



# Energy & Sustainability Statement

For

196 Fortfield Road, Whitchurch, Bristol, BS14 9NR

Prepared on behalf of:  
MMC Homebuilding Ltd

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## Executive Summary

This report has been produced on behalf MMC Homebuilding Ltd to demonstrate how the application for the proposed relocatable 3-bedroom dwelling at Fortfield Road, Whitchurch, BS14 9NR will address the carbon reduction and sustainability requirements set by Bristol City Council.

The Energy Assessment demonstrates that the proposed specification achieves an 85.25% reduction in carbon emissions beyond Part L of the 2021 Building Regulations

The carbon savings by the proposed development are shown in the table below.

A sustainability statement has been prepared to demonstrate a commitment to enhance the environmental performance of the development. This includes specification of materials, waste reduction, biodiversity and internal water use limited by design to 105 litres/per person/per day.



## Introduction to the Proposed Development

The proposed three-bedroom dwelling will be situated on Fortfield Road which is within a residential area. The dwelling will be a detached single storey building.

The location is within a well-established housing estate which is served by local amenities and transport links



## Energy Assessment

This assessment outlines the measures and specification proposed to meet the requirements outlined in Bristol City Council local plan BCS14.

The proposed dwelling has been modelled using SAP 10.2 and is designed to achieve an **85.25%** reduction in carbon emissions beyond Part L 2021 Building Regulations.

<b>NO DISTRICT HEAT CONNECTION</b>	<b>Regulated Energy Demand (MWh/yr)</b>	<b>Regulated CO2 emissions (tonnes/yr)</b>	<b>CO2 saved (tonnes/yr)</b>	<b>%CO2 reduction</b>
Baseline – Part L TER		797.5806		
Proposed scheme after energy efficiency measures		391.0032	797.5806 – 391.0032 = 406.577	406.577/797.5806 = 0.509 x 100 = 50.98
Residual emissions Proposed scheme after energy efficiency measures and CHP		406.577	406.577 - 406.577 = 0	406.577 - 406.577 = 0 / 406.577 = 0 x 100 = 0
Proposed scheme after on-site renewables		117.6505	406.577 – 117.6505 = 288.93	288.93 / 406.577 = 0.71 x 100 = 71.06
Total CO2 reduction beyond Part L TER			797.5806 – 117.6505 = 679.93	679.93 / 797.5806 = 0.85 x 100 = <b>85.25%</b>

### On Site Renewables

	Plot 1	Total
Renewable energy from heat pump	5739.66	5739.66
Renewable energy from wood burner	0.00	0.00
Renewable energy from PV	2478.59	2478.59
Total renewable energy use	8218.25	8218.25
Total dwelling energy use	7983.16	7983.16
% renewable energy	102.9%	<b>102.9%</b>

Appendix A & B

This has been achieved based on the following design specification.

## Proposed Design Specification

The following section outlines the measures which have been taken to reduce the energy demand of the proposal. This includes both architectural and building fabric measures (passive design) and energy efficient services (active design) considered at the earliest design stage.

Active design measures to reduce the energy demand include high efficiency lighting and ventilation. Other possible measures include enhanced U-values, air tightness improvement and the development approach to limiting thermal bridges. The specification for the proposal is listed below.

<b>Demand Reduction Measures</b>	<b>Specification</b>
<i>Building Fabric – U-Values (W/m<sup>2</sup>K)</i>	
Walls	0.16
Ground floor	0.17
Roofs	0.11
External opaque doors (whole frame)	1
Glazing (windows (whole frame) triple glazed)	0.8
Glazing (glazed doors)	1
<i>Building Fabric – Other</i>	
Air permeability (m <sup>3</sup> /hm <sup>2</sup> )	3.0
Thermal bridging	thermal bridging details i.e., ROI Steel frame
<i>Services</i>	
Ventilation	Natural with extracts
Low energy lighting	100%

It is proposed that the heating will be provided by an air source heat pump.

## Cooling and Overheating

The developer will address the following as a matter of priority to reduce overheating risk and the requirement for active cooling:

- 1. Minimise internal heat generation through energy efficient design**  
For example, heat distribution infrastructure within the building will be designed to minimise pipe lengths and adopting pipe configurations which minimise heat loss e.g. twin pipes.
- 2. Reduce the amount of heat entering the building in summer**  
For example, through use of carefully designed shading measures, including balconies, louvres, internal or external blinds, shutters, trees and vegetation.
- 3. Manage the heat within the building through exposed internal thermal mass and high ceilings**  
Increasing the amount of exposed thermal mass can help to absorb excess heat within the building.
- 4. Passive ventilation**  
For example, through the use of openable windows, shallow floorplates, dual aspect units, designing in the 'stack effect'.
- 5. Mechanical ventilation**  
Mechanical ventilation can be used to make use of 'free cooling' where the outside air temperature is below that in the building during summer months. This will require a by-pass on the heat recovery system for summer mode operation.
- 6. Active cooling systems**  
If air conditioning is necessary, the lowest carbon options should be used.

## Overheating Risk Analysis

An overheating analysis will be carried out at design stage using either the Simplified Method or Dynamic Thermal Modelling to demonstrate compliance with the Approved Document Part O 2021

## Renewable Energy

The use of renewable technology in the proposed design of this dwelling has been fully considered.

An air source heat pump has been identified suitable to provide space heating and hot water.

An ASHP operates by converting the energy of the outside air to heat, creating a comfortable temperature inside the building as well as supplying energy for the hot water system.

Due to limited roof space, solar hot water cannot be used effectively alongside photovoltaic arrays. Accordingly, it is considered preferable to install photovoltaic arrays, in the available space identified as these represent a greater carbon saving.

The dwelling will benefit from a photovoltaic array. A total of 2.87kWp is designed which will face south. Battery storage has also been incorporated in to the design.

## Monitoring

The applicant will consider options for post occupancy monitoring of the dwelling. It is the intention of the applicant to provide smart meters at the development to support the growth of demand side response.

## Sustainability Statement

The report so far has sought to address the energy targets outlined in Bristol City Council Policy BCS14.

The following section of this reports looks to address additional sustainability measures.

### Internal Water Use

It is the intention of the applicant to reduce the consumption of potable water within the proposed dwellings from all sources, using efficient fittings and flow restrictors where required.

Performance in domestic properties is assessed under the methodologies set out in Part G of the Building Regulations and the former Code for Sustainable Homes, achieving a maximum internal water use of **105 L/p/d** (litres per person per day) by design.

Although a variety of specifications are available to meet this target, the proposed flow rate criteria for dwellings at the development has been chosen as follows:

<b>Fitting</b>	<b>Flow Rate / Capacity</b>
<i>Sanitary Fittings</i>	
Dual Flush WC	6 litres per flush (full) 2.6 litres per flush (part)
Taps (main)	5 litres per minute
Bath (if present)	170 litres to overflow
Shower	8 litres per minute
Taps (kitchen/utility)	6 litres per minute
<i>Appliances</i>	
Washing Machine	8.17 litres per kilogram (dry load)
Dishwasher	1.25 litres per place setting

Appendix D

This specification of fittings achieves an internal water consumption rate of 104 litres per person per day, meeting the required result of 105 litres per person per day.

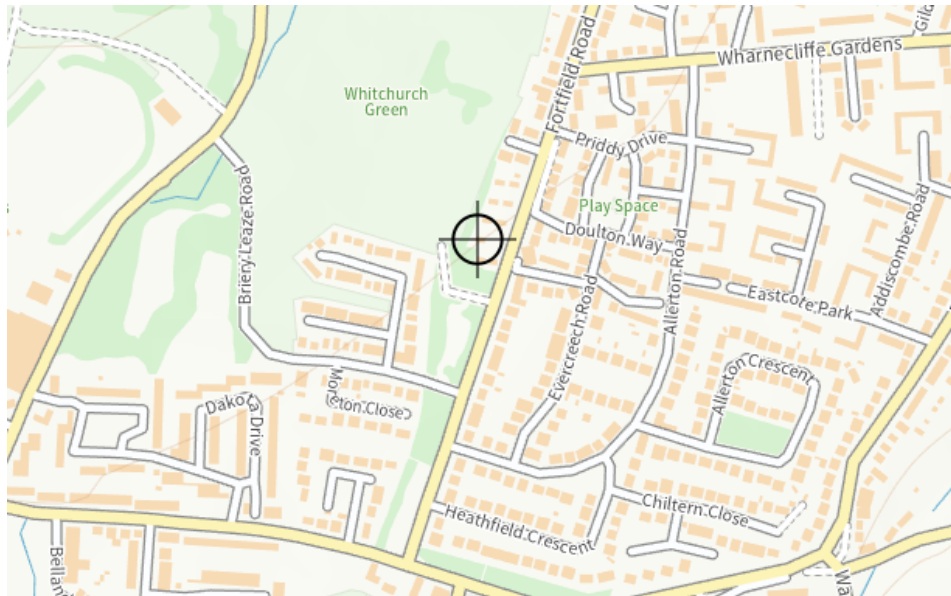
The developer will minimise the use of mains water by:

- A. Incorporating water saving measures and equipment.
- B. Designing residential development so that mains water consumption would meet a target of 105 litres or less per head per day (excluding an allowance of 5 litres or less per head per day for external water consumption).

## Flood Risk

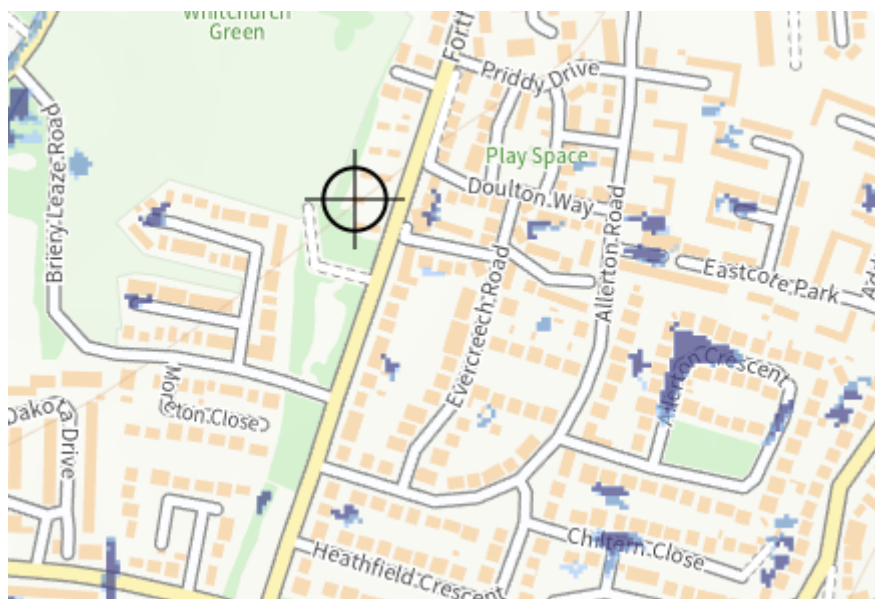
### Flood risk from rivers or the sea

Using GOV.UK's map, the development has been found to be in a Flood Zone 1 (there is less than a 0.1 per cent chance of flooding occurring each year). As the development is also less than 1 hectare, a Flood Risk Assessment is not required.



### Flood risk from surface water

Using the GOV.UK's map, the development is within an area of very low flood risk from surface water.



## Materials and Waste Reduction

### Sustainable Specification

Materials will be chosen to lower the environmental impact of the development wherever possible. BRE's Green Guide will be consulted when finalising specifications of products and element build types. This applies primarily to:

- Roofs
- External walls
- Internal walls (including separating walls)
- Upper and ground floors (including separating floors)
- Windows

In all cases, it is the applicant's intention to secure Green Guide ratings of between A+ and D, exceeding the requirements of the former Code for Sustainable Homes. All timber used during the development will come from a 'legal source' and will not be on the CITES list, or in the case of Appendix III of the CITES list, it will not have been sourced from a country seeking to protect this species as listed in Appendix III.

To promote the reduction of emissions of gases with high Global Warming Potential (GWP) associated with the manufacture, installation, use and disposal of foamed thermal and acoustic insulating materials, products will be chosen with a GWP of <5 wherever possible. They may also be chosen to comply with additional voluntary industry standards for responsible sourcing, including FSC Chain of Custody and BES 6001:2008 Framework Standard for Responsible Sourcing of Construction Products certifications where applicable. Products such as paints and varnishes will be sourced to minimise the use of Volatile Organic Compounds (Formaldehyde, VCM, etc.).



## Minimising Site Waste

A Site Waste Management Plan (SWMP) will be created to include procedures, commitments for waste minimisation and diversion from landfill, as well as setting target benchmarks for resource efficiency in accordance with guidance from:

- DEFRA (Department for Environment, Food and Rural Affairs)
- BRE (Building Research Establishment)
- Envirowise
- WRAP (Waste & Resources Action Programme)
- Environmental performance indicators and/or key performance indicators (KPI) from Envirowise or Constructing Excellence.

The applicant will seek to establish a 'take back' scheme from suppliers in order to avoid the unnecessary waste of excess materials. Care will also be taken to minimise loss through breakage etc. following guidance from the Waste and Resources Action Programme (WRAP) and others.

## Biodiversity

The presence of any significant ecological features as defined using guidance from BRE will be noted, and the appropriate measures for protection and conservation undertaken before works begin. Features to promote biodiversity, such as bird and bat boxes, will be incorporated into the design wherever feasible.

Additional planting will be carried out to ensure a net gain in vegetation.

## Conclusion

This report outlines how a variety of sustainability criteria have been considered and solution successfully incorporated into the proposed design of the development.

Based on the modelling undertaken, it has been demonstrated that it is possible to reduce regulated on-site carbon dioxide emissions of the proposed dwelling at Fortfield Road by 85.25% beyond the requirements of Part L 2021 of the Building Regulations, where the building and services specification described in this report are implemented.

Fabric performance has been improved to meet and surpass the requirements of Part L of the Building Regulations, whilst heating, hot water equipment and controls have been chosen to maximize carbon savings. An air source heat pump will provide space heating and photovoltaic panels will be installed.

Additional efforts to enhance the environmental performance of the development include the specification of materials, waste reduction, biodiversity and internal water use limited by design to 105 Litres/per person/per day.

## Appendices

Appendix A – TER/DER Lean and Clean

Appendix B – TER/DER Green

Appendix C – SAP worksheets and PEA

Appendix D – Water calculations

# Full SAP Calculation Printout



Property Reference	Fortfield		Issued on Date	25/01/2024	
Assessment Reference	Lean & Clean_Copy	Prop Type Ref			
Property	196, Fortfield Road , Bristol, BS14 9NR				
SAP Rating	79 C	DER	5.25	TER	10.71
Environmental	96 A	% DER < TER		50.98	
CO <sub>2</sub> Emissions (t/year)	0.35	DFEE	47.12	TFEE	47.18
Compliance Check	See BREL	% DFEE < TFEE		0.13	
% DPER < TPER	4.07	DPER	55.20	TPER	57.54
Assessor Details	Ms. Natalie Wheeler			Assessor ID	AX45-0001
Client					

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

### 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	74.4400 (1b)	2.4000 (2b)	178.6560 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	74.4400		178.6560 (4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 178.6560 (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	2 * 10 = 20.0000 (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) =	20.0000 / (5) = 0.1119 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	3.0000 (17)
Infiltration rate	0.2619 (18)
Number of sides sheltered	2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.2227 (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	0.2839	0.2783	0.2728	0.2449	0.2394	0.2115	0.2115	0.2060	0.2227	0.2394	0.2505	0.2616 (22b)
Effective ac	0.5403	0.5387	0.5372	0.5300	0.5286	0.5224	0.5224	0.5212	0.5248	0.5286	0.5314	0.5342 (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
Front door			2.1700	1.0000	2.1700		(26)
Windows (Uw = 0.80)			9.3000	0.7752	7.2093		(27)
Patio doors (Uw = 1.00)			3.2300	0.9615	3.1058		(27)
Heatloss Floor			74.4400	0.1700	12.6548	0.0000	0.0000 (28a)
External Wall	112.4200	14.7000	97.7200	0.1600	15.6352	14.0000	1368.0800 (29a)
Wall to store	7.4900		7.4900	0.1600	1.1984	14.0000	104.8600 (29a)
External Roof	74.4400		74.4400	0.1100	8.1884	9.0000	669.9600 (30)
Total net area of external elements Aum(A, m <sup>2</sup> )			268.7900				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 50.1619		(33)
Internal Wall 1			66.0000			14.0000	924.0000 (32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		3066.9000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							41.1996 (35)

#### List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	10.0100	0.0060	0.0601
E3 Sill	7.5000	0.0120	0.0900
E4 Jamb	21.0000	0.0230	0.4830
E5 Ground floor (normal)	46.8400	0.3200	14.9888
E14 Flat roof	46.8400	0.0540	2.5294

