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement	332.2836	175.9327	79.4306	14.0560	1.1099	0.0000	0.0000	0.0000	0.0000	16.5820	160.4754	353.4480 (98)
Space heating efficiency (main heating system 1)	379.6158	379.6158	379.6158	379.6158	379.6158	0.0000	0.0000	0.0000	0.0000	379.6158	379.6158	379.6158 (210)
Space heating fuel (main heating system)	87.5316	46.3450	20.9239	3.7027	0.2924	0.0000	0.0000	0.0000	0.0000	4.3681	42.2731	93.1068 (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	329.5100	291.6078	309.5818	270.8669	261.8429	235.0781	231.0243	240.4481	243.4315	272.5478	291.2639	325.6690 (64)
Efficiency of water heater	193.6116	193.6116	193.6116	193.6116	193.6116	193.6116	193.6116	193.6116	193.6116	193.6116	193.6116	193.6116 (216)
Fuel for water heating, kWh/month	170.1912	150.6148	159.8984	139.9022	135.2413	121.4174	119.3236	124.1910	125.7319	140.7704	150.4372	168.2074 (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	17.5802	15.8789	17.5802	17.0131	17.5802	17.0131	17.5802	17.5802	17.0131	17.5802	17.0131	17.5802 (231)
Lighting	27.1628	21.7910	19.6204	14.3747	11.1035	9.0716	10.1290	13.1660	17.1013	22.4379	25.3435	27.9177 (232)
Electricity generated by PVs (Appendix M) (negative quantity)	-132.5948	-197.4590	-288.5085	-316.5229	-331.3500	-304.6044	-300.6486	-292.8042	-267.6269	-225.8317	-149.3014	-112.9890 (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)
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)
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)
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)
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)
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)
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)
Annual totals kWh/year												
Space heating fuel - main system 1												298.5435 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												193.6116
Water heating fuel used												1705.9266 (219)
Space cooling fuel												0.0000 (221)

Electricity for pumps and fans:  
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.7280)

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mechanical ventilation fans (SFP = 0.7280)	206.9928 (230a)
Total electricity for the above, kWh/year	206.9928 (231)
Electricity for lighting (calculated in Appendix L)	219.2194 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-2920.2414 (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	-489.5591 (238)

## 10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	298.5435	16.4900	49.2298 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1705.9266	16.4900	281.3073 (247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000 (247a)
Pumps, fans and electric keep-hot	206.9928	16.4900	34.1331 (249)
Energy for lighting	219.2194	16.4900	36.1493 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-2920.2414	16.4900	-481.5478 (252)
PV Unit electricity exported	0.0000	5.5900	0.0000 (255)
Total			-481.5478 (252)
Total energy cost			-80.7283 (255)

## 11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.3600 (256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] = -0.2210 (257)
SAP value	103.5830
SAP rating (Section 12)	104 (258)
SAP band	A

## 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	298.5435	0.1595	47.6060 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1705.9266	0.1410	240.5041 (264)
Space and water heating			288.1101 (265)
Pumps, fans and electric keep-hot	206.9928	0.1387	28.7125 (267)
Energy for lighting	219.2194	0.1443	31.6401 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-2920.2414	0.1347	-393.3931 (269)
PV Unit electricity exported	0.0000	0.0000	0.0000 (272)
Total			-393.3931 (269)
Total CO2, kg/year			-44.9304 (272)
CO2 emissions per m2			-0.5200 (273)
EI value			100.4579
EI rating			100 (274)
EI band			A

## SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022) CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING

### 1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	73.0700 (1b)	x 2.8500 (2b)	= 208.2495 (1b) - (3b)
First floor	13.4100 (1c)	x 1.8500 (2c)	= 24.8085 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	86.4800		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	233.0580 (5)

### 2. Ventilation rate

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

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Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =											Air changes per hour	0.0000 / (5) =	0.0000 (8)
Pressure Test												Yes		
Pressure Test Method												Blower Door		
Measured/design AP50												2.0000	(17)	
Infiltration rate												0.1000	(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) =	0.1000 (21)	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	7.0000	6.5000	6.4000	5.8000	5.7000	5.0000	4.9000	4.8000	5.5000	6.2000	6.3000	6.9000	(22)
Wind factor	1.7500	1.6250	1.6000	1.4500	1.4250	1.2500	1.2250	1.2000	1.3750	1.5500	1.5750	1.7250	(22a)
Adj infilt rate	0.1750	0.1625	0.1600	0.1450	0.1425	0.1250	0.1225	0.1200	0.1375	0.1550	0.1575	0.1725	(22b)
Balanced mechanical ventilation with heat recovery													
If mechanical ventilation													0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)													0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =													81.0000 (23c)
Effective ac	0.2700	0.2575	0.2550	0.2400	0.2375	0.2200	0.2175	0.2150	0.2325	0.2500	0.2525	0.2675	(25)