# Full SAP Calculation Printout



E16 Corner (normal)													
E17 Corner (inverted - internal area greater than external area)													26.4000
Thermal bridges (Sum(L x Psi) calculated using Appendix K)													14.4000
Point Thermal bridges													0.0750
Total fabric heat loss													-0.0450
													1.9800
													-0.6480
													19.4832 (36)
													0.0000
													(33) + (36) + (36a) =
													69.6451 (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	31.8539	31.7617	31.6712	31.2465	31.1671	30.7971	30.7971	30.7286	30.9396	31.1671	31.3278	31.4959	(38)
Average = Sum(39)m / 12 =	101.4990	101.4068	101.3163	100.8916	100.8122	100.4422	100.4422	100.3737	100.5847	100.8122	100.9729	101.1410	(39)
	100.8912												
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP (average)	1.3635	1.3623	1.3610	1.3553	1.3543	1.3493	1.3493	1.3484	1.3512	1.3543	1.3564	1.3587	(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													2.3489 (42)
Hot water usage for mixer showers													
Hot water usage for baths	71.5538	70.4785	68.9116	65.9135	63.7010	61.2337	59.8312	61.3863	63.0910	65.7401	68.8026	71.2797	(42a)
Hot water usage for other uses	27.4748	27.0667	26.4921	25.4327	24.6393	23.7597	23.2845	23.8551	24.4764	25.4177	26.4989	27.3819	(42b)
Average daily hot water use (litres/day)	38.6853	37.2786	35.8719	34.4651	33.0584	31.6516	31.6516	33.0584	34.4651	35.8719	37.2786	38.6853	(42c)
	126.6122												(43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy content (annual)	137.7139	134.8238	131.2756	125.8113	121.3987	116.6450	114.7674	118.2998	122.0325	127.0297	132.5801	137.3469	(44)
Distribution loss (46)m = 0.15 x (45)m	218.1052	191.9874	201.7656	172.2294	163.4260	143.4286	138.8012	146.4798	150.4782	172.3780	188.8847	215.0521	(45)
Total = Sum(45)m =	32.7158	28.7981	30.2648	25.8344	24.5139	21.5143	20.8202	21.9720	22.5717	25.8567	28.3327	32.2578	(46)
Water storage loss:													
Store volume													200.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):													1.6700 (48)
Temperature factor from Table 2b													0.5400 (49)
Enter (49) or (54) in (55)													0.9018 (55)
Total storage loss	27.9558	25.2504	27.9558	27.0540	27.9558	27.0540	27.9558	27.9558	27.0540	27.9558	27.0540	27.9558	(56)
If cylinder contains dedicated solar storage	27.9558	25.2504	27.9558	27.0540	27.9558	27.0540	27.9558	27.9558	27.0540	27.9558	27.0540	27.9558	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	246.0610	217.2378	229.7214	199.2834	191.3818	170.4826	166.7570	174.4356	177.5322	200.3338	215.9387	243.0079	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	246.0610	217.2378	229.7214	199.2834	191.3818	170.4826	166.7570	174.4356	177.5322	200.3338	215.9387	243.0079	(64)
Total per year (kWh/year) = Sum(64)m =													2432.1733 (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	72.5200	63.8358	67.0871	57.2663	54.3392	47.6900	46.1514	48.7045	50.0340	57.3157	62.8042	71.5048	(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	117.4462	117.4462	117.4462	117.4462	117.4462	117.4462	117.4462	117.4462	117.4462	117.4462	117.4462	117.4462	(66)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	108.1017	119.6840	108.1017	111.7050	108.1017	111.7050	108.1017	108.1017	111.7050	108.1017	111.7050	108.1017	(67)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	207.4305	209.5830	204.1588	192.6114	178.0348	164.3349	155.1825	153.0300	158.4542	170.0016	184.5782	198.2781	(68)
Pumps, fans	34.7446	34.7446	34.7446	34.7446	34.7446	34.7446	34.7446	34.7446	34.7446	34.7446	34.7446	34.7446	(69)
Losses e.g. evaporation (negative values) (Table 5)	10.7194	10.7194	10.7194	10.7194	10.7194	0.0000	0.0000	0.0000	0.0000	10.7194	10.7194	10.7194	(70)
Water heating gains (Table 5)	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	(71)
Total internal gains	97.4731	94.9937	90.1708	79.5365	73.0365	66.2361	62.0314	65.4631	69.4917	77.0372	87.2280	96.1086	(72)
	481.9585	493.2139	471.3845	452.8061	428.1262	400.5099	383.5495	384.8286	397.8848	424.0937	452.4645	471.4416	(73)

#### 6. Solar gains

[Jan]													
East			5.4000		19.6403		0.6300		0.7000		0.7700		32.4125 (76)
West			3.9000		19.6403		0.6300		0.7000		0.7700		23.4090 (80)
West			3.2300		19.6403		0.6300		0.7000		0.7700		19.3875 (80)
Solar gains	75.2091	147.1249	242.2937	353.3710	433.0694	443.3236	422.0621	362.5451	281.7976	174.5761	93.7769	61.8483 (83)	
Total gains	557.1675	640.3388	713.6782	806.1771	861.1956	843.8335	805.6116	747.3738	679.6824	598.6698	546.2413	533.2899 (84)	

#### 7. Mean internal temperature (heating season)

# 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	8.3934	8.4010	8.4085	8.4439	8.4505	8.4817	8.4817	8.4874	8.4696	8.4505	8.4371	8.4231
alpha	1.5596	1.5601	1.5606	1.5629	1.5634	1.5654	1.5654	1.5658	1.5646	1.5634	1.5625	1.5615
util living area	0.8743	0.8447	0.8022	0.7288	0.6356	0.5259	0.4255	0.4612	0.6164	0.7656	0.8465	0.8816 (86)
MIT	17.5041	17.8204	18.3540	19.0713	19.7398	20.2650	20.5410	20.4916	20.0559	19.1892	18.2252	17.4372 (87)
Th 2	19.7914	19.7924	19.7933	19.7977	19.7986	19.8024	19.8024	19.8031	19.8009	19.7986	19.7969	19.7951 (88)
util rest of house	0.8623	0.8301	0.7828	0.7006	0.5935	0.4619	0.3363	0.3729	0.5576	0.7348	0.8295	0.8702 (89)
MIT 2	15.8993	16.2780	16.9170	17.7674	18.5414	19.1263	19.4041	19.3636	18.9168	17.9268	16.7761	15.8210 (90)
Living area fraction												0.4066 (91)
MIT	16.5519	16.9052	17.5013	18.2976	19.0288	19.5893	19.8664	19.8223	19.3800	18.4401	17.3653	16.4782 (92)
Temperature adjustment												0.0000
adjusted MIT	16.5519	16.9052	17.5013	18.2976	19.0288	19.5893	19.8664	19.8223	19.3800	18.4401	17.3653	16.4782 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.8190	0.7844	0.7365	0.6584	0.5626	0.4492	0.3415	0.3745	0.5337	0.6916	0.7844	0.8278 (94)
Useful gains	456.3265	502.2827	525.5966	530.7550	484.5316	379.0436	275.1441	279.8960	362.7417	414.0299	428.4574	441.4672 (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	1243.5534	1217.4106	1114.6133	948.1433	738.8282	501.1399	328.0823	343.5067	531.0877	790.3782	1036.5199	1241.8284 (97)
Space heating kWh	585.6968	480.5659	438.2284	300.5196	189.1966	0.0000	0.0000	0.0000	0.0000	280.0032	437.8050	595.4688 (98a)
Space heating requirement - total per year (kWh/year)												3307.4843
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	585.6968	480.5659	438.2284	300.5196	189.1966	0.0000	0.0000	0.0000	0.0000	280.0032	437.8050	595.4688 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3307.4843
Space heating per m2										(98c) / (4) =		44.4315 (99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Fraction of main heating from main system 2												0.0000 (203)
Fraction of total heating from main system 1												1.0000 (204)
Fraction of total heating from main system 2												0.0000 (205)
Efficiency of main space heating system 1 (in %)												170.0000 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement	585.6968	480.5659	438.2284	300.5196	189.1966	0.0000	0.0000	0.0000	0.0000	280.0032	437.8050	595.4688 (98)
Space heating efficiency (main heating system 1)	170.0000	170.0000	170.0000	170.0000	170.0000	0.0000	0.0000	0.0000	0.0000	170.0000	170.0000	170.0000 (210)
Space heating fuel (main heating system)	344.5275	282.6858	257.7814	176.7762	111.2921	0.0000	0.0000	0.0000	0.0000	164.7078	257.5324	350.2758 (211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)
Space heating fuel used, main system 2												0.0000 (213)
Water heating												
Water heating requirement	246.0610	217.2378	229.7214	199.2834	191.3818	170.4826	166.7570	174.4356	177.5322	200.3338	215.9387	243.0079 (64)
Efficiency of water heater												360.1646 (216)
(217)m	360.1646	360.1646	360.1646	360.1646	360.1646	360.1646	360.1646	360.1646	360.1646	360.1646	360.1646	360.1646 (217)
Fuel for water heating, kWh/month	68.3190	60.3162	63.7823	55.3312	53.1373	47.3346	46.3002	48.4322	49.2920	55.6229	59.9556	67.4713 (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	9.1041	8.2231	9.1041	8.8104	9.1041	8.8104	9.1041	9.1041	8.8104	9.1041	8.8104	9.1041 (231)
Lighting	23.6328	18.9591	17.0706	12.5066	9.6605	7.8927	8.8126	11.4550	14.8789	19.5219	22.0499	24.2896 (232)
Electricity generated by PVs (Appendix M) (negative quantity)	-9.1126	-14.4916	-23.4025	-29.3780	-34.0608	-30.8029	-30.3922	-27.3847	-22.5449	-17.6137	-10.5374	-7.7024 (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)	-1.1552	-2.6423	-5.7785	-9.7303	-14.2541	-16.6984	-16.4814	-13.5690	-9.5300	-4.2897	-1.6416	-0.8899 (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												1945.5790 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												360.1646
Water heating fuel used												675.2949 (219)
Space cooling fuel												0.0000 (221)
Electricity for pumps and fans:												
warm air heating system fans												107.1936 (230b)
Total electricity for the above, kWh/year												107.1936 (231)
Electricity for lighting (calculated in Appendix L)												190.7304 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-354.0841 (233)

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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	2564.7138 (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	1945.5790	0.1538	299.1804 (261)
Space heating - main system 2	0.0000	0.0000	0.0000 (262)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	675.2949	0.1412	95.3451 (264)
Space and water heating			394.5255 (265)
Pumps, fans and electric keep-hot	107.1936	0.1387	14.8691 (267)
Energy for lighting	190.7304	0.1443	27.5283 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-257.4236	0.1329	-34.2112
PV Unit electricity exported	-96.6604	0.1211	-11.7085
Total			-45.9197 (269)
Total CO2, kg/year			391.0032 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			5.2500 (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	1945.5790	1.5693	3053.2101 (275)
Space heating - main system 2	0.0000	0.0000	0.0000 (276)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	675.2949	1.5221	1027.8563 (278)
Space and water heating			4081.0665 (279)
Pumps, fans and electric keep-hot	107.1936	1.5128	162.1625 (281)
Energy for lighting	190.7304	1.5338	292.5486 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-257.4236	1.4911	-383.8403
PV Unit electricity exported	-96.6604	0.4442	-42.9410
Total			-426.7813 (283)
Total Primary energy kWh/year			4108.9962 (286)
Dwelling Primary energy Rate (DPER)			55.2000 (287)

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

### 1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	74.4400 (1b)	2.4000 (2b)	178.6560 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	74.4400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	178.6560 (5)

### 2. Ventilation rate

		m3 per hour
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	3 * 10 =	30.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1679 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.4179 (18)
Number of sides sheltered		2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3552 (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	0.4529	0.4440	0.4352	0.3908	0.3819	0.3375	0.3375	0.3286	0.3552	0.3819	0.3996	0.4174 (22b)
Effective ac	0.6026	0.5986	0.5947	0.5763	0.5729	0.5569	0.5569	0.5540	0.5631	0.5729	0.5799	0.5871 (25)

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### 3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1700	1.0000	2.1700			(26)
TER Opening Type (Uw = 1.20)			12.5300	1.1450	14.3473			(27)
Heatloss Floor			74.4400	0.1300	9.6772			(28a)
External Wall	112.4200	14.7000	97.7200	0.1800	17.5896			(29a)
Wall to store	7.4900		7.4900	0.1800	1.3482			(29a)
External Roof	74.4400		74.4400	0.1100	8.1884			(30)
Total net area of external elements Aum(A, m2)			268.7900					(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	53.3207		(33)

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

List of Thermal Bridges 41.1996 (35)

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	10.0100	0.0500	0.5005
E3 Sill	7.5000	0.0500	0.3750
E4 Jamb	21.0000	0.0500	1.0500
E5 Ground floor (normal)	46.8400	0.1600	7.4944
E14 Flat roof	46.8400	0.0800	3.7472
E16 Corner (normal)	26.4000	0.0900	2.3760
E17 Corner (inverted - internal area greater than external area)	14.4000	-0.0900	-1.2960

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 14.2471 (36)

Point Thermal bridges 0.0000

Total fabric heat loss (33) + (36) + (36a) = 67.5678 (37)

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

(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	35.5253	35.2905	35.0604	33.9793	33.7770	32.8354	32.8354	32.6610	33.1981	33.7770	34.1862	34.6140 (38)
Heat transfer coeff	103.0932	102.8584	102.6282	101.5471	101.3448	100.4032	100.4032	100.2289	100.7659	101.3448	101.7540	102.1818 (39)
Average = Sum(39)m / 12 =												101.5461

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.3849	1.3818	1.3787	1.3641	1.3614	1.3488	1.3488	1.3464	1.3537	1.3614	1.3669	1.3727 (40)
HLP (average)												1.3641
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

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

Assumed occupancy													2.3489 (42)
Hot water usage for mixer showers													
63.6034	62.6476	61.2547	58.5898	56.6231	54.4299	53.1833	54.5656	56.0809	58.4357	61.1579	63.3597	63.3597 (42a)	
Hot water usage for baths													
27.4748	27.0667	26.4921	25.4327	24.6393	23.7597	23.2845	23.8551	24.4764	25.4177	26.4989	27.3819	27.3819 (42b)	
Hot water usage for other uses													
38.6853	37.2786	35.8719	34.4651	33.0584	31.6516	31.6516	33.0584	34.4651	35.8719	37.2786	38.6853	38.6853 (42c)	
Average daily hot water use (litres/day)													119.2821 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	129.7635	126.9929	123.6187	118.4876	114.3208	109.8412	108.1195	111.4791	115.0223	119.7252	124.9354	129.4269 (44)
Energy conte	205.5137	180.8362	189.9974	162.2035	153.8978	135.0626	130.7611	138.0344	141.8341	162.4660	177.9934	202.6513 (45)
Energy content (annual)												
Distribution loss (46)m = 0.15 x (45)m												
30.8271	27.1254	28.4996	24.3305	23.0847	20.2594	19.6142	20.7052	21.2751	24.3699	26.6990	30.3977	30.3977 (46)

Water storage loss: Store volume 150.0000 (47)

a) If manufacturer declared loss factor is known (kWh/day): 1.3938 (48)

Temperature factor from Table 2b 0.5400 (49)

Enter (49) or (54) in (55) 0.7527 (55)

Total storage loss 23.3325 (56)

If cylinder contains dedicated solar storage 23.3325 (57)

Primary loss 23.2624 (59)

Combi loss 0.0000 (61)

Total heat required for water heating calculated for each month

252.1086 222.9219 236.5923 207.2954 200.4927 180.1545 177.3560 184.6293 186.9259 209.0609 223.0852 249.2462 (62)

WWHRS -29.0768 -25.7158 -26.9281 -22.2975 -20.7805 -17.7820 -16.6678 -17.7245 -18.3980 -21.6892 -24.5712 -28.5384 (63a)

FV 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 223.0318 197.2061 209.6642 184.9979 179.7122 162.3724 160.6882 166.9048 168.5279 187.3717 198.5140 220.7078 (64)

12Total per year (kWh/year) Total per year (kWh/year) = Sum(64)m = 2259.6992 (64)

Electric shower(s) 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 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 105.6092 93.7966 100.4500 90.0062 88.4469 80.9818 80.7540 83.1724 83.2333 91.2959 95.2563 104.6575 (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	117.4462	117.4462	117.4462	117.4462	117.4462	117.4462	117.4462	117.4462	117.4462	117.4462	117.4462	117.4462 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	108.1017	119.6840	108.1017	111.7050	108.1017	111.7050	108.1017	108.1017	111.7050	108.1017	111.7050	108.1017 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	207.4305	209.5830	204.1588	192.6114	178.0348	164.3349	155.1825	153.0300	158.4542	170.0016	184.5782	198.2781 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.7446	34.7446	34.7446	34.7446	34.7446	34.7446	34.7446	34.7446	34.7446	34.7446	34.7446	34.7446 (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)	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570 (71)
Water heating gains (Table 5)	141.9479	139.5783	135.0135	125.0085	118.8803	112.4747	108.5403	111.7908	115.6018	122.7095	132.3004	140.6687 (72)
Total internal gains												



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518.7139 530.0791 508.5078 490.5588 466.2506 446.7485 430.0583 431.1563 443.9949 462.0466 489.8175 508.2823 (73)

## 6. Solar gains

[Jan]			Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W				
East			5.4000	19.6403	0.6300	0.7000	0.7700	32.4125 (76)				
West			7.1300	19.6403	0.6300	0.7000	0.7700	42.7965 (80)				
Solar gains	75.2091	147.1249	242.2937	353.3710	433.0694	443.3236	422.0621	362.5451	281.7976	174.5761	93.7769	61.8483 (83)
Total gains	593.9230	677.2040	750.8016	843.9298	899.3200	890.0721	852.1205	793.7015	725.7926	636.6227	583.5944	570.1306 (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	8.2636	8.2824	8.3010	8.3894	8.4061	8.4850	8.4850	8.4997	8.4544	8.4061	8.3723	8.3373
alpha	1.5509	1.5522	1.5534	1.5593	1.5604	1.5657	1.5657	1.5666	1.5636	1.5604	1.5582	1.5558
util living area	0.8654	0.8357	0.7927	0.7177	0.6237	0.5092	0.4089	0.4426	0.5968	0.7513	0.8350	0.8722 (86)
MIT	16.6392	17.0570	17.7644	18.7243	19.6038	20.3022	20.6560	20.5952	20.0367	18.8938	17.6187	16.5668 (87)
Th 2	19.7749	19.7773	19.7797	19.7909	19.7930	19.8028	19.8028	19.8046	19.7990	19.7930	19.7888	19.7843 (88)
util rest of house	0.8526	0.8203	0.7725	0.6888	0.5812	0.4456	0.3217	0.3562	0.5375	0.7193	0.8170	0.8600 (89)
MIT 2	14.9624	15.4617	16.3073	17.4440	18.4598	19.2352	19.5887	19.5399	18.9700	17.6703	16.1517	14.8787 (90)
Living area fraction									fLA = Living area / (4) =			
MIT	15.6442	16.1104	16.8998	17.9646	18.9250	19.6691	20.0227	19.9690	19.4037	18.1678	16.7482	15.5651 (92)
Temperature adjustment												0.0000
adjusted MIT	15.6442	16.1104	16.8998	17.9646	18.9250	19.6691	20.0227	19.9690	19.4037	18.1678	16.7482	15.5651 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.7908	0.7568	0.7103	0.6355	0.5459	0.4378	0.3390	0.3691	0.5151	0.6650	0.7549	0.7991 (94)	
Useful gains	469.6607	512.5197	533.2866	536.2986	490.9814	389.6958	288.8380	292.9684	373.8404	423.3276	440.5381	455.5923 (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	1169.5132	1153.0846	1067.3099	920.4812	732.2172	508.9555	343.6484	357.7209	534.4372	766.9617	981.7481	1161.3086 (97)	
Space heating kWh	520.6902	430.4597	397.3133	276.6115	179.4794	0.0000	0.0000	0.0000	0.0000	255.6637	389.6712	525.0529 (98a)	
Space heating requirement - total per year (kWh/year)												2974.9420	
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	520.6902	430.4597	397.3133	276.6115	179.4794	0.0000	0.0000	0.0000	0.0000	255.6637	389.6712	525.0529 (98c)	
Space heating requirement after solar contribution - total per year (kWh/year)												2974.9420	
Space heating per m2												(98c) / (4) =	39.9643 (99)

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

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

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

Efficiency of main space heating system 1 (in %) 92.3000 (206)

Efficiency of main space heating system 2 (in %) 0.0000 (207)

Efficiency of secondary/supplementary heating system, % 0.0000 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	520.6902	430.4597	397.3133	276.6115	179.4794	0.0000	0.0000	0.0000	0.0000	255.6637	389.6712	525.0529 (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)	564.1281	466.3702	430.4586	299.6874	194.4522	0.0000	0.0000	0.0000	0.0000	276.9921	422.1790	568.8548 (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	223.0318	197.2061	209.6642	184.9979	179.7122	162.3724	160.6882	166.9048	168.5279	187.3717	198.5140	220.7078 (64)
Efficiency of water heater												79.8000 (216)
(217)m	85.8949	85.7611	85.4703	84.9599	84.0569	79.8000	79.8000	79.8000	79.8000	84.7572	85.5438	85.9318 (217)
Fuel for water heating, kWh/month	259.6566	229.9483	245.3065	217.7474	213.7984	203.4742	201.3637	209.1538	211.1879	221.0688	232.0612	256.8408 (219)
Space cooling fuel requirement												
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041 (231)
Lighting	22.4614	18.0194	16.2244	11.8867	9.1816	7.5015	8.3758	10.8872	14.1414	18.5542	20.9570	23.0857 (232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	-58.3716	-76.6172	-102.6428	-107.3498	-109.4447	-100.0192	-98.7749	-96.2111	-90.9603	-83.5712	-62.1199	-51.1615 (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	-52.7170	-107.8262	-208.9091	-306.2957	-398.0759	-397.4856	-392.7783	-335.6243	-250.1956	-151.5254	-69.4657	-41.9219 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												

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(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												3223.1224	(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												2701.6076	(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)												181.2763	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-3750.0648	(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												2441.9414	(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	3223.1224	0.2100	676.8557	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2701.6076	0.2100	567.3376	(264)
Space and water heating			1244.1933	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	181.2763	0.1443	26.1638	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1037.2441	0.1361	-141.1996	
PV Unit electricity exported	-2712.8207	0.1266	-343.5061	
Total			-484.7057	(269)
Total CO2, kg/year			797.5806	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			10.7100	(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	3223.1224	1.1300	3642.1284	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2701.6076	1.1300	3052.8166	(278)
Space and water heating			6694.9449	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	181.2763	1.5338	278.0476	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1037.2441	1.5032	-1559.1807	
PV Unit electricity exported	-2712.8207	0.4648	-1260.9911	
Total			-2820.1719	(283)
Total Primary energy kWh/year			4282.9214	(286)
Target Primary Energy Rate (TPER)			57.5400	(287)

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Property Reference	Fortfield		Issued on Date	25/01/2024	
Assessment Reference	Green_Copy	Prop Type Ref			
Property	196, Fortfield Road , Bristol, BS14 9NR				
SAP Rating	93 A	DER	1.58	TER	10.71
Environmental	99 A	% DER < TER	85.25		
CO <sub>2</sub> Emissions (t/year)	0.06	DFEE	47.12	TFEE	47.18
Compliance Check	See BREL	% DFEE < TFEE	0.13		
% DPER < TPER	62.66	DPER	21.48	TPER	57.54
Assessor Details	Ms. Natalie Wheeler			Assessor ID	AX45-0001
Client					

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

## 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	74.4400 (1b)	2.4000 (2b)	178.6560 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	74.4400		178.6560 (4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 178.6560 (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	2 * 10 = 20.0000 (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) =	20.0000 / (5) = 0.1119 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	3.0000 (17)
Infiltration rate	0.2619 (18)
Number of sides sheltered	2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.2227 (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	0.2839	0.2783	0.2728	0.2449	0.2394	0.2115	0.2115	0.2060	0.2227	0.2394	0.2505	0.2616 (22b)
Effective ac	0.5403	0.5387	0.5372	0.5300	0.5286	0.5224	0.5224	0.5212	0.5248	0.5286	0.5314	0.5342 (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
Front door			2.1700	1.0000	2.1700		(26)
Windows (Uw = 0.80)			9.3000	0.7752	7.2093		(27)
Patio doors (Uw = 1.00)			3.2300	0.9615	3.1058		(27)
Heatloss Floor			74.4400	0.1700	12.6548	0.0000	0.0000 (28a)
External Wall	112.4200	14.7000	97.7200	0.1600	15.6352	14.0000	1368.0800 (29a)
Wall to store	7.4900		7.4900	0.1600	1.1984	14.0000	104.8600 (29a)
External Roof	74.4400		74.4400	0.1100	8.1884	9.0000	669.9600 (30)
Total net area of external elements Aum(A, m <sup>2</sup> )			268.7900				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 50.1619		(33)
Internal Wall 1			66.0000			14.0000	924.0000 (32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) = 3066.9000		(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							41.1996 (35)

### List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	10.0100	0.0060	0.0601
E3 Sill	7.5000	0.0120	0.0900
E4 Jamb	21.0000	0.0230	0.4830
E5 Ground floor (normal)	46.8400	0.3200	14.9888
E14 Flat roof	46.8400	0.0540	2.5294



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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	8.3934	8.4010	8.4085	8.4439	8.4505	8.4817	8.4817	8.4874	8.4696	8.4505	8.4371	8.4231
alpha	1.5596	1.5601	1.5606	1.5629	1.5634	1.5654	1.5654	1.5658	1.5646	1.5634	1.5625	1.5615
util living area	0.8743	0.8447	0.8022	0.7288	0.6356	0.5259	0.4255	0.4612	0.6164	0.7656	0.8465	0.8816 (86)
MIT	17.5041	17.8204	18.3540	19.0713	19.7398	20.2650	20.5410	20.4916	20.0559	19.1892	18.2252	17.4372 (87)
Th 2	19.7914	19.7924	19.7933	19.7977	19.7986	19.8024	19.8024	19.8031	19.8009	19.7986	19.7969	19.7951 (88)
util rest of house	0.8623	0.8301	0.7828	0.7006	0.5935	0.4619	0.3363	0.3729	0.5576	0.7348	0.8295	0.8702 (89)
MIT 2	15.8993	16.2780	16.9170	17.7674	18.5414	19.1263	19.4041	19.3636	18.9168	17.9268	16.7761	15.8210 (90)
Living area fraction												0.4066 (91)
MIT	16.5519	16.9052	17.5013	18.2976	19.0288	19.5893	19.8664	19.8223	19.3800	18.4401	17.3653	16.4782 (92)
Temperature adjustment												0.0000
adjusted MIT	16.5519	16.9052	17.5013	18.2976	19.0288	19.5893	19.8664	19.8223	19.3800	18.4401	17.3653	16.4782 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.8190	0.7844	0.7365	0.6584	0.5626	0.4492	0.3415	0.3745	0.5337	0.6916	0.7844	0.8278 (94)
Useful gains	456.3265	502.2827	525.5966	530.7550	484.5316	379.0436	275.1441	279.8960	362.7417	414.0299	428.4574	441.4672 (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	1243.5534	1217.4106	1114.6133	948.1433	738.8282	501.1399	328.0823	343.5067	531.0877	790.3782	1036.5199	1241.8284 (97)
Space heating kWh	585.6968	480.5659	438.2284	300.5196	189.1966	0.0000	0.0000	0.0000	0.0000	280.0032	437.8050	595.4688 (98a)
Space heating requirement - total per year (kWh/year)												3307.4843
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	585.6968	480.5659	438.2284	300.5196	189.1966	0.0000	0.0000	0.0000	0.0000	280.0032	437.8050	595.4688 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3307.4843
Space heating per m2										(98c) / (4) =		44.4315 (99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Fraction of main heating from main system 2												0.0000 (203)
Fraction of total heating from main system 1												1.0000 (204)
Fraction of total heating from main system 2												0.0000 (205)
Efficiency of main space heating system 1 (in %)												170.0000 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	585.6968	480.5659	438.2284	300.5196	189.1966	0.0000	0.0000	0.0000	0.0000	280.0032	437.8050	595.4688 (98)
Space heating efficiency (main heating system 1)	170.0000	170.0000	170.0000	170.0000	170.0000	0.0000	0.0000	0.0000	0.0000	170.0000	170.0000	170.0000 (210)
Space heating fuel (main heating system)	344.5275	282.6858	257.7814	176.7762	111.2921	0.0000	0.0000	0.0000	0.0000	164.7078	257.5324	350.2758 (211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)
Space heating fuel used, main system 2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (213)
Water heating												
Water heating requirement	246.0610	217.2378	229.7214	199.2834	191.3818	170.4826	166.7570	174.4356	177.5322	200.3338	215.9387	243.0079 (64)
Efficiency of water heater												360.1646 (216)
(217)m	360.1646	360.1646	360.1646	360.1646	360.1646	360.1646	360.1646	360.1646	360.1646	360.1646	360.1646	360.1646 (217)
Fuel for water heating, kWh/month	68.3190	60.3162	63.7823	55.3312	53.1373	47.3346	46.3002	48.4322	49.2920	55.6229	59.9556	67.4713 (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	9.1041	8.2231	9.1041	8.8104	9.1041	8.8104	9.1041	9.1041	8.8104	9.1041	8.8104	9.1041 (231)
Lighting	23.6328	18.9591	17.0706	12.5066	9.6605	7.8927	8.8126	11.4550	14.8789	19.5219	22.0499	24.2896 (232)
Electricity generated by PVs (Appendix M) (negative quantity)	-68.1946	-108.7109	-173.4450	-210.1900	-230.6695	-188.3171	-185.7744	-174.5112	-152.2138	-130.6701	-79.0863	-57.5172 (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)	-3.6796	-11.2264	-30.8219	-63.5678	-107.5353	-144.1920	-142.3406	-112.1645	-72.3107	-22.6537	-6.1668	-2.6292 (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												1945.5790 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												360.1646
Water heating fuel used												675.2949 (219)
Space cooling fuel												0.0000 (221)
Electricity for pumps and fans:												
warm air heating system fans												107.1936 (230b)
Total electricity for the above, kWh/year												107.1936 (231)
Electricity for lighting (calculated in Appendix L)												190.7304 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-2478.5885 (233)

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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	440.2094 (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	1945.5790	0.1538	299.1804 (261)
Space heating - main system 2	0.0000	0.0000	0.0000 (262)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	675.2949	0.1412	95.3451 (264)
Space and water heating			394.5255 (265)
Pumps, fans and electric keep-hot	107.1936	0.1387	14.8691 (267)
Energy for lighting	190.7304	0.1443	27.5283 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1759.3000	0.1341	-235.9749
PV Unit electricity exported	-719.2885	0.1158	-83.2975
Total			-319.2724 (269)
Total CO2, kg/year			117.6505 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			1.5800 (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	1945.5790	1.5693	3053.2101 (275)
Space heating - main system 2	0.0000	0.0000	0.0000 (276)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	675.2949	1.5221	1027.8563 (278)
Space and water heating			4081.0665 (279)
Pumps, fans and electric keep-hot	107.1936	1.5128	162.1625 (281)
Energy for lighting	190.7304	1.5338	292.5486 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1759.3000	1.4957	-2631.4329
PV Unit electricity exported	-719.2885	0.4243	-305.1679
Total			-2936.6008 (283)
Total Primary energy kWh/year			1599.1767 (286)
Dwelling Primary energy Rate (DPER)			21.4800 (287)

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

### 1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	74.4400 (1b)	2.4000 (2b)	178.6560 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	74.4400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	178.6560 (5)

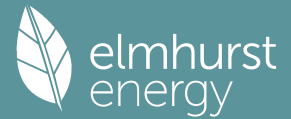
### 2. Ventilation rate

		m3 per hour
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	3 * 10 =	30.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1679 (8)
Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design AP50	5.0000	(17)
Infiltration rate	0.4179	(18)
Number of sides sheltered	2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3552 (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	0.4529	0.4440	0.4352	0.3908	0.3819	0.3375	0.3375	0.3286	0.3552	0.3819	0.3996	0.4174 (22b)
Effective ac	0.6026	0.5986	0.5947	0.5763	0.5729	0.5569	0.5569	0.5540	0.5631	0.5729	0.5799	0.5871 (25)



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### 3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1700	1.0000	2.1700			(26)
TER Opening Type (Uw = 1.20)			12.5300	1.1450	14.3473			(27)
Heatloss Floor			74.4400	0.1300	9.6772			(28a)
External Wall	112.4200	14.7000	97.7200	0.1800	17.5896			(29a)
Wall to store	7.4900		7.4900	0.1800	1.3482			(29a)
External Roof	74.4400		74.4400	0.1100	8.1884			(30)
Total net area of external elements Aum(A, m2)			268.7900					(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	53.3207		(33)

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

List of Thermal Bridges	K1 Element	Length	Psi-value	Total	
E1 Steel lintel with perforated steel base plate		10.0100	0.0500	0.5005	
E3 Sill		7.5000	0.0500	0.3750	
E4 Jamb		21.0000	0.0500	1.0500	
E5 Ground floor (normal)		46.8400	0.1600	7.4944	
E14 Flat roof		46.8400	0.0800	3.7472	
E16 Corner (normal)		26.4000	0.0900	2.3760	
E17 Corner (inverted - internal area greater than external area)		14.4000	-0.0900	-1.2960	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)					14.2471 (36)

Point Thermal bridges													0.0000	
Total fabric heat loss													(33) + (36) + (36a) =	67.5678 (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	35.5253	35.2905	35.0604	33.9793	33.7770	32.8354	32.8354	32.6610	33.1981	33.7770	34.1862	34.6140	(38)
Average = Sum(39)m / 12 =	103.0932	102.8584	102.6282	101.5471	101.3448	100.4032	100.4032	100.2289	100.7659	101.3448	101.7540	102.1818	(39)
HLP	1.3849	1.3818	1.3787	1.3641	1.3614	1.3488	1.3488	1.3464	1.3537	1.3614	1.3669	1.3727	(40)
HLP (average)												1.3641	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

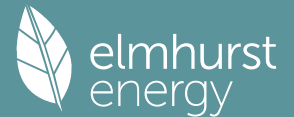
### 4. Water heating energy requirements (kWh/year)

Assumed occupancy														2.3489 (42)
Hot water usage for mixer showers	63.6034	62.6476	61.2547	58.5898	56.6231	54.4299	53.1833	54.5656	56.0809	58.4357	61.1579	63.3597	63.3597	(42a)
Hot water usage for baths	27.4748	27.0667	26.4921	25.4327	24.6393	23.7597	23.2845	23.8551	24.4764	25.4177	26.4989	27.3819	27.3819	(42b)
Hot water usage for other uses	38.6853	37.2786	35.8719	34.4651	33.0584	31.6516	31.6516	33.0584	34.4651	35.8719	37.2786	38.6853	38.6853	(42c)
Average daily hot water use (litres/day)														119.2821 (43)
Daily hot water use	129.7635	126.9929	123.6187	118.4876	114.3208	109.8412	108.1195	111.4791	115.0223	119.7252	124.9354	129.4269	129.4269	(44)
Energy conte	205.5137	180.8362	189.9974	162.2035	153.8978	135.0626	130.7611	138.0344	141.8341	162.4660	177.9934	202.6513	202.6513	(45)
Energy content (annual)														Total = Sum(45)m = 1981.2515
Distribution loss (46)m = 0.15 x (45)m	30.8271	27.1254	28.4996	24.3305	23.0847	20.2594	19.6142	20.7052	21.2751	24.3699	26.6990	30.3977	30.3977	(46)
Water storage loss:														150.0000 (47)
Store volume														1.3938 (48)
a) If manufacturer declared loss factor is known (kWh/day):														0.5400 (49)
Temperature factor from Table 2b														0.7527 (55)
Enter (49) or (54) in (55)														
Total storage loss	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	(56)
If cylinder contains dedicated solar storage	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	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	252.1086	222.9219	236.5923	207.2954	200.4927	180.1545	177.3560	184.6293	186.9259	209.0609	223.0852	249.2462	249.2462	(62)
WWHRS	-29.0768	-25.7158	-26.9281	-22.2975	-20.7805	-17.7820	-16.6678	-17.7245	-18.3980	-21.6892	-24.5712	-28.5384	-28.5384	(63a)
FV 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	223.0318	197.2061	209.6642	184.9979	179.7122	162.3724	160.6882	166.9048	168.5279	187.3717	198.5140	220.7078	220.7078	(64)
12Total per year (kWh/year)														Total per year (kWh/year) = Sum(64)m = 2259.6992 (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	0.0000	2260 (64)
Total Energy used by instantaneous electric shower (s) (kWh/year) = Sum(64a)m =														0.0000 (64a)
Heat gains from water heating, kWh/month	105.6092	93.7966	100.4500	90.0062	88.4469	80.9818	80.7540	83.1724	83.2333	91.2959	95.2563	104.6575	104.6575	(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	117.4462	117.4462	117.4462	117.4462	117.4462	117.4462	117.4462	117.4462	117.4462	117.4462	117.4462	117.4462	117.4462	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	108.1017	119.6840	108.1017	111.7050	108.1017	111.7050	108.1017	108.1017	111.7050	108.1017	111.7050	108.1017	108.1017	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	207.4305	209.5830	204.1588	192.6114	178.0348	164.3349	155.1825	153.0300	158.4542	170.0016	184.5782	198.2781	198.2781	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.7446	34.7446	34.7446	34.7446	34.7446	34.7446	34.7446	34.7446	34.7446	34.7446	34.7446	34.7446	34.7446	(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	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	(71)
Water heating gains (Table 5)	141.9479	139.5783	135.0135	125.0085	118.8803	112.4747	108.5403	111.7908	115.6018	122.7095	132.3004	140.6687	140.6687	(72)
Total internal gains														