### 3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Window (Uw = 1.20)			8.8200	1.1450	10.0992			(27)
Glazed door (Uw = 1.20)			4.0100	1.1450	4.5916			(27)
Sliding door (Uw = 1.20)			6.7200	1.1450	7.6947			(27)
Solid door			1.9500	1.4000	2.7300			(26)
Ground floor			73.0700	0.1100	8.0377	110.0000	8037.7000	(28a)
Rendered external wall	70.1400	7.3500	62.7900	0.1600	10.0464	190.0000	11930.1000	(29a)
Timber clad external wall	52.2000	14.1500	38.0500	0.1600	6.0880	190.0000	7229.5000	(29a)
Sloped roof	81.3000		81.3000	0.1300	10.5690	9.0000	731.7000	(30)
Total net area of external elements Aum(A, m2)			276.7100					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	59.8566			(33)
Internal block wall			131.2400			75.0000	9843.0000	(32c)
First floor			13.4100			18.0000	241.3800	(32d)
Ground floor ceiling			13.4100			0.0000	0.0000	(32e)
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) =	38013.3800 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K								439.5627 (35)
List of Thermal Bridges								
K1 Element			Length	Psi-value	Total			
E2 Other lintels (including other steel lintels)			14.0200	0.0050	0.0701			
E3 Sill			7.9700	0.0150	0.1195			
E4 Jamb			35.0000	0.0260	0.9100			
E5 Ground floor (normal)			46.1800	0.0720	3.3250			
E6 Intermediate floor within a dwelling			15.5200	0.0390	0.6053			
E11 Eaves (insulation at rafter level)			32.1100	0.0200	0.6422			
E13 Gable (insulation at rafter level)			15.6500	0.0410	0.6417			
E16 Corner (normal)			16.4300	0.0320	0.5258			
E17 Corner (inverted - internal area greater than external area)			7.1500	-0.0530	-0.3790			
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							6.4605 (36)	
Point Thermal bridges							(36a) =	0.0000
Total fabric heat loss							(33) + (36) + (36a) =	66.3171 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat transfer coeff	20.7655	19.8041	19.6118	18.4582	18.2659	16.9200	16.7277	16.5355	17.8814	19.2273	19.4196	20.5732	(38)
Average = Sum(39)m / 12 =	87.0826	86.1212	85.9290	84.7753	84.5831	83.2372	83.0449	82.8526	84.1985	85.5444	85.7367	86.8903	(39)
													84.9997
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP (average)	1.0070	0.9959	0.9936	0.9803	0.9781	0.9625	0.9603	0.9581	0.9736	0.9892	0.9914	1.0047	(40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

### 4. Water heating energy requirements (kWh/year)

Assumed occupancy													2.5744 (42)
Hot water usage for mixer showers													100.6890 (42a)
Hot water usage for baths													29.0022 (42b)
Hot water usage for other uses													40.9945 (42c)
Average daily hot water use (litres/day)													157.4375 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy conte	171.1714	167.7295	163.4167	156.5688	151.1125	145.2047	142.7204	147.0121	151.5688	157.7987	164.7607	170.6857	(44)
Energy content (annual)	271.0936	238.8446	251.1654	214.3349	203.4265	178.5461	172.6079	182.0317	186.8995	214.1314	234.7319	267.2526	(45)
Distribution loss (46)m = 0.15 x (45)m													Total = Sum(45)m = 2615.0660
Water storage loss:	40.6640	35.8267	37.6748	32.1502	30.5140	26.7819	25.8912	27.3048	28.0349	32.1197	35.2098	40.0879	(46)
Store volume													200.0000 (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													
Primary 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	(57)
Combi loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	(59)
Total heat required for water heating calculated for each month	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)
WWHRS	329.5100	291.6078	309.5818	270.8669	261.8429	235.0781	231.0243	240.4481	243.4315	272.5478	291.2639	325.6690	(62)
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)