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518.7139 530.0791 508.5078 490.5588 466.2506 446.7485 430.0583 431.1563 443.9949 462.0466 489.8175 508.2823 (73)

## 6. Solar gains

[Jan]			Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W				
East			5.4000	19.6403	0.6300	0.7000	0.7700	32.4125 (76)				
West			7.1300	19.6403	0.6300	0.7000	0.7700	42.7965 (80)				
Solar gains	75.2091	147.1249	242.2937	353.3710	433.0694	443.3236	422.0621	362.5451	281.7976	174.5761	93.7769	61.8483 (83)
Total gains	593.9230	677.2040	750.8016	843.9298	899.3200	890.0721	852.1205	793.7015	725.7926	636.6227	583.5944	570.1306 (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	8.2636	8.2824	8.3010	8.3894	8.4061	8.4850	8.4850	8.4997	8.4544	8.4061	8.3723	8.3373
alpha	1.5509	1.5522	1.5534	1.5593	1.5604	1.5657	1.5657	1.5666	1.5636	1.5604	1.5582	1.5558
util living area	0.8654	0.8357	0.7927	0.7177	0.6237	0.5092	0.4089	0.4426	0.5968	0.7513	0.8350	0.8722 (86)
MIT	16.6392	17.0570	17.7644	18.7243	19.6038	20.3022	20.6560	20.5952	20.0367	18.8938	17.6187	16.5668 (87)
Th 2	19.7749	19.7773	19.7797	19.7909	19.7930	19.8028	19.8028	19.8046	19.7990	19.7930	19.7888	19.7843 (88)
util rest of house	0.8526	0.8203	0.7725	0.6888	0.5812	0.4456	0.3217	0.3562	0.5375	0.7193	0.8170	0.8600 (89)
MIT 2	14.9624	15.4617	16.3073	17.4440	18.4598	19.2352	19.5887	19.5399	18.9700	17.6703	16.1517	14.8787 (90)
Living area fraction									fLA = Living area / (4) =			
MIT	15.6442	16.1104	16.8998	17.9646	18.9250	19.6691	20.0227	19.9690	19.4037	18.1678	16.7482	15.5651 (92)
Temperature adjustment												0.0000
adjusted MIT	15.6442	16.1104	16.8998	17.9646	18.9250	19.6691	20.0227	19.9690	19.4037	18.1678	16.7482	15.5651 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.7908	0.7568	0.7103	0.6355	0.5459	0.4378	0.3390	0.3691	0.5151	0.6650	0.7549	0.7991 (94)	
Useful gains	469.6607	512.5197	533.2866	536.2986	490.9814	389.6958	288.8380	292.9684	373.8404	423.3276	440.5381	455.5923 (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	1169.5132	1153.0846	1067.3099	920.4812	732.2172	508.9555	343.6484	357.7209	534.4372	766.9617	981.7481	1161.3086 (97)	
Space heating kWh	520.6902	430.4597	397.3133	276.6115	179.4794	0.0000	0.0000	0.0000	0.0000	255.6637	389.6712	525.0529 (98a)	
Space heating requirement - total per year (kWh/year)												2974.9420	
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	520.6902	430.4597	397.3133	276.6115	179.4794	0.0000	0.0000	0.0000	0.0000	255.6637	389.6712	525.0529 (98c)	
Space heating requirement after solar contribution - total per year (kWh/year)												2974.9420	
Space heating per m2												(98c) / (4) =	39.9643 (99)

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

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

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

Efficiency of main space heating system 1 (in %) 92.3000 (206)

Efficiency of main space heating system 2 (in %) 0.0000 (207)

Efficiency of secondary/supplementary heating system, % 0.0000 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	520.6902	430.4597	397.3133	276.6115	179.4794	0.0000	0.0000	0.0000	0.0000	255.6637	389.6712	525.0529 (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)	564.1281	466.3702	430.4586	299.6874	194.4522	0.0000	0.0000	0.0000	0.0000	276.9921	422.1790	568.8548 (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	223.0318	197.2061	209.6642	184.9979	179.7122	162.3724	160.6882	166.9048	168.5279	187.3717	198.5140	220.7078 (64)
Efficiency of water heater												79.8000 (216)
(217)m	85.8949	85.7611	85.4703	84.9599	84.0569	79.8000	79.8000	79.8000	79.8000	84.7572	85.5438	85.9318 (217)
Fuel for water heating, kWh/month	259.6566	229.9483	245.3065	217.7474	213.7984	203.4742	201.3637	209.1538	211.1879	221.0688	232.0612	256.8408 (219)
Space cooling fuel requirement												
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041 (231)
Lighting	22.4614	18.0194	16.2244	11.8867	9.1816	7.5015	8.3758	10.8872	14.1414	18.5542	20.9570	23.0857 (232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	-58.3716	-76.6172	-102.6428	-107.3498	-109.4447	-100.0192	-98.7749	-96.2111	-90.9603	-83.5712	-62.1199	-51.1615 (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	-52.7170	-107.8262	-208.9091	-306.2957	-398.0759	-397.4856	-392.7783	-335.6243	-250.1956	-151.5254	-69.4657	-41.9219 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												



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(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												3223.1224	(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												2701.6076	(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)												181.2763	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-3750.0648	(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												2441.9414	(238)

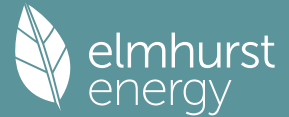
## 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3223.1224	0.2100	676.8557	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2701.6076	0.2100	567.3376	(264)
Space and water heating			1244.1933	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	181.2763	0.1443	26.1638	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1037.2441	0.1361	-141.1996	
PV Unit electricity exported	-2712.8207	0.1266	-343.5061	
Total			-484.7057	(269)
Total CO2, kg/year			797.5806	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			10.7100	(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	3223.1224	1.1300	3642.1284	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2701.6076	1.1300	3052.8166	(278)
Space and water heating			6694.9449	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	181.2763	1.5338	278.0476	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1037.2441	1.5032	-1559.1807	
PV Unit electricity exported	-2712.8207	0.4648	-1260.9911	
Total			-2820.1719	(283)
Total Primary energy kWh/year			4282.9214	(286)
Target Primary Energy Rate (TPER)			57.5400	(287)

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Property Reference	Fortfield		Issued on Date	25/01/2024	
Assessment Reference	Green_Copy	Prop Type Ref			
Property	196, Fortfield Road , Bristol, BS14 9NR				
SAP Rating	93 A	DER	1.58	TER	10.71
Environmental	99 A	% DER < TER	85.25		
CO <sub>2</sub> Emissions (t/year)	0.06	DFEE	47.12	TFEE	47.18
Compliance Check	See BREL	% DFEE < TFEE	0.13		
% DPER < TPER	62.66	DPER	21.48	TPER	57.54
Assessor Details	Ms. Natalie Wheeler			Assessor ID	AX45-0001
Client					

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

## 1. Overall dwelling characteristics

Ground floor		Area (m <sup>2</sup> )	74.4400 (1b)	x	Storey height (m)	2.4000 (2b)	=	Volume (m <sup>3</sup> )	178.6560 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	74.4400								(4)
Dwelling volume								(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	178.6560 (5)

## 2. Ventilation rate

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	2 * 10 =	20.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =		20.0000 / (5) =	0.1119 (8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50			3.0000 (17)
Infiltration rate			0.2619 (18)
Number of sides sheltered			2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.2227 (21)

Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind factor	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Adj infilt rate	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Effective ac	0.2839	0.2783	0.2728	0.2449	0.2394	0.2115	0.2115	0.2060	0.2227	0.2394	0.2505	0.2616	(22b)
	0.5403	0.5387	0.5372	0.5300	0.5286	0.5224	0.5224	0.5212	0.5248	0.5286	0.5314	0.5342	(25)

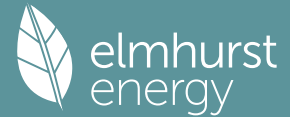
## 3. Heat losses and heat loss parameter

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
Front door			2.1700	1.0000	2.1700		(26)
Windows (Uw = 0.80)			9.3000	0.7752	7.2093		(27)
Patio doors (Uw = 1.00)			3.2300	0.9615	3.1058		(27)
Heatloss Floor			74.4400	0.1700	12.6548	0.0000	0.0000 (28a)
External Wall	112.4200	14.7000	97.7200	0.1600	15.6352	14.0000	1368.0800 (29a)
Wall to store	7.4900		7.4900	0.1600	1.1984	14.0000	104.8600 (29a)
External Roof	74.4400		74.4400	0.1100	8.1884	9.0000	669.9600 (30)
Total net area of external elements Aum(A, m <sup>2</sup> )			268.7900				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	50.1619	(33)
Internal Wall 1			66.0000			14.0000	924.0000 (32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		3066.9000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							41.1996 (35)

### List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	10.0100	0.0060	0.0601
E3 Sill	7.5000	0.0120	0.0900
E4 Jamb	21.0000	0.0230	0.4830
E5 Ground floor (normal)	46.8400	0.3200	14.9888
E14 Flat roof	46.8400	0.0540	2.5294

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E16 Corner (normal)	26.4000	0.0750	1.9800	
E17 Corner (inverted - internal area greater than external area)	14.4000	-0.0450	-0.6480	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)				19.4832 (36)
Point Thermal bridges				0.0000
Total fabric heat loss			(33) + (36) + (36a) =	69.6451 (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	31.8539	31.7617	31.6712	31.2465	31.1671	30.7971	30.7971	30.7286	30.9396	31.1671	31.3278	31.4959 (38)
Average = Sum(39)m / 12 =	101.4990	101.4068	101.3163	100.8916	100.8122	100.4422	100.4422	100.3737	100.5847	100.8122	100.9729	101.1410 (39)

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.3635	1.3623	1.3610	1.3553	1.3543	1.3493	1.3493	1.3484	1.3512	1.3543	1.3564	1.3587 (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													2.3489 (42)
Hot water usage for mixer showers	71.5538	70.4785	68.9116	65.9135	63.7010	61.2337	59.8312	61.3863	63.0910	65.7401	68.8026	71.2797	71.2797 (42a)
Hot water usage for baths	27.4748	27.0667	26.4921	25.4327	24.6393	23.7597	23.2845	23.8551	24.4764	25.4177	26.4989	27.3819	27.3819 (42b)
Hot water usage for other uses	38.6853	37.2786	35.8719	34.4651	33.0584	31.6516	31.6516	33.0584	34.4651	35.8719	37.2786	38.6853	38.6853 (42c)
Average daily hot water use (litres/day)													126.6122 (43)

Daily hot water use	137.7139	134.8238	131.2756	125.8113	121.3987	116.6450	114.7674	118.2998	122.0325	127.0297	132.5801	137.3469	137.3469 (44)
Energy content (annual)	218.1052	191.9874	201.7656	172.2294	163.4260	143.4286	138.8012	146.4798	150.4782	172.3780	188.8847	215.0521	215.0521 (45)
Distribution loss (46)m = 0.15 x (45)m	32.7158	28.7981	30.2648	25.8344	24.5139	21.5143	20.8202	21.9720	22.5717	25.8567	28.3327	32.2578	32.2578 (46)
Water storage loss:													200.0000 (47)
Store volume													1.6700 (48)
a) If manufacturer declared loss factor is known (kWh/day):													0.5400 (49)
Temperature factor from Table 2b													0.9018 (55)
Enter (49) or (54) in (55)													0.9018 (55)
Total storage loss	27.9558	25.2504	27.9558	27.0540	27.9558	27.0540	27.9558	27.9558	27.0540	27.9558	27.0540	27.9558	27.9558 (56)
If cylinder contains dedicated solar storage	27.9558	25.2504	27.9558	27.0540	27.9558	27.0540	27.9558	27.9558	27.0540	27.9558	27.0540	27.9558	27.9558 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)
Total heat required for water heating calculated for each month	246.0610	217.2378	229.7214	199.2834	191.3818	170.4826	166.7570	174.4356	177.5322	200.3338	215.9387	243.0079	243.0079 (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)
Output from w/h	246.0610	217.2378	229.7214	199.2834	191.3818	170.4826	166.7570	174.4356	177.5322	200.3338	215.9387	243.0079	243.0079 (64)
Total per year (kWh/year)	Total per year (kWh/year) = Sum(64)m =											2432.1733 (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	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	72.5200	63.8358	67.0871	57.2663	54.3392	47.6900	46.1514	48.7045	50.0340	57.3157	62.8042	71.5048	71.5048 (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	117.4462	117.4462	117.4462	117.4462	117.4462	117.4462	117.4462	117.4462	117.4462	117.4462	117.4462	117.4462 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	108.1017	119.6840	108.1017	111.7050	108.1017	111.7050	108.1017	108.1017	111.7050	108.1017	111.7050	108.1017 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	207.4305	209.5830	204.1588	192.6114	178.0348	164.3349	155.1825	153.0300	158.4542	170.0016	184.5782	198.2781 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.7446	34.7446	34.7446	34.7446	34.7446	34.7446	34.7446	34.7446	34.7446	34.7446	34.7446	34.7446 (69)
Pumps, fans	10.7194	10.7194	10.7194	10.7194	10.7194	0.0000	0.0000	0.0000	0.0000	10.7194	10.7194	10.7194 (70)
Losses e.g. evaporation (negative values) (Table 5)	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570 (71)
Water heating gains (Table 5)	97.4731	94.9937	90.1708	79.5365	73.0365	66.2361	62.0314	65.4631	69.4917	77.0372	87.2280	96.1086 (72)
Total internal gains	481.9585	493.2139	471.3845	452.8061	428.1262	400.5099	383.5495	384.8286	397.8848	424.0937	452.4645	471.4416 (73)

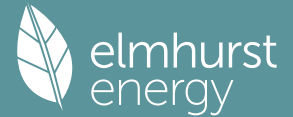
## 6. Solar gains

[Jan]	Area m <sup>2</sup>	Solar flux Table 6a W/m <sup>2</sup>	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W						
East	5.4000	19.6403	0.6300	0.7000	0.7700	32.4125 (76)						
West	3.9000	19.6403	0.6300	0.7000	0.7700	23.4090 (80)						
West	3.2300	19.6403	0.6300	0.7000	0.7700	19.3875 (80)						
Solar gains	75.2091	147.1249	242.2937	353.3710	433.0694	443.3236	422.0621	362.5451	281.7976	174.5761	93.7769	61.8483 (83)
Total gains	557.1675	640.3388	713.6782	806.1771	861.1956	843.8335	805.6116	747.3738	679.6824	598.6698	546.2413	533.2899 (84)

## 7. Mean internal temperature (heating season)

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	8.3934	8.4010	8.4085	8.4439	8.4505	8.4817	8.4817	8.4874	8.4696	8.4505	8.4371	8.4231
alpha	1.5596	1.5601	1.5606	1.5629	1.5634	1.5654	1.5654	1.5658	1.5646	1.5634	1.5625	1.5615
util living area	0.8743	0.8447	0.8022	0.7288	0.6356	0.5259	0.4255	0.4612	0.6164	0.7656	0.8465	0.8816 (86)
MIT	17.5041	17.8204	18.3540	19.0713	19.7398	20.2650	20.5410	20.4916	20.0559	19.1892	18.2252	17.4372 (87)
Th 2	19.7914	19.7924	19.7933	19.7977	19.7986	19.8024	19.8024	19.8031	19.8009	19.7986	19.7969	19.7951 (88)
util rest of house	0.8623	0.8301	0.7828	0.7006	0.5935	0.4619	0.3363	0.3729	0.5576	0.7348	0.8295	0.8702 (89)
MIT 2	15.8993	16.2780	16.9170	17.7674	18.5414	19.1263	19.4041	19.3636	18.9168	17.9268	16.7761	15.8210 (90)
Living area fraction	fLA = Living area / (4) =											0.4066 (91)
MIT	16.5519	16.9052	17.5013	18.2976	19.0288	19.5893	19.8664	19.8223	19.3800	18.4401	17.3653	16.4782 (92)
Temperature adjustment												0.0000
adjusted MIT	16.5519	16.9052	17.5013	18.2976	19.0288	19.5893	19.8664	19.8223	19.3800	18.4401	17.3653	16.4782 (93)

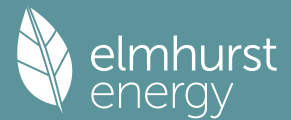
## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.8190	0.7844	0.7365	0.6584	0.5626	0.4492	0.3415	0.3745	0.5337	0.6916	0.7844	0.8278 (94)
Useful gains	456.3265	502.2827	525.5966	530.7550	484.5316	379.0436	275.1441	279.8960	362.7417	414.0299	428.4574	441.4672 (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	1243.5534	1217.4106	1114.6133	948.1433	738.8282	501.1399	328.0823	343.5067	531.0877	790.3782	1036.5199	1241.8284 (97)
Space heating kWh	585.6968	480.5659	438.2284	300.5196	189.1966	0.0000	0.0000	0.0000	0.0000	280.0032	437.8050	595.4688 (98a)
Space heating requirement - total per year (kWh/year)												3307.4843
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	585.6968	480.5659	438.2284	300.5196	189.1966	0.0000	0.0000	0.0000	0.0000	280.0032	437.8050	595.4688 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3307.4843
Space heating per m <sup>2</sup>												(98c) / (4) = 44.4315 (99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Fraction of main heating from main system 2												0.0000 (203)
Fraction of total heating from main system 1												1.0000 (204)
Fraction of total heating from main system 2												0.0000 (205)
Efficiency of main space heating system 1 (in %)												170.0000 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement	585.6968	480.5659	438.2284	300.5196	189.1966	0.0000	0.0000	0.0000	0.0000	280.0032	437.8050	595.4688 (98)
Space heating efficiency (main heating system 1)	170.0000	170.0000	170.0000	170.0000	170.0000	0.0000	0.0000	0.0000	0.0000	170.0000	170.0000	170.0000 (210)
Space heating fuel (main heating system)	344.5275	282.6858	257.7814	176.7762	111.2921	0.0000	0.0000	0.0000	0.0000	164.7078	257.5324	350.2758 (211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)
Space heating fuel used, main system 2												0.0000 (213)
Water heating												
Water heating requirement	246.0610	217.2378	229.7214	199.2834	191.3818	170.4826	166.7570	174.4356	177.5322	200.3338	215.9387	243.0079 (64)
Efficiency of water heater												360.1646 (216)
(217)m	360.1646	360.1646	360.1646	360.1646	360.1646	360.1646	360.1646	360.1646	360.1646	360.1646	360.1646	360.1646 (217)
Fuel for water heating, kWh/month	68.3190	60.3162	63.7823	55.3312	53.1373	47.3346	46.3002	48.4322	49.2920	55.6229	59.9556	67.4713 (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	9.1041	8.2231	9.1041	8.8104	9.1041	8.8104	9.1041	9.1041	8.8104	9.1041	8.8104	9.1041 (231)
Lighting	23.6328	18.9591	17.0706	12.5066	9.6605	7.8927	8.8126	11.4550	14.8789	19.5219	22.0499	24.2896 (232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	-68.1946	-108.7109	-173.4450	-210.1900	-230.6695	-188.3171	-185.7744	-174.5112	-152.2138	-130.6701	-79.0863	-57.5172 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233b)m	-3.6796	-11.2264	-30.8219	-63.5678	-107.5353	-144.1920	-142.3406	-112.1645	-72.3107	-22.6537	-6.1668	-2.6292 (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												1945.5790 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												360.1646
Water heating fuel used												675.2949 (219)
Space cooling fuel												0.0000 (221)
Electricity for pumps and fans:												
warm air heating system fans												107.1936 (230b)
Total electricity for the above, kWh/year												107.1936 (231)
Electricity for lighting (calculated in Appendix L)												190.7304 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-2478.5885 (233)

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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	440.2094 (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	1945.5790	0.1538	299.1804 (261)
Space heating - main system 2	0.0000	0.0000	0.0000 (262)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	675.2949	0.1412	95.3451 (264)
Space and water heating			394.5255 (265)
Pumps, fans and electric keep-hot	107.1936	0.1387	14.8691 (267)
Energy for lighting	190.7304	0.1443	27.5283 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1759.3000	0.1341	-235.9749
PV Unit electricity exported	-719.2885	0.1158	-83.2975
Total			-319.2724 (269)
Total CO2, kg/year			117.6505 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			1.5800 (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	1945.5790	1.5693	3053.2101 (275)
Space heating - main system 2	0.0000	0.0000	0.0000 (276)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	675.2949	1.5221	1027.8563 (278)
Space and water heating			4081.0665 (279)
Pumps, fans and electric keep-hot	107.1936	1.5128	162.1625 (281)
Energy for lighting	190.7304	1.5338	292.5486 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1759.3000	1.4957	-2631.4329
PV Unit electricity exported	-719.2885	0.4243	-305.1679
Total			-2936.6008 (283)
Total Primary energy kWh/year			1599.1767 (286)
Dwelling Primary energy Rate (DPER)			21.4800 (287)

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

### 1. Overall dwelling characteristics

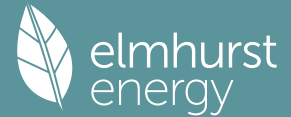
	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	74.4400 (1b)	x 2.4000 (2b)	= 178.6560 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	74.4400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	178.6560 (5)

### 2. Ventilation rate

		m3 per hour
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	3 * 10 =	30.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1679 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.4179 (18)
Number of sides sheltered		2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3552 (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	0.4529	0.4440	0.4352	0.3908	0.3819	0.3375	0.3375	0.3286	0.3552	0.3819	0.3996	0.4174 (22b)
Effective ac	0.6026	0.5986	0.5947	0.5763	0.5729	0.5569	0.5569	0.5540	0.5631	0.5729	0.5799	0.5871 (25)

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### 3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1700	1.0000	2.1700			(26)
TER Opening Type (Uw = 1.20)			12.5300	1.1450	14.3473			(27)
Heatloss Floor			74.4400	0.1300	9.6772			(28a)
External Wall	112.4200	14.7000	97.7200	0.1800	17.5896			(29a)
Wall to store	7.4900		7.4900	0.1800	1.3482			(29a)
External Roof	74.4400		74.4400	0.1100	8.1884			(30)
Total net area of external elements Aum(A, m2)			268.7900					(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	53.3207		(33)

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

41.1996 (35)

#### List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	10.0100	0.0500	0.5005
E3 Sill	7.5000	0.0500	0.3750
E4 Jamb	21.0000	0.0500	1.0500
E5 Ground floor (normal)	46.8400	0.1600	7.4944
E14 Flat roof	46.8400	0.0800	3.7472
E16 Corner (normal)	26.4000	0.0900	2.3760
E17 Corner (inverted - internal area greater than external area)	14.4000	-0.0900	-1.2960

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

14.2471 (36)

#### Point Thermal bridges

(36a) = 0.0000

#### Total fabric heat loss

(33) + (36) + (36a) = 67.5678 (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	35.5253	35.2905	35.0604	33.9793	33.7770	32.8354	32.8354	32.6610	33.1981	33.7770	34.1862	34.6140 (38)
Average = Sum(39)m / 12 =	103.0932	102.8584	102.6282	101.5471	101.3448	100.4032	100.4032	100.2289	100.7659	101.3448	101.7540	102.1818 (39)

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.3849	1.3818	1.3787	1.3641	1.3614	1.3488	1.3488	1.3464	1.3537	1.3614	1.3669	1.3727 (40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

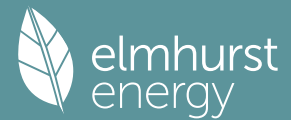
### 4. Water heating energy requirements (kWh/year)

Assumed occupancy													2.3489 (42)
Hot water usage for mixer showers													63.5997 (42a)
Hot water usage for baths													27.3819 (42b)
Hot water usage for other uses													38.6853 (42c)
Average daily hot water use (litres/day)													119.2821 (43)
Daily hot water use	129.7635	126.9929	123.6187	118.4876	114.3208	109.8412	108.1195	111.4791	115.0223	119.7252	124.9354	129.4269 (44)	
Energy content (annual)	205.5137	180.8362	189.9974	162.2035	153.8978	135.0626	130.7611	138.0344	141.8341	162.4660	177.9934	202.6513 (45)	
Distribution loss (46)m = 0.15 x (45)m													1981.2515
Water storage loss:													30.8271 (46)
Store volume													150.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):													1.3938 (48)
Temperature factor from Table 2b													0.5400 (49)
Enter (49) or (54) in (55)													0.7527 (55)
Total storage loss	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325 (56)	
If cylinder contains dedicated solar storage	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325 (57)	
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)	
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)	
Total heat required for water heating calculated for each month	252.1086	222.9219	236.5923	207.2954	200.4927	180.1545	177.3560	184.6293	186.9259	209.0609	223.0852	249.2462 (62)	
WWHRS	-29.0768	-25.7158	-26.9281	-22.2975	-20.7805	-17.7820	-16.6678	-17.7245	-18.3980	-21.6892	-24.5712	-28.5384 (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	223.0318	197.2061	209.6642	184.9979	179.7122	162.3724	160.6882	166.9048	168.5279	187.3717	198.5140	220.7078 (64)	
12Total per year (kWh/year)													2259.6992 (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	105.6092	93.7966	100.4500	90.0062	88.4469	80.9818	80.7540	83.1724	83.2333	91.2959	95.2563	104.6575 (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	117.4462	117.4462	117.4462	117.4462	117.4462	117.4462	117.4462	117.4462	117.4462	117.4462	117.4462	117.4462 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	108.1017	119.6840	108.1017	111.7050	108.1017	111.7050	108.1017	108.1017	111.7050	108.1017	111.7050	108.1017 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	207.4305	209.5830	204.1588	192.6114	178.0348	164.3349	155.1825	153.0300	158.4542	170.0016	184.5782	198.2781 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.7446	34.7446	34.7446	34.7446	34.7446	34.7446	34.7446	34.7446	34.7446	34.7446	34.7446	34.7446 (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)	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570 (71)
Water heating gains (Table 5)	141.9479	139.5783	135.0135	125.0085	118.8803	112.4747	108.5403	111.7908	115.6018	122.7095	132.3004	140.6687 (72)
Total internal gains												

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518.7139 530.0791 508.5078 490.5588 466.2506 446.7485 430.0583 431.1563 443.9949 462.0466 489.8175 508.2823 (73)

## 6. Solar gains

[Jan]												Gains W
	Area m2				Solar flux Table 6a W/m2		Specific data or Table 6b g		Specific data or Table 6c FF		Access factor Table 6d	
East	5.4000				19.6403		0.6300		0.7000		0.7700	32.4125 (76)
West	7.1300				19.6403		0.6300		0.7000		0.7700	42.7965 (80)
Solar gains	75.2091	147.1249	242.2937	353.3710	433.0694	443.3236	422.0621	362.5451	281.7976	174.5761	93.7769	61.8483 (83)
Total gains	593.9230	677.2040	750.8016	843.9298	899.3200	890.0721	852.1205	793.7015	725.7926	636.6227	583.5944	570.1306 (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	8.2636	8.2824	8.3010	8.3894	8.4061	8.4850	8.4850	8.4997	8.4544	8.4061	8.3723	8.3373
alpha	1.5509	1.5522	1.5534	1.5593	1.5604	1.5657	1.5657	1.5666	1.5636	1.5604	1.5582	1.5558
util living area	0.8654	0.8357	0.7927	0.7177	0.6237	0.5092	0.4089	0.4426	0.5968	0.7513	0.8350	0.8722 (86)
MIT	16.6392	17.0570	17.7644	18.7243	19.6038	20.3022	20.6560	20.5952	20.0367	18.8938	17.6187	16.5668 (87)
Th 2	19.7749	19.7773	19.7797	19.7909	19.7930	19.8028	19.8028	19.8046	19.7990	19.7930	19.7888	19.7843 (88)
util rest of house	0.8526	0.8203	0.7725	0.6888	0.5812	0.4456	0.3217	0.3562	0.5375	0.7193	0.8170	0.8600 (89)
MIT 2	14.9624	15.4617	16.3073	17.4440	18.4598	19.2352	19.5887	19.5399	18.9700	17.6703	16.1517	14.8787 (90)
Living area fraction	FLA = Living area / (4) = 0.4066 (91)											
MIT	15.6442	16.1104	16.8998	17.9646	18.9250	19.6691	20.0227	19.9690	19.4037	18.1678	16.7482	15.5651 (92)
Temperature adjustment	0.0000											
adjusted MIT	15.6442	16.1104	16.8998	17.9646	18.9250	19.6691	20.0227	19.9690	19.4037	18.1678	16.7482	15.5651 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.7908	0.7568	0.7103	0.6355	0.5459	0.4378	0.3390	0.3691	0.5151	0.6650	0.7549	0.7991 (94)
Useful gains	469.6607	512.5197	533.2866	536.2986	490.9814	389.6958	288.8380	292.9684	373.8404	423.3276	440.5381	455.5923 (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	1169.5132	1153.0846	1067.3099	920.4812	732.2172	508.9555	343.6484	357.7209	534.4372	766.9617	981.7481	1161.3086 (97)
Space heating kWh	520.6902	430.4597	397.3133	276.6115	179.4794	0.0000	0.0000	0.0000	0.0000	255.6637	389.6712	525.0529 (98a)
Space heating requirement - total per year (kWh/year)	2974.9420											
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	520.6902	430.4597	397.3133	276.6115	179.4794	0.0000	0.0000	0.0000	0.0000	255.6637	389.6712	525.0529 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)	2974.9420											
Space heating per m2	(98c) / (4) = 39.9643 (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 %)	92.3000 (206)											
Efficiency of main space heating system 2 (in %)	0.0000 (207)											
Efficiency of secondary/supplementary heating system, %	0.0000 (208)											
Space heating requirement	520.6902	430.4597	397.3133	276.6115	179.4794	0.0000	0.0000	0.0000	0.0000	255.6637	389.6712	525.0529 (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)	564.1281	466.3702	430.4586	299.6874	194.4522	0.0000	0.0000	0.0000	0.0000	276.9921	422.1790	568.8548 (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	223.0318	197.2061	209.6642	184.9979	179.7122	162.3724	160.6882	166.9048	168.5279	187.3717	198.5140	220.7078 (64)
Efficiency of water heater (217)m	85.8949	85.7611	85.4703	84.9599	84.0569	79.8000	79.8000	79.8000	79.8000	84.7572	85.5438	79.8000 (216)
Fuel for water heating, kWh/month	259.6566	229.9483	245.3065	217.7474	213.7984	203.4742	201.3637	209.1538	211.1879	221.0688	232.0612	256.8408 (219)
Space cooling fuel requirement												
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041 (231)
Lighting	22.4614	18.0194	16.2244	11.8867	9.1816	7.5015	8.3758	10.8872	14.1414	18.5542	20.9570	23.0857 (232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	-58.3716	-76.6172	-102.6428	-107.3498	-109.4447	-100.0192	-98.7749	-96.2111	-90.9603	-83.5712	-62.1199	-51.1615 (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	-52.7170	-107.8262	-208.9091	-306.2957	-398.0759	-397.4856	-392.7783	-335.6243	-250.1956	-151.5254	-69.4657	-41.9219 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												

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(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												3223.1224	(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												2701.6076	(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)												181.2763	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-3750.0648	(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												2441.9414	(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	3223.1224	0.2100	676.8557	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2701.6076	0.2100	567.3376	(264)
Space and water heating			1244.1933	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	181.2763	0.1443	26.1638	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1037.2441	0.1361	-141.1996	
PV Unit electricity exported	-2712.8207	0.1266	-343.5061	
Total			-484.7057	(269)
Total CO2, kg/year			797.5806	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			10.7100	(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	3223.1224	1.1300	3642.1284	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2701.6076	1.1300	3052.8166	(278)
Space and water heating			6694.9449	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	181.2763	1.5338	278.0476	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1037.2441	1.5032	-1559.1807	
PV Unit electricity exported	-2712.8207	0.4648	-1260.9911	
Total			-2820.1719	(283)
Total Primary energy kWh/year			4282.9214	(286)
Target Primary Energy Rate (TPER)			57.5400	(287)

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

### 1. Overall dwelling characteristics

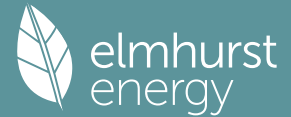
	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )	
Ground floor	74.4400 (1b)	2.4000 (2b)	178.6560 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	74.4400		(4)	
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 178.6560 (5)	

### 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)
Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1679 (8)



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Pressure test													Yes
Pressure Test Method													Blower Door
Measured/design AP50													3.0000 (17)
Infiltration rate													0.3179 (18)
Number of sides sheltered													2 (19)
Shelter factor													(20) = 1 - [0.075 x (19)] = 0.8500 (20)
Infiltration rate adjusted to include shelter factor													(21) = (18) x (20) = 0.2702 (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	0.3445	0.3378	0.3310	0.2973	0.2905	0.2567	0.2567	0.2500	0.2702	0.2905	0.3040	0.3175	(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	0.5594	0.5571	0.5548	0.5442	0.5422	0.5330	0.5330	0.5312	0.5365	0.5422	0.5462	0.5504	(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	
Front door			2.1700	1.0000	2.1700			(26)
Windows (Uw = 0.80)			9.3000	0.7752	7.2093			(27)
Patio doors (Uw = 1.00)			3.2300	0.9615	3.1058			(27)
Heatloss Floor			74.4400	0.1700	12.6548	0.0000	0.0000	(28a)
External Wall	112.4200	14.7000	97.7200	0.1600	15.6352	14.0000	1368.0800	(29a)
Wall to store	7.4900		7.4900	0.1600	1.1984	14.0000	104.8600	(29a)
External Roof	74.4400		74.4400	0.1100	8.1884	9.0000	669.9600	(30)
Total net area of external elements Aum(A, m2)			268.7900					(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 50.1619			(33)
Internal Wall 1			66.0000			14.0000	924.0000	(32c)
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 3066.9000	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							41.1996	(35)

#### List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	10.0100	0.0060	0.0601
E3 Sill	7.5000	0.0120	0.0900
E4 Jamb	21.0000	0.0230	0.4830
E5 Ground floor (normal)	46.8400	0.3200	14.9888
E14 Flat roof	46.8400	0.0540	2.5294
E16 Corner (normal)	26.4000	0.0750	1.9800
E17 Corner (inverted - internal area greater than external area)	14.4000	-0.0450	-0.6480
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			19.4832 (36)
Point Thermal bridges			(36a) = 0.0000
Total fabric heat loss			(33) + (36) + (36a) = 69.6451 (37)