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PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	329.5100	291.6078	309.5818	270.8669	261.8429	235.0781	231.0243	240.4481	243.4315	272.5478	291.2639	325.6690	(64)
	Total per year (kWh/year) = Sum(64)m =											3302.8720	(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	136.8717	121.6264	130.2456	116.4919	114.3724	104.5922	104.1252	107.2587	107.3697	117.9318	123.2739	135.5946	(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	154.4646	154.4646	154.4646	154.4646	154.4646	154.4646	154.4646	154.4646	154.4646	154.4646	154.4646	154.4646	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	31.0328	27.5630	22.4158	16.9702	12.6854	10.7096	11.5721	15.0418	20.1891	25.6347	29.9194	31.8953	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	346.9415	350.5417	341.4694	322.1555	297.7752	274.8612	259.5532	255.9530	265.0253	284.3392	308.7195	331.6335	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.0209	53.0209	53.0209	53.0209	53.0209	53.0209	53.0209	53.0209	53.0209	53.0209	53.0209	53.0209	(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)	-102.9764	-102.9764	-102.9764	-102.9764	-102.9764	-102.9764	-102.9764	-102.9764	-102.9764	-102.9764	-102.9764	-102.9764	(71)
Water heating gains (Table 5)	183.9674	180.9916	175.0613	161.7944	153.7264	145.2669	139.9533	144.1649	149.1246	158.5105	171.2138	182.2508	(72)
Total internal gains	666.4508	663.6054	643.4555	605.4291	568.6961	535.3468	515.5876	519.6688	538.8481	572.9934	614.3618	650.2887	(73)

## 6. Solar gains

[Jan]		Area m <sup>2</sup>	Solar flux Table 6a W/m <sup>2</sup>	Specific data g or Table 6b	Specific data FF or Table 6c	Access factor Table 6d	Gains W						
North		1.1000	14.1336	0.6300	0.7000	0.7700	4.7513 (74)						
South		4.8100	58.4943	0.6300	0.7000	0.7700	85.9865 (78)						
West		2.9100	26.4917	0.6300	0.7000	0.7700	23.5600 (80)						
East		2.0800	26.4917	0.6300	0.7000	0.7700	16.8401 (76)						
South		1.9300	58.4943	0.6300	0.7000	0.7700	34.5018 (78)						
South		6.7200	58.4943	0.6300	0.7000	0.7700	120.1308 (78)						
Solar gains	285.7705	418.6410	552.2981	681.5871	709.0100	766.0014	675.5466	673.5880	623.9921	474.9798	336.0406	244.6823	(83)
Total gains	952.2213	1082.2465	1195.7537	1287.0163	1277.7061	1301.3481	1191.1342	1193.2568	1162.8401	1047.9732	950.4024	894.9710	(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	121.2558	122.6094	122.8837	124.5559	124.8391	126.8577	127.1514	127.4465	125.4092	123.4361	123.1593	121.5241		
alpha	9.0837	9.1740	9.1922	9.3037	9.3226	9.4572	9.4768	9.4964	9.3606	9.2291	9.2106	9.1016		
util living area	0.9789	0.9473	0.8803	0.7593	0.6194	0.4348	0.3556	0.3402	0.4776	0.7299	0.9246	0.9831	(86)	
Living	20.7755	20.8491	20.9127	20.9528	20.9644	20.9670	20.9671	20.9672	20.9665	20.9582	20.8925	20.7668		
Non living	19.8424	19.9344	20.0012	20.0474	20.0576	20.0724	20.0744	20.0763	20.0626	20.0447	19.9865	19.8343		
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	20.8852	20.8491	20.9127	20.9528	20.9644	20.9670	20.9671	20.9672	20.9665	20.9582	20.8925	20.7994	(87)	
T 2	20.0775	20.0868	20.0886	20.0998	20.1017	20.1147	20.1166	20.1184	20.1054	20.0924	20.0905	20.0794	(88)	
util rest of house	0.9679	0.9249	0.8419	0.7084	0.5616	0.3783	0.2940	0.2790	0.4131	0.6632	0.8895	0.9735	(89)	
MIT 2	19.9838	19.9344	20.0012	20.0474	20.0576	20.0724	20.0744	20.0763	20.0626	20.0447	19.9865	19.8785	(90)	
Living area fraction									fLA = Living area / (4) =			0.3498	(91)	
MIT	20.2991	20.2543	20.3201	20.3641	20.3748	20.3853	20.3866	20.3879	20.3788	20.3642	20.3034	20.2006	(92)	
Temperature adjustment												0.0000		
adjusted MIT	20.2991	20.2543	20.3201	20.3641	20.3748	20.3853	20.3866	20.3879	20.3788	20.3642	20.3034	20.2006	(93)	

## 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.9710	0.9295	0.8524	0.7237	0.5793	0.3956	0.3128	0.2977	0.4328	0.6837	0.8987	0.9750	(94)
Useful gains	924.5707	1005.9966	1019.2303	931.4636	740.2275	514.7986	372.5877	355.2636	503.2922	716.5168	854.1189	872.5890	(95)
Ext temp.	6.6000	6.8000	7.7000	9.2000	11.6000	14.2000	15.9000	16.1000	14.4000	11.9000	9.3000	7.0000	(96)
Heat loss rate W	1192.9528	1158.7046	1084.4282	946.4417	742.2007	514.8470	372.5919	355.2661	503.4049	724.0665	943.3961	1147.0043	(97)
Space heating kWh	199.6763	102.6197	48.5073	10.7843	1.4680	0.0000	0.0000	0.0000	0.0000	5.6169	64.2796	204.1650	(98a)
Space heating requirement - total per year (kWh/year)												637.1171	
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	199.6763	102.6197	48.5073	10.7843	1.4680	0.0000	0.0000	0.0000	0.0000	5.6169	64.2796	204.1650	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												637.1171	
Space heating per m <sup>2</sup>												(98c) / (4) =	7.3672 (99)