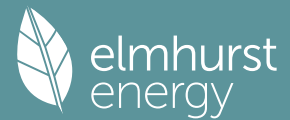
#### Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	32.9777	32.8418	32.7086	32.0830	31.9659	31.4210	31.4210	31.3201	31.6309	31.9659	32.2027	32.4503 (38)
Average = Sum(39)m / 12 =	102.6228	102.4869	102.3537	101.7281	101.6110	101.0661	101.0661	100.9652	101.2760	101.6110	101.8478	102.0954 (39)
HLP	1.3786	1.3768	1.3750	1.3666	1.3650	1.3577	1.3577	1.3563	1.3605	1.3650	1.3682	1.3715 (40)
HLP (average)												1.3666
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

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

Assumed occupancy													2.3489 (42)
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)
Hot water usage for baths	27.4748	27.0667	26.4921	25.4327	24.6393	23.7597	23.2845	23.8551	24.4764	25.4177	26.4989	27.3819	(42b)
Hot water usage for other uses	38.6853	37.2786	35.8719	34.4651	33.0584	31.6516	31.6516	33.0584	34.4651	35.8719	37.2786	38.6853	(42c)
Average daily hot water use (litres/day)													60.6419 (43)
Daily hot water use	66.1601	64.3453	62.3640	59.8978	57.6977	55.4113	54.9362	56.9135	58.9415	61.2895	63.7775	66.0672	(44)
Energy conte	104.7814	91.6269	95.8511	81.9971	77.6722	68.1347	66.4405	70.4708	72.6808	83.1693	90.8628	103.4453	(45)
Energy content (annual)										Total = Sum(45)m =			1007.1328
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
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	89.0642	77.8829	81.4735	69.6975	66.0214	57.9145	56.4745	59.9002	61.7786	70.6939	77.2334	87.9285	(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	89.0642	77.8829	81.4735	69.6975	66.0214	57.9145	56.4745	59.9002	61.7786	70.6939	77.2334	87.9285	(64)
12Total per year (kWh/year)										Total per year (kWh/year) = Sum(64)m =			856.0629 (64)
Electric shower(s)	50.9357	45.3842	49.5578	47.2924	48.1798	45.9588	47.4908	48.1798	47.2924	49.5578	48.6259	50.9357	(64a)
Heat gains from water heating, kWh/month	35.0000	30.8168	32.7578	29.2475	28.5503	25.9683	25.9913	27.0200	27.2678	30.0629	31.4648	34.7161	(65)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =													579.3910 (64a)

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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	117.4462	117.4462	117.4462	117.4462	117.4462	117.4462	117.4462	117.4462	117.4462	117.4462	117.4462	117.4462
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	108.1017	119.6840	108.1017	111.7050	108.1017	111.7050	108.1017	108.1017	111.7050	108.1017	111.7050	108.1017
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	207.4305	209.5830	204.1588	192.6114	178.0348	164.3349	155.1825	153.0300	158.4542	170.0016	184.5782	198.2781
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.7446	34.7446	34.7446	34.7446	34.7446	34.7446	34.7446	34.7446	34.7446	34.7446	34.7446	34.7446
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
Losses e.g. evaporation (negative values) (Table 5)	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570
Water heating gains (Table 5)	47.0430	45.8583	44.0293	40.6215	38.3741	36.0671	34.9346	36.3172	37.8719	40.4071	43.7011	46.6614
Total internal gains	420.8090	433.3591	414.5236	403.1718	382.7444	370.3409	356.4526	355.6827	366.2650	376.7443	398.2182	411.2750

## 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					
East	5.4000	19.6403	0.6300	0.7000	0.7700	32.4125						
West	3.9000	19.6403	0.6300	0.7000	0.7700	23.4090						
West	3.2300	19.6403	0.6300	0.7000	0.7700	19.3875						
Solar gains	75.2091	147.1249	242.2937	353.3710	433.0694	443.3236	422.0621	362.5451	281.7976	174.5761	93.7769	61.8483
Total gains	496.0181	580.4840	656.8174	756.5427	815.8138	813.6645	778.5147	718.2279	648.0626	551.3204	491.9951	473.1233

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	8.3014	8.3124	8.3233	8.3745	8.3841	8.4293	8.4293	8.4377	8.4118	8.3841	8.3646	8.3443
alpha	1.5534	1.5542	1.5549	1.5583	1.5589	1.5620	1.5620	1.5625	1.5608	1.5589	1.5576	1.5563
util living area	0.8919	0.8627	0.8207	0.7465	0.6532	0.5387	0.4371	0.4748	0.6323	0.7861	0.8652	0.8987
MIT	16.3930	16.8313	17.5686	18.5700	19.4955	20.2356	20.6174	20.5471	19.9420	18.7239	17.3917	16.3070
Th 2	19.7798	19.7812	19.7826	19.7891	19.7903	19.7959	19.7970	19.7970	19.7937	19.7903	19.7878	19.7852
util rest of house	0.8812	0.8492	0.8024	0.7191	0.6115	0.4741	0.3463	0.3850	0.5736	0.7567	0.8497	0.8886
MIT 2	15.6072	16.0372	16.7600	17.7327	18.6103	19.2851	19.6000	19.5531	19.0437	17.9039	16.6017	15.5261
Living area fraction	fLA = Living area / (4) =											
MIT	15.9267	16.3601	17.0888	18.0732	18.9703	19.6716	20.0137	19.9573	19.4090	18.2374	16.9229	15.8436
Temperature adjustment	0.0000											
adjusted MIT	15.9267	16.3601	17.0888	18.0732	18.9703	19.6716	20.0137	19.9573	19.4090	18.2374	16.9229	15.8436

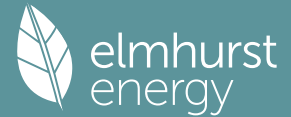
## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.8328	0.7974	0.7495	0.6714	0.5787	0.4667	0.3641	0.3982	0.5519	0.7086	0.7990	0.8414
Useful gains	413.0774	462.8511	492.2771	507.9575	472.1476	379.7580	283.4693	285.9652	357.6370	390.6417	393.1236	398.1054
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	1193.1677	1174.5083	1083.8014	933.1699	738.7417	512.5653	345.0095	359.1657	537.6694	776.0398	1000.4446	1188.7603
Space heating kWh	580.3871	478.2337	440.0941	306.1529	198.3460	0.0000	0.0000	0.0000	0.0000	286.7362	437.2711	588.2472
Space heating requirement - total per year (kWh/year)	3315.4685											
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
Solar heating contribution - total per year (kWh/year)	0.0000											
Space heating kWh	580.3871	478.2337	440.0941	306.1529	198.3460	0.0000	0.0000	0.0000	0.0000	286.7362	437.2711	588.2472
Space heating requirement after solar contribution - total per year (kWh/year)	3315.4685											
Space heating per m <sup>2</sup>	(98c) / (4) = 44.5388											

## 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	950.0214	747.8892	767.3356	0.0000	0.0000	0.0000	0.0000
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.5956	0.6545	0.6225	0.0000	0.0000	0.0000	0.0000
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	565.8535	489.4828	477.6537	0.0000	0.0000	0.0000	0.0000
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	907.3929	868.5108	800.1798	0.0000	0.0000	0.0000	0.0000
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	245.9084	281.9968	239.9595	0.0000	0.0000	0.0000	0.0000
Cooled fraction	fc = cooled area / (4) = 1.0000											
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
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	61.4771	70.4992	59.9899	0.0000	0.0000	0.0000	0.0000
Space cooling requirement	191.9662											
Energy for space heating	44.5388											
Energy for space cooling	2.5788											
Total	47.1176											
Fabric Energy Efficiency (DFEE)	47.1											

# Full SAP Calculation Printout



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	74.4400 (1b)	x 2.4000 (2b)	= 178.6560 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	74.4400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 178.6560 (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)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1679 (8)
Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design AP50	5.0000	(17)
Infiltration rate	0.4179	(18)
Number of sides sheltered	2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3552 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infiltr rate	0.4529	0.4440	0.4352	0.3908	0.3819	0.3375	0.3375	0.3286	0.3552	0.3819	0.3996	0.4174 (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	0.6026	0.5986	0.5947	0.5763	0.5729	0.5569	0.5569	0.5540	0.5631	0.5729	0.5799	0.5871 (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			2.1700	1.0000	2.1700		(26)
TER Opening Type (Uw = 1.20)			12.5300	1.1450	14.3473		(27)
Heatloss Floor			74.4400	0.1300	9.6772		(28a)
External Wall	112.4200	14.7000	97.7200	0.1800	17.5896		(29a)
Wall to store	7.4900		7.4900	0.1800	1.3482		(29a)
External Roof	74.4400		74.4400	0.1100	8.1884		(30)
Total net area of external elements Aum(A, m <sup>2</sup> )			268.7900				(31)
Fabric heat loss, W/K = Sum (A x U)					53.3207		(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							41.1996 (35)

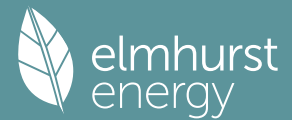
List of Thermal Bridges	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	10.0100	0.0500	0.5005
E3 Sill	7.5000	0.0500	0.3750
E4 Jamb	21.0000	0.0500	1.0500
E5 Ground floor (normal)	46.8400	0.1600	7.4944
E14 Flat roof	46.8400	0.0800	3.7472
E16 Corner (normal)	26.4000	0.0900	2.3760
E17 Corner (inverted - internal area greater than external area)	14.4000	-0.0900	-1.2960
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			14.2471 (36)
Point Thermal bridges			(36a) = 0.0000
Total fabric heat loss			(33) + (36) + (36a) = 67.5678 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	35.5253	35.2905	35.0604	33.9793	33.7770	32.8354	32.8354	32.6610	33.1981	33.7770	34.1862	34.6140 (38)
Heat transfer coeff	103.0932	102.8584	102.6282	101.5471	101.3448	100.4032	100.4032	100.2289	100.7659	101.3448	101.7540	102.1818 (39)
Average = Sum(39)m / 12 =												101.5461
HLP	1.3849	1.3818	1.3787	1.3641	1.3614	1.3488	1.3488	1.3464	1.3537	1.3614	1.3669	1.3727 (40)
HLP (average)												1.3641
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

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

Assumed occupancy	2.3489 (42)											
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (42a)

# Full SAP Calculation Printout



Hot water usage for baths	27.4748	27.0667	26.4921	25.4327	24.6393	23.7597	23.2845	23.8551	24.4764	25.4177	26.4989	27.3819 (42b)
Hot water usage for other uses	38.6853	37.2786	35.8719	34.4651	33.0584	31.6516	31.6516	33.0584	34.4651	35.8719	37.2786	38.6853 (42c)
Average daily hot water use (litres/day)												60.6419 (43)
Daily hot water use	66.1601	64.3453	62.3640	59.8978	57.6977	55.4113	54.9362	56.9135	58.9415	61.2895	63.7775	66.0672 (44)
Energy content (annual)	104.7814	91.6269	95.8511	81.9971	77.6722	68.1347	66.4405	70.4708	72.6808	83.1693	90.8628	103.4453 (45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage												
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	89.0642	77.8829	81.4735	69.6975	66.0214	57.9145	56.4745	59.9002	61.7786	70.6939	77.2334	87.9285 (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	89.0642	77.8829	81.4735	69.6975	66.0214	57.9145	56.4745	59.9002	61.7786	70.6939	77.2334	87.9285 (64)
12Total per year (kWh/year)												856.0629 (64)
Electric shower(s)	50.9357	45.3842	49.5578	47.2924	48.1798	45.9588	47.4908	48.1798	47.2924	49.5578	48.6259	50.9357 (64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												579.3910 (64a)
Heat gains from water heating, kWh/month	35.0000	30.8168	32.7578	29.2475	28.5503	25.9683	25.9913	27.0200	27.2678	30.0629	31.4648	34.7161 (65)

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

Metabolic gains (Table 5), Watts	117.4462	117.4462	117.4462	117.4462	117.4462	117.4462	117.4462	117.4462	117.4462	117.4462	117.4462	117.4462 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	108.1017	119.6840	108.1017	111.7050	108.1017	111.7050	108.1017	111.7050	108.1017	111.7050	108.1017	108.1017 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	207.4305	209.5830	204.1588	192.6114	178.0348	164.3349	155.1825	153.0300	158.4542	170.0016	184.5782	198.2781 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.7446	34.7446	34.7446	34.7446	34.7446	34.7446	34.7446	34.7446	34.7446	34.7446	34.7446	34.7446 (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)	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570 (71)
Water heating gains (Table 5)	47.0430	45.8583	44.0293	40.6215	38.3741	36.0671	34.9346	36.3172	37.8719	40.4071	43.7011	46.6614 (72)
Total internal gains	420.8090	433.3591	414.5236	403.1718	382.7444	370.3409	356.4526	355.6827	366.2650	376.7443	398.2182	411.2750 (73)

## 6. Solar gains

[Jan]	Area m <sup>2</sup>	Solar flux Table 6a W/m <sup>2</sup>	Specific data or Table 6b	g	Specific data or Table 6c	FF	Access factor Table 6d	Gains W				
East	5.4000	19.6403	0.6300	0.7000	0.7700		32.4125 (76)					
West	7.1300	19.6403	0.6300	0.7000	0.7700		42.7965 (80)					
Solar gains	75.2091	147.1249	242.2937	353.3710	433.0694	443.3236	422.0621	362.5451	281.7976	174.5761	93.7769	61.8483 (83)
Total gains	496.0181	580.4840	656.8174	756.5427	815.8138	813.6645	778.5147	718.2279	648.0626	551.3204	491.9951	473.1233 (84)

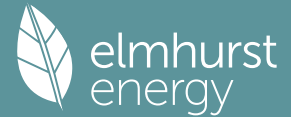
## 7. Mean internal temperature (heating season)

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)												
tau	8.2636	8.2824	8.3010	8.3894	8.4061	8.4850	8.4850	8.4997	8.4544	8.4061	8.3723	8.3373
alpha	1.5509	1.5522	1.5534	1.5593	1.5604	1.5657	1.5657	1.5666	1.5636	1.5604	1.5582	1.5558
util living area	0.8922	0.8629	0.8210	0.7463	0.6527	0.5371	0.4355	0.4730	0.6312	0.7857	0.8651	0.8987 (86)
MIT	16.3812	16.8218	17.5619	18.5739	19.5000	20.2427	20.6216	20.5524	19.9483	18.7288	17.3938	16.3048 (87)
Th 2	19.7749	19.7773	19.7797	19.7909	19.7930	19.8028	19.8028	19.8046	19.7990	19.7930	19.7888	19.7843 (88)
util rest of house	0.8814	0.8495	0.8027	0.7188	0.6111	0.4729	0.3453	0.3839	0.5727	0.7564	0.8496	0.8886 (89)
MIT 2	15.5930	16.0257	16.7518	17.7376	18.6162	19.2959	19.6085	19.5629	19.0527	17.9102	16.6043	15.5234 (90)
Living area fraction												0.4066 (91)
MIT	15.9135	16.3494	17.0812	18.0777	18.9756	19.6809	20.0205	19.9652	19.4169	18.2431	16.9253	15.8412 (92)
Temperature adjustment												0.0000
adjusted MIT	15.9135	16.3494	17.0812	18.0777	18.9756	19.6809	20.0205	19.9652	19.4169	18.2431	16.9253	15.8412 (93)

## 8. Space heating requirement

Utilisation	0.8330	0.7976	0.7497	0.6712	0.5784	0.4657	0.3631	0.3970	0.5511	0.7083	0.7990	0.8415 (94)
Useful gains	413.1976	462.9944	492.4311	507.8009	471.8421	378.9074	282.6960	285.1642	357.1699	390.4975	393.0937	398.1250 (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	1197.2732	1177.6710	1085.9340	931.9647	737.3415	510.1412	343.4251	357.3408	535.7604	774.5837	999.7654	1189.5179 (97)
Space heating kWh	583.3523	480.2627	441.5662	305.3979	197.5316	0.0000	0.0000	0.0000	0.0000	285.7601	436.8037	588.7963 (98a)

# Full SAP Calculation Printout



Space heating requirement - total per year (kWh/year)												3319.4707	
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	0.0000 (98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh													
	583.3523	480.2627	441.5662	305.3979	197.5316	0.0000	0.0000	0.0000	0.0000	285.7601	436.8037	588.7963	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3319.4707	
Space heating per m2												(98c) / (4) = 44.5926 (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	943.7905	742.9840	761.7394	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.5982	0.6570	0.6253	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	564.5710	488.1548	476.3442	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	907.3929	868.5108	800.1798	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	246.8318	282.9848	240.9338	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction													
Intermittency factor (Table 10b)													
	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	61.7079	70.7462	60.2334	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement													
Energy for space heating													
Energy for space cooling													
Total													
Fabric Energy Efficiency (TFEE)													

## 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	74.4400 (1b)	x 2.4000 (2b)	= 178.6560 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	74.4400		(4)	
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	178.6560 (5)	

### 2. Ventilation rate

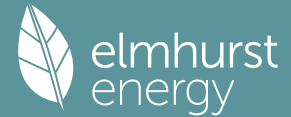
		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000 (6a)	
Number of open flues	0 * 20 =	0.0000 (6b)	
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)	
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)	
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)	
Number of blocked chimneys	0 * 20 =	0.0000 (6f)	
Number of intermittent extract fans	2 * 10 =	20.0000 (7a)	
Number of passive vents	0 * 10 =	0.0000 (7b)	
Number of flueless gas fires	0 * 40 =	0.0000 (7c)	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1119 (8)	Air changes per hour
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design APF50		3.0000 (17)	
Infiltration rate		0.2619 (18)	
Number of sides sheltered		2 (19)	
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)	
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2227 (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													
	0.2839	0.2783	0.2728	0.2449	0.2394	0.2115	0.2115	0.2060	0.2227	0.2394	0.2505	0.2616	(22b)
Effective ac	0.5403	0.5387	0.5372	0.5300	0.5286	0.5224	0.5224	0.5212	0.5248	0.5286	0.5314	0.5342	(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	
Front door			2.1700	1.0000	2.1700			(26)
Windows (Uw = 0.80)			9.3000	0.7752	7.2093			(27)
Patio doors (Uw = 1.00)			3.2300	0.9615	3.1058			(27)
Heatloss Floor			74.4400	0.1700	12.6548	0.0000	0.0000	(28a)
External Wall	112.4200	14.7000	97.7200	0.1600	15.6352	14.0000	1368.0800	(29a)
Wall to store	7.4900		7.4900	0.1600	1.1984	14.0000	104.8600	(29a)
External Roof	74.4400		74.4400	0.1100	8.1884	9.0000	669.9600	(30)
Total net area of external elements Aum(A, m2)			268.7900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		50.1619			(33)