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

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000	(201)
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Fraction of space heat from main system(s)													1.0000	(202)
Efficiency of main space heating system 1 (in %)													378.5900	(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	199.6763	102.6197	48.5073	10.7843	1.4680	0.0000	0.0000	0.0000	0.0000	5.6169	64.2796	204.1650	(98)	
Space heating efficiency (main heating system 1)	378.5900	378.5900	378.5900	378.5900	378.5900	0.0000	0.0000	0.0000	0.0000	378.5900	378.5900	378.5900	(210)	
Space heating fuel (main heating system)	52.7421	27.1058	12.8126	2.8485	0.3878	0.0000	0.0000	0.0000	0.0000	1.4836	16.9787	53.9277	(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	329.5100	291.6078	309.5818	270.8669	261.8429	235.0781	231.0243	240.4481	243.4315	272.5478	291.2639	325.6690	(64)	
Efficiency of water heater	193.3186	193.3186	193.3186	193.3186	193.3186	193.3186	193.3186	193.3186	193.3186	193.3186	193.3186	193.3186	(216)	
Fuel for water heating, kWh/month	170.4492	150.8431	160.1407	140.1142	135.4463	121.6014	119.5044	124.3792	125.9224	140.9837	150.6652	168.4623	(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	17.5802	15.8789	17.5802	17.0131	17.5802	17.0131	17.5802	17.5802	17.0131	17.5802	17.0131	17.5802	(231)	
Lighting	27.1628	21.7910	19.6204	14.3747	11.1035	9.0716	10.1290	13.1660	17.1013	22.4379	25.3435	27.9177	(232)	
Electricity generated by PVs (Appendix M) (negative quantity)	-166.4528	-216.9933	-308.9596	-334.8680	-338.7019	-312.9957	-305.5314	-305.5593	-288.4091	-251.5905	-182.1078	-142.1992	(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)	
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)	
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)	
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)	
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)	
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)	
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)	
Annual totals kWh/year														
Space heating fuel - main system 1													168.2868	(211)
Space heating fuel - main system 2													0.0000	(213)
Space heating fuel - secondary													0.0000	(215)
Efficiency of water heater													193.3186	(216)
Water heating fuel used													1708.5120	(219)
Space cooling fuel													0.0000	(221)
Electricity for pumps and fans:														
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.7280)														
mechanical ventilation fans (SFP = 0.7280)													206.9928	(230a)
Total electricity for the above, kWh/year													206.9928	(231)
Electricity for lighting (calculated in Appendix L)													219.2194	(232)
Energy saving/generation technologies (Appendices M ,N and Q)														
PV generation													-3154.3687	(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													-851.3576	(238)

## 10a. Fuel costs - using BEDF prices (531)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	168.2868	21.5100	36.1985 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1708.5120	21.5100	367.5009 (247)
Energy for instantaneous electric shower(s)	0.0000	21.5100	0.0000 (247a)
Pumps, fans and electric keep-hot	206.9928	21.5100	44.5241 (249)
Energy for lighting	219.2194	21.5100	47.1541 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-3154.3687	21.5100	-678.5047
PV Unit electricity exported	0.0000	5.5900	0.0000
Total			-678.5047 (252)
Total energy cost			-183.1270 (255)

## 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	168.2868	0.1599	26.9085 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1708.5120	0.1410	240.8686 (264)
Space and water heating			267.7771 (265)
Pumps, fans and electric keep-hot	206.9928	0.1387	28.7125 (267)
Energy for lighting	219.2194	0.1443	31.6401 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-3154.3687	0.1355	-427.4914
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-427.4914 (269)
Total CO2, kg/year			-99.3617 (272)

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 13a. Primary energy - Individual heating systems including micro-CHP  
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	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	168.2868	1.5918	267.8817 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1708.5120	1.5213	2599.1642 (278)
Space and water heating			2867.0458 (279)
Pumps, fans and electric keep-hot	206.9928	1.5128	313.1387 (281)
Energy for lighting	219.2194	1.5338	336.2461 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-3154.3687	1.5009	-4734.4640
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-4734.4640 (283)
Total Primary energy kWh/year			-1218.0334 (286)