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Internal Wall 1 66.0000 14.0000 924.0000 (32c)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 3066.9000 (34)  
 Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 41.1996 (35)

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	10.0100	0.0060	0.0601
E3 Sill	7.5000	0.0120	0.0900
E4 Jamb	21.0000	0.0230	0.4830
E5 Ground floor (normal)	46.8400	0.3200	14.9888
E14 Flat roof	46.8400	0.0540	2.5294
E16 Corner (normal)	26.4000	0.0750	1.9800
E17 Corner (inverted - internal area greater than external area)	14.4000	-0.0450	-0.6480
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			19.4832 (36)
Point Thermal bridges			0.0000 (36a) =
Total fabric heat loss			69.6451 (33) + (36) + (36a) = (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	31.8539	31.7617	31.6712	31.2465	31.1671	30.7971	30.7971	30.7286	30.9396	31.1671	31.3278	31.4959 (38)
Heat transfer coeff	101.4990	101.4068	101.3163	100.8916	100.8122	100.4422	100.4422	100.3737	100.5847	100.8122	100.9729	101.1410 (39)
Average = Sum(39)m / 12 =												100.8912
HLP	1.3635	1.3623	1.3610	1.3553	1.3543	1.3493	1.3493	1.3484	1.3512	1.3543	1.3564	1.3587 (40)
HLP (average)												1.3553
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

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

Assumed occupancy	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hot water usage for mixer showers	71.5538	70.4785	68.9116	65.9135	63.7010	61.2337	59.8312	61.3863	63.0910	65.7401	68.8026	71.2797 (42a)
Hot water usage for baths	27.4748	27.0667	26.4921	25.4327	24.6393	23.7597	23.2845	23.8551	24.4764	25.4177	26.4989	27.3819 (42b)
Hot water usage for other uses	38.6853	37.2786	35.8719	34.4651	33.0584	31.6516	31.6516	33.0584	34.4651	35.8719	37.2786	38.6853 (42c)
Average daily hot water use (litres/day)												126.6122 (43)
Daily hot water use	137.7139	134.8238	131.2756	125.8113	121.3987	116.6450	114.7674	118.2998	122.0325	127.0297	132.5801	137.3469 (44)
Energy conte	218.1052	191.9874	201.7656	172.2294	163.4260	143.4286	138.8012	146.4798	150.4782	172.3780	188.8847	215.0521 (45)
Energy content (annual)												Total = Sum(45)m = 2103.0163
Distribution loss (46)m = 0.15 x (45)m	32.7158	28.7981	30.2648	25.8344	24.5139	21.5143	20.8202	21.9720	22.5717	25.8567	28.3327	32.2578 (46)
Water storage loss:												
Store volume												200.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6700 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.9018 (55)
Total storage loss	27.9558	25.2504	27.9558	27.0540	27.9558	27.0540	27.9558	27.9558	27.0540	27.9558	27.0540	27.9558 (56)
If cylinder contains dedicated solar storage	27.9558	25.2504	27.9558	27.0540	27.9558	27.0540	27.9558	27.9558	27.0540	27.9558	27.0540	27.9558 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)
Total heat required for water heating calculated for each month	246.0610	217.2378	229.7214	199.2834	191.3818	170.4826	166.7570	174.4356	177.5322	200.3338	215.9387	243.0079 (62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000 (63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63d)
Output from w/h	246.0610	217.2378	229.7214	199.2834	191.3818	170.4826	166.7570	174.4356	177.5322	200.3338	215.9387	243.0079 (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	72.5200	63.8358	67.0871	57.2663	54.3392	47.6900	46.1514	48.7045	50.0340	57.3157	62.8042	71.5048 (65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	140.9354	140.9354	140.9354	140.9354	140.9354	140.9354	140.9354	140.9354	140.9354	140.9354	140.9354	140.9354 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.9999	23.9810	19.5027	14.7648	11.0369	9.3178	10.0682	13.0870	17.5654	22.3033	26.0312	27.7503 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	309.5978	312.8104	304.7146	287.4797	265.7236	245.2760	231.6157	228.4030	236.4988	253.7338	275.4899	295.9375 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	51.4425	51.4425	51.4425	51.4425	51.4425	51.4425	51.4425	51.4425	51.4425	51.4425	51.4425	51.4425 (69)
Pumps, fans	10.7194	10.7194	10.7194	10.7194	10.7194	0.0000	0.0000	0.0000	0.0000	10.7194	10.7194	10.7194 (70)
Losses e.g. evaporation (negative values) (Table 5)	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570 (71)
Water heating gains (Table 5)	97.4731	94.9937	90.1708	79.5365	73.0365	66.2361	62.0314	65.4631	69.4917	77.0372	87.2280	96.1086 (72)
Total internal gains	543.2110	540.9255	523.5284	490.9212	458.9373	419.2508	402.1363	405.3741	421.9768	462.2146	497.8894	528.9367 (73)

#### 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
East	5.4000	19.6403	0.6300	0.7000	0.7700	32.4125 (76)
West	3.9000	19.6403	0.6300	0.7000	0.7700	23.4090 (80)
West	3.2300	19.6403	0.6300	0.7000	0.7700	19.3875 (80)

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Solar gains	75.2091	147.1249	242.2937	353.3710	433.0694	443.3236	422.0621	362.5451	281.7976	174.5761	93.7769	61.8483 (83)
Total gains	618.4201	688.0504	765.8222	844.2922	892.0067	862.5744	824.1984	767.9192	703.7745	636.7907	591.6662	590.7850 (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	8.3934	8.4010	8.4085	8.4439	8.4505	8.4817	8.4817	8.4874	8.4696	8.4505	8.4371	8.4231
alpha	1.5596	1.5601	1.5606	1.5629	1.5634	1.5654	1.5654	1.5658	1.5646	1.5634	1.5625	1.5615
util living area	0.8574	0.8312	0.7865	0.7165	0.6250	0.5190	0.4187	0.4530	0.6058	0.7504	0.8316	0.8657 (86)
MIT	17.6222	17.9055	18.4359	19.1192	19.7678	20.2760	20.5475	20.5003	20.0763	19.2429	18.3067	17.5507 (87)
Th 2	19.7914	19.7924	19.7933	19.7977	19.7986	19.8024	19.8024	19.8031	19.8009	19.7986	19.7969	19.7951 (88)
util rest of house	0.8441	0.8157	0.7662	0.6877	0.5827	0.4552	0.3304	0.3654	0.5467	0.7185	0.8134	0.8532 (89)
MIT 2	16.0389	16.3778	17.0114	17.8207	18.5705	19.1361	19.4086	19.3700	18.9364	17.9863	16.8709	15.9555 (90)
Living area fraction												fLA = Living area / (4) = 0.4066 (91)
MIT	16.6827	16.9990	17.5906	18.3488	19.0574	19.5996	19.8717	19.8296	19.3999	18.4972	17.4548	16.6042 (92)
Temperature adjustment												0.0000
adjusted MIT	16.6827	16.9990	17.5906	18.3488	19.0574	19.5996	19.8717	19.8296	19.3999	18.4972	17.4548	16.6042 (93)

## 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.7992	0.7694	0.7200	0.6464	0.5529	0.4432	0.3359	0.3676	0.5240	0.6761	0.7676	0.8090 (94)
Useful gains	494.2700	529.3827	551.4226	545.7124	493.1934	382.2859	276.8876	282.2613	368.7853	430.5587	454.1873	477.9580 (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												
	1256.8348	1226.9222	1123.6614	953.3000	741.7152	502.1703	328.6186	344.2437	533.0905	796.1387	1045.5513	1254.5720 (97)
Space heating kWh												
	567.3482	468.7465	425.7457	293.4631	184.9002	0.0000	0.0000	0.0000	0.0000	271.9915	425.7820	577.8009 (98a)
Space heating requirement - total per year (kWh/year)												3215.7781
Solar heating kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (98b)
Solar heating contribution - total per year (kWh/year)												0.0000
Space heating kWh												
	567.3482	468.7465	425.7457	293.4631	184.9002	0.0000	0.0000	0.0000	0.0000	271.9915	425.7820	577.8009 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3215.7781
Space heating per m2												(98c) / (4) = 43.1996 (99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Fraction of main heating from main system 2												0.0000 (203)
Fraction of total heating from main system 1												1.0000 (204)
Fraction of total heating from main system 2												0.0000 (205)
Efficiency of main space heating system 1 (in %)												170.0000 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	567.3482	468.7465	425.7457	293.4631	184.9002	0.0000	0.0000	0.0000	0.0000	271.9915	425.7820	577.8009 (98)
Space heating efficiency (main heating system 1)	170.0000	170.0000	170.0000	170.0000	170.0000	0.0000	0.0000	0.0000	0.0000	170.0000	170.0000	170.0000 (210)
Space heating fuel (main heating system)	333.7342	275.7333	250.4386	172.6254	108.7648	0.0000	0.0000	0.0000	0.0000	159.9950	250.4600	339.8829 (211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)
Space heating fuel used, main system 2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (213)
Water heating												
Water heating requirement	246.0610	217.2378	229.7214	199.2834	191.3818	170.4826	166.7570	174.4356	177.5322	200.3338	215.9387	243.0079 (64)
Efficiency of water heater (217)m	360.1646	360.1646	360.1646	360.1646	360.1646	360.1646	360.1646	360.1646	360.1646	360.1646	360.1646	360.1646 (216)
Fuel for water heating, kWh/month	68.3190	60.3162	63.7823	55.3312	53.1373	47.3346	46.3002	48.4322	49.2920	55.6229	59.9556	67.4713 (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	9.1041	8.2231	9.1041	8.8104	9.1041	8.8104	9.1041	9.1041	8.8104	9.1041	8.8104	9.1041 (231)
Lighting	23.6328	18.9591	17.0706	12.5066	9.6605	7.8927	8.8126	11.4550	14.8789	19.5219	22.0499	24.2896 (232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	-68.1411	-108.5919	-173.1090	-209.7306	-230.1379	-188.3171	-185.7744	-174.5112	-152.2138	-130.4640	-79.0151	-57.4800 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233b)m	-3.7330	-11.3453	-31.1579	-64.0273	-108.0669	-144.1920	-142.3406	-112.1645	-72.3107	-22.8599	-6.2380	-2.6664 (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												1891.6342 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												360.1646

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Water heating fuel used	675.2949	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
warm air heating system fans	107.1936	(230b)
Total electricity for the above, kWh/year	107.1936	(231)
Electricity for lighting (calculated in Appendix L)	190.7304	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-2478.5885	(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	386.2645	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	1891.6342	16.4900	311.9305 (240)
Space heating - main system 2	0.0000	16.4900	0.0000 (241)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	675.2949	16.4900	111.3561 (247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000 (247a)
Pumps, fans and electric keep-hot	107.1936	16.4900	17.6762 (249)
Energy for lighting	190.7304	16.4900	31.4514 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1757.4861	16.4900	-289.8095
PV Unit electricity exported	-721.1025	5.5900	-40.3096
Total			-330.1191 (252)
Total energy cost			142.2952 (255)

## 11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600 (256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	0.4289 (257)
SAP value		93.0477
SAP rating (Section 12)		93 (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	1891.6342	0.1538	290.8552 (261)
Space heating - main system 2	0.0000	0.0000	0.0000 (262)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	675.2949	0.1412	95.3451 (264)
Space and water heating			386.2003 (265)
Pumps, fans and electric keep-hot	107.1936	0.1387	14.8691 (267)
Energy for lighting	190.7304	0.1443	27.5283 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1757.4861	0.1341	-235.7150
PV Unit electricity exported	-721.1025	0.1159	-83.5760
Total			-319.2911 (269)
Total CO2, kg/year			109.3066 (272)
CO2 emissions per m2			1.4700 (273)
EI value			98.7737
EI rating			99 (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

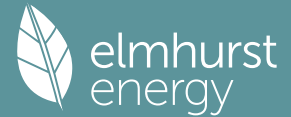
	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	74.4400 (1b)	x 2.4000 (2b)	= 178.6560 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	74.4400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	178.6560 (5)

### 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)



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Number of flues attached to other heater 0 \* 35 = 0.0000 (6e)  
 Number of blocked chimneys 0 \* 20 = 0.0000 (6f)  
 Number of intermittent extract fans 2 \* 10 = 20.0000 (7a)  
 Number of passive vents 0 \* 10 = 0.0000 (7b)  
 Number of flueless gas fires 0 \* 40 = 0.0000 (7c)

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = 20.0000 / (5) = 0.1119 (8)  
 Pressure test Yes  
 Pressure Test Method Blower Door  
 Measured/design AP50 3.0000 (17)  
 Infiltration rate 0.2619 (18)  
 Number of sides sheltered 2 (19)  
 Shelter factor (20) = 1 - [0.075 x (19)] = 0.8500 (20)  
 Infiltration rate adjusted to include shelter factor (21) = (18) x (20) = 0.2227 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.6000	4.4000	4.4000	4.1000	4.2000	3.8000	3.9000	3.6000	3.7000	4.0000	3.9000	4.2000 (22)
Wind factor	1.1500	1.1000	1.1000	1.0250	1.0500	0.9500	0.9750	0.9000	0.9250	1.0000	0.9750	1.0500 (22a)
Adj infilt rate												
Effective ac	0.2561	0.2449	0.2449	0.2282	0.2338	0.2115	0.2171	0.2004	0.2060	0.2227	0.2171	0.2338 (22b)
	0.5328	0.5300	0.5300	0.5260	0.5273	0.5224	0.5236	0.5201	0.5212	0.5248	0.5236	0.5273 (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
Front door			2.1700	1.0000	2.1700		(26)
Windows (Uw = 0.80)			9.3000	0.7752	7.2093		(27)
Patio doors (Uw = 1.00)			3.2300	0.9615	3.1058		(27)
Heatloss Floor			74.4400	0.1700	12.6548	0.0000	0.0000 (28a)
External Wall	112.4200	14.7000	97.7200	0.1600	15.6352	14.0000	1368.0800 (29a)
Wall to store	7.4900		7.4900	0.1600	1.1984	14.0000	104.8600 (29a)
External Roof	74.4400		74.4400	0.1100	8.1884	9.0000	669.9600 (30)
Total net area of external elements Aum(A, m2)			268.7900				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 50.1619		(33)
Internal Wall 1			66.0000			14.0000	924.0000 (32c)
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 3066.9000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							41.1996 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	10.0100	0.0060	0.0601
E3 Sill	7.5000	0.0120	0.0900
E4 Jamb	21.0000	0.0230	0.4830
E5 Ground floor (normal)	46.8400	0.3200	14.9888
E14 Flat roof	46.8400	0.0540	2.5294
E16 Corner (normal)	26.4000	0.0750	1.9800
E17 Corner (inverted - internal area greater than external area)	14.4000	-0.0450	-0.6480
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			19.4832 (36)
Point Thermal bridges			(36a) = 0.0000
Total fabric heat loss			(33) + (36) + (36a) = 69.6451 (37)

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

(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	31.4109	31.2465	31.2465	31.0136	31.0894	30.7971	30.8675	30.6620	30.7286	30.9396	30.8675	31.0894 (38)
Heat transfer coeff	101.0560	100.8916	100.8916	100.6587	100.7345	100.4422	100.5126	100.3071	100.3737	100.5847	100.5126	100.7345 (39)
Average = Sum(39)m / 12 =												100.6417

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.3575	1.3553	1.3553	1.3522	1.3532	1.3493	1.3502	1.3475	1.3484	1.3512	1.3502	1.3532 (40)
HLP (average)												1.3520
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

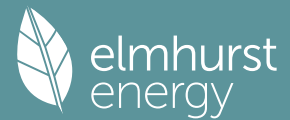
### 4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.3489 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hot water usage for mixer showers	71.5538	70.4785	68.9116	65.9135	63.7010	61.2337	59.8312	61.3863	63.0910	65.7401	68.8026	71.2797 (42a)
Hot water usage for baths	27.4748	27.0667	26.4921	25.4327	24.6393	23.7597	23.2845	23.8551	24.4764	25.4177	26.4989	27.3819 (42b)
Hot water usage for other uses	38.6853	37.2786	35.8719	34.4651	33.0584	31.6516	31.6516	33.0584	34.4651	35.8719	37.2786	38.6853 (42c)
Average daily hot water use (litres/day)												126.6122 (43)

Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	137.7139	134.8238	131.2756	125.8113	121.3987	116.6450	114.7674	118.2998	122.0325	127.0297	132.5801	137.3469 (44)
Energy conte	218.1052	191.9874	201.7656	172.2294	163.4260	143.4286	138.8012	146.4798	150.4782	172.3780	188.8847	215.0521 (45)
Energy content (annual)												Total = Sum(45)m = 2103.0163
Distribution loss (46)m = 0.15 x (45)m	32.7158	28.7981	30.2648	25.8344	24.5139	21.5143	20.8202	21.9720	22.5717	25.8567	28.3327	32.2578 (46)
Water storage loss:												
Store volume												200.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6700 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.9018 (55)
Total storage loss	27.9558	25.2504	27.9558	27.0540	27.9558	27.0540	27.9558	27.9558	27.0540	27.9558	27.0540	27.9558 (56)
If cylinder contains dedicated solar storage	27.9558	25.2504	27.9558	27.0540	27.9558	27.0540	27.9558	27.9558	27.0540	27.9558	27.0540	27.9558 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)
Total heat required for water heating calculated for each month	246.0610	217.2378	229.7214	199.2834	191.3818	170.4826	166.7570	174.4356	177.5322	200.3338	215.9387	243.0079 (62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000 (63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63d)
Output from w/h	246.0610	217.2378	229.7214	199.2834	191.3818	170.4826	166.7570	174.4356	177.5322	200.3338	215.9387	243.0079 (64)

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Electric shower(s)	Total per year (kWh/year) = Sum(64)m = 2432.1733 (64)											
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	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	72.5200	63.8358	67.0871	57.2663	54.3392	47.6900	46.1514	48.7045	50.0340	57.3157	62.8042	71.5048 (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
140.9354	140.9354	140.9354	140.9354	140.9354	140.9354	140.9354	140.9354	140.9354	140.9354	140.9354	140.9354	140.9354 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
26.9999	23.9810	19.5027	14.7648	11.0369	9.3178	10.0682	13.0870	17.5654	22.3033	26.0312	27.7503	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
309.5978	312.8104	304.7146	287.4797	265.7236	245.2760	231.6157	228.4030	236.4988	253.7338	275.4899	295.9375	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
51.4425	51.4425	51.4425	51.4425	51.4425	51.4425	51.4425	51.4425	51.4425	51.4425	51.4425	51.4425	(69)
Pumps, fans	10.7194	10.7194	10.7194	10.7194	10.7194	0.0000	0.0000	0.0000	0.0000	10.7194	10.7194	(70)
Losses e.g. evaporation (negative values) (Table 5)												
-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	(71)
Water heating gains (Table 5)												
97.4731	94.9937	90.1708	79.5365	73.0365	66.2361	62.0314	65.4631	69.4917	77.0372	87.2280	96.1086	(72)
Total internal gains	543.2110	540.9255	523.5284	490.9212	458.9373	419.2508	402.1363	405.3741	421.9768	462.2146	497.8894	528.9367 (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							
East	5.4000	23.7835	0.6300	0.7000	0.7700	39.2501 (76)						
West	3.9000	23.7835	0.6300	0.7000	0.7700	28.3473 (80)						
West	3.2300	23.7835	0.6300	0.7000	0.7700	23.4774 (80)						
Solar gains	91.0748	155.6234	253.9955	386.7973	444.9323	499.3158	458.4932	402.3585	317.0146	192.8835	109.0684	72.4290 (83)
Total gains	634.2859	696.5489	777.5240	877.7185	903.8696	918.5666	860.6295	807.7326	738.9914	655.0981	606.9578	601.3657 (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	8.4301	8.4439	8.4439	8.4634	8.4570	8.4817	8.4757	8.4931	8.4874	8.4696	8.4757	8.4570
alpha	1.5620	1.5629	1.5629	1.5642	1.5638	1.5654	1.5650	1.5662	1.5658	1.5646	1.5650	1.5638
util living area	0.8439	0.8195	0.7709	0.6914	0.5970	0.4639	0.3790	0.3965	0.5671	0.7247	0.8125	0.8531 (86)
MIT	17.8682	18.1085	18.6317	19.2960	19.9142	20.4104	20.6055	20.5913	20.1977	19.4326	18.5687	17.8140 (87)
Th 2	19.7960	19.7977	19.7977	19.8002	19.7994	19.8024	19.8017	19.8038	19.8031	19.8009	19.8017	19.7994 (88)
util rest of house	0.8290	0.8024	0.7485	0.6598	0.5504	0.3939	0.2866	0.3016	0.5026	0.6886	0.7915	0.8389 (89)
MIT 2	16.3378	16.6247	17.2470	18.0270	18.7354	19.2698	19.4567	19.4497	19.0656	18.2084	17.1873	16.2758 (90)
Living area fraction	FLA = Living area / (4) = 0.4066 (91)											
MIT	16.9601	17.2281	17.8101	18.5431	19.2148	19.7336	19.9238	19.9139	19.5260	18.7062	17.7490	16.9013 (92)
Temperature adjustment	0.0000											
adjusted MIT	16.9601	17.2281	17.8101	18.5431	19.2148	19.7336	19.9238	19.9139	19.5260	18.7062	17.7490	16.9013 (93)

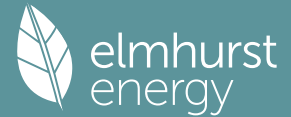
## 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.7833	0.7560	0.7032	0.6211	0.5247	0.3895	0.2968	0.3111	0.4856	0.6487	0.7457	0.7939	(94)
Useful gains	496.8537	526.5862	546.7280	545.1365	474.2899	357.8016	255.4287	251.3091	358.8905	424.9833	452.6301	477.3984 (95)
Ext temp.	5.1000	5.6000	7.2000	9.5000	12.4000	15.3000	17.0000	17.0000	14.6000	11.3000	8.0000	5.1000 (96)
Heat loss rate W	1198.5347	1173.1734	1070.4679	910.2622	686.4819	445.3229	293.8825	292.2846	494.4373	744.9491	979.8979	1188.7952 (97)
Space heating kWh	522.0507	434.5066	389.6625	262.8905	157.8708	0.0000	0.0000	0.0000	0.0000	238.0545	379.6328	529.2792 (98a)
Space heating requirement - total per year (kWh/year)												2913.9477
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	522.0507	434.5066	389.6625	262.8905	157.8708	0.0000	0.0000	0.0000	0.0000	238.0545	379.6328	529.2792 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2913.9477
Space heating per m2												(98c) / (4) = 39.1449 (99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Fraction of main heating from main system 2												0.0000 (203)
Fraction of total heating from main system 1												1.0000 (204)
Fraction of total heating from main system 2												0.0000 (205)
Efficiency of main space heating system 1 (in %)												170.0000 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	522.0507	434.5066	389.6625	262.8905	157.8708	0.0000	0.0000	0.0000	0.0000	238.0545	379.6328	529.2792 (98)
Space heating efficiency (main heating system 1)	170.0000	170.0000	170.0000	170.0000	170.0000	0.0000	0.0000	0.0000	0.0000	170.0000	170.0000	170.0000 (210)

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Space heating fuel (main heating system)	307.0887	255.5921	229.2132	154.6415	92.8652	0.0000	0.0000	0.0000	0.0000	140.0321	223.3134	311.3407	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Space heating fuel used, main system 2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Water heating													
Water heating requirement	246.0610	217.2378	229.7214	199.2834	191.3818	170.4826	166.7570	174.4356	177.5322	200.3338	215.9387	243.0079	(64)
Efficiency of water heater (217)m	360.1646	360.1646	360.1646	360.1646	360.1646	360.1646	360.1646	360.1646	360.1646	360.1646	360.1646	360.1646	(216)
Fuel for water heating, kWh/month	68.3190	60.3162	63.7823	55.3312	53.1373	47.3346	46.3002	48.4322	49.2920	55.6229	59.9556	67.4713	(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	9.1041	8.2231	9.1041	8.8104	9.1041	8.8104	9.1041	9.1041	8.8104	9.1041	8.8104	9.1041	(231)
Lighting	23.6328	18.9591	17.0706	12.5066	9.6605	7.8927	8.8126	11.4550	14.8789	19.5219	22.0499	24.2896	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-80.2609	-112.4010	-177.3682	-220.6741	-229.9133	-198.0192	-192.4193	-183.4905	-162.6792	-139.2469	-89.1930	-65.6779	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-5.4221	-12.6735	-34.4151	-76.9062	-116.1627	-175.4156	-162.8257	-132.8874	-87.5415	-27.9401	-8.4533	-3.6438	(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												1714.0869	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												360.1646	
Water heating fuel used												675.2949	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
warm air heating system fans												107.1936	(230b)
Total electricity for the above, kWh/year												107.1936	(231)
Electricity for lighting (calculated in Appendix L)												190.7304	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-2695.6303	(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												-8.3246	(238)

## 10a. Fuel costs - using BEDF prices (535)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	1714.0869	25.1600	431.2643 (240)
Space heating - main system 2	0.0000	25.1600	0.0000 (241)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	675.2949	25.1600	169.9042 (247)
Energy for instantaneous electric shower(s)	0.0000	25.1600	0.0000 (247a)
Pumps, fans and electric keep-hot	107.1936	25.1600	26.9699 (249)
Energy for lighting	190.7304	25.1600	47.9878 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1851.3434	25.1600	-465.7980
PV Unit electricity exported	-844.2869	5.8100	-49.0531
Total			-514.8511 (252)
Total energy cost			161.2751 (255)

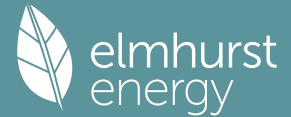
## 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	1714.0869	0.1540	263.9050 (261)
Space heating - main system 2	0.0000	0.0000	0.0000 (262)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	675.2949	0.1412	95.3451 (264)
Space and water heating			359.2501 (265)
Pumps, fans and electric keep-hot	107.1936	0.1387	14.8691 (267)
Energy for lighting	190.7304	0.1443	27.5283 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1851.3434	0.1344	-248.7388
PV Unit electricity exported	-844.2869	0.1158	-97.8092
Total			-346.5481 (269)
Total CO2, kg/year			55.0994 (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	1714.0869	1.5700	2691.1337 (275)

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Space heating - main system 2	0.0000	0.0000	0.0000 (276)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	675.2949	1.5221	1027.8563 (278)
Space and water heating			3718.9900 (279)
Pumps, fans and electric keep-hot	107.1936	1.5128	162.1625 (281)
Energy for lighting	190.7304	1.5338	292.5486 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1851.3434	1.4966	-2770.6469
PV Unit electricity exported	-844.2869	0.4244	-358.3290
Total			-3128.9759 (283)
Total Primary energy kWh/year			1044.7251 (286)

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SAP 10 EPC IMPROVEMENTS  
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Current energy efficiency rating: A 93  
Current environmental impact rating: A 99

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 + 0.6 -£ 20 -13 kg (23.2%)

Recommended measures Typical annual savings Energy Environmental efficiency impact  
(none) Total Savings £0 0.00 kg/m²

Potential energy efficiency rating: A 93  
Potential environmental impact rating: A 99

Fuel prices for cost data on this page from database revision number 535 TEST (04 Jan 2024)  
Recommendation texts revision number 6.1 (11 Jun 2019)

Typical heating and lighting costs of this home (per year, Severn Valley):

	Current £676	Potential £676	£0 Saving
Electricity			
Space heating	£458	£458	£0
Water heating	£170	£170	£0
Lighting	£48	£48	£0
Generated (PV)	-£515	-£515	£0
Total cost of fuels	£161	£161	£0
Total cost of uses	£161	£161	£0
Delivered energy	-0 kWh/m²	-0 kWh/m²	0 kWh/m²
Carbon dioxide emissions	0.1 tonnes	0.1 tonnes	0.0 tonnes
CO2 emissions per m²	1 kg/m²	1 kg/m²	0 kg/m²
Primary energy	14 kWh/m²	14 kWh/m²	0 kWh/m²

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)  
CALCULATION OF ENERGY RATING FOR IMPROVED DWELLING  
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1. Overall dwelling characteristics  
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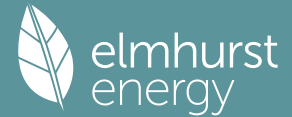
	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	74.4400 (1b)	x 2.4000 (2b)	= 178.6560 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	74.4400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	178.6560 (5)

-----  
2. Ventilation rate  
-----

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

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = 20.0000 / (5) = 0.1119 (8)  
Pressure test Yes  
Pressure Test Method Blower Door

# Full SAP Calculation Printout



Measured/design AP50 3.0000 (17)  
 Infiltration rate 0.2619 (18)  
 Number of sides sheltered 2 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 0.8500 (20)  
 Infiltration rate adjusted to include shelter factor (21) = (18) x (20) = 0.2227 (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	0.2839	0.2783	0.2728	0.2449	0.2394	0.2115	0.2115	0.2060	0.2227	0.2394	0.2505	0.2616 (22b)
	0.5403	0.5387	0.5372	0.5300	0.5286	0.5224	0.5224	0.5212	0.5248	0.5286	0.5314	0.5342 (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
Front door			2.1700	1.0000	2.1700		(26)
Windows (Uw = 0.80)			9.3000	0.7752	7.2093		(27)
Patio doors (Uw = 1.00)			3.2300	0.9615	3.1058		(27)
Heatloss Floor			74.4400	0.1700	12.6548	0.0000	0.0000 (28a)
External Wall	112.4200	14.7000	97.7200	0.1600	15.6352	14.0000	1368.0800 (29a)
Wall to store	7.4900		7.4900	0.1600	1.1984	14.0000	104.8600 (29a)
External Roof	74.4400		74.4400	0.1100	8.1884	9.0000	669.9600 (30)
Total net area of external elements Aum(A, m2)			268.7900				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 50.1619		(33)
Internal Wall 1			66.0000			14.0000	924.0000 (32c)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 3066.9000 (34)  
 Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 41.1996 (35)

#### List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	10.0100	0.0060	0.0601
E3 Sill	7.5000	0.0120	0.0900
E4 Jamb	21.0000	0.0230	0.4830
E5 Ground floor (normal)	46.8400	0.3200	14.9888
E14 Flat roof	46.8400	0.0540	2.5294
E16 Corner (normal)	26.4000	0.0750	1.9800
E17 Corner (inverted - internal area greater than external area)	14.4000	-0.0450	-0.6480

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 19.4832 (36)  
 Point Thermal bridges 0.0000 (36a) =  
 Total fabric heat loss (33) + (36) + (36a) = 69.6451 (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	31.8539	31.7617	31.6712	31.2465	31.1671	30.7971	30.7971	30.7286	30.9396	31.1671	31.3278	31.4959 (38)
Average = Sum(39)m / 12 =	101.4990	101.4068	101.3163	100.8916	100.8122	100.4422	100.4422	100.3737	100.5847	100.8122	100.9729	101.1410 (39)
												100.8912

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.3635	1.3623	1.3610	1.3553	1.3543	1.3493	1.3493	1.3484	1.3512	1.3543	1.3564	1.3587 (40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Assumed occupancy												2.3489 (42)
Hot water usage for mixer showers	71.5538	70.4785	68.9116	65.9135	63.7010	61.2337	59.8312	61.3863	63.0910	65.7401	68.8026	71.2797 (42a)
Hot water usage for baths	27.4748	27.0667	26.4921	25.4327	24.6393	23.7597	23.2845	23.8551	24.4764	25.4177	26.4989	27.3819 (42b)
Hot water usage for other uses	38.6853	37.2786	35.8719	34.4651	33.0584	31.6516	31.6516	33.0584	34.4651	35.8719	37.2786	38.6853 (42c)
Average daily hot water use (litres/day)												126.6122 (43)

Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	137.7139	134.8238	131.2756	125.8113	121.3987	116.6450	114.7674	118.2998	122.0325	127.0297	132.5801	137.3469 (44)
Energy content (annual)	218.1052	191.9874	201.7656	172.2294	163.4260	143.4286	138.8012	146.4798	150.4782	172.3780	188.8847	215.0521 (45)
Distribution loss (46)m = 0.15 x (45)m	32.7158	28.7981	30.2648	25.8344	24.5139	21.5143	20.8202	21.9720	22.5717	25.8567	28.3327	32.2578 (46)

Water storage loss:  
 Store volume 200.0000 (47)  
 a) If manufacturer declared loss factor is known (kWh/day): 1.6700 (48)  
 Temperature factor from Table 2b 0.5400 (49)  
 Enter (49) or (54) in (55) 0.9018 (55)

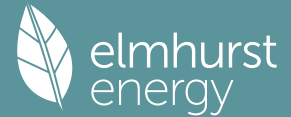
Total storage loss	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
27.9558	25.2504	27.9558	27.0540	27.9558	27.0540	27.9558	27.9558	27.9558	27.0540	27.9558	27.0540	27.9558 (56)
If cylinder contains dedicated solar storage	27.9558	25.2504	27.9558	27.0540	27.9558	27.0540	27.9558	27.9558	27.0540	27.9558	27.0540	27.9558 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)
Total heat required for water heating calculated for each month	246.0610	217.2378	229.7214	199.2834	191.3818	170.4826	166.7570	174.4356	177.5322	200.3338	215.9387	243.0079 (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 (64a)

Output from w/h 246.0610 217.2378 229.7214 199.2834 191.3818 170.4826 166.7570 174.4356 177.5322 200.3338 215.9387 243.0079 (64)  
 Total per year (kWh/year) = Sum(64)m = 2432.1733 (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 72.5200 63.8358 67.0871 57.2663 54.3392 47.6900 46.1514 48.7045 50.0340 57.3157 62.8042 71.5048 (65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	140.9354	140.9354	140.9354	140.9354	140.9354	140.9354	140.9354	140.9354	140.9354	140.9354	140.9354	140.9354 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.9999	23.9810	19.5027	14.7648	11.0369	9.3178	10.0682	13.0870	17.5654	22.3033	26.0312	27.7503 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	309.5978	312.8104	304.7146	287.4797	265.7236	245.2760	231.6157	228.4030	236.4988	253.7338	275.4899	295.9375 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	51.4425	51.4425	51.4425	51.4425	51.4425	51.4425	51.4425	51.4425	51.4425	51.4425	51.4425	51.4425 (69)
Pumps, fans	10.7194	10.7194	10.7194	10.7194	10.7194	0.0000	0.0000	0.0000	0.0000	10.7194	10.7194	10.7194 (70)
Losses e.g. evaporation (negative values) (Table 5)	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570 (71)
Water heating gains (Table 5)	97.4731	94.9937	90.1708	79.5365	73.0365	66.2361	62.0314	65.4631	69.4917	77.0372	87.2280	96.1086 (72)
Total internal gains	543.2110	540.9255	523.5284	490.9212	458.9373	419.2508	402.1363	405.3741	421.9768	462.2146	497.8894	528.9367 (73)

## 6. Solar gains

[Jan]	Area m <sup>2</sup>	Solar flux Table 6a W/m <sup>2</sup>	Specific data or Table 6b	g	Specific data or Table 6c	FF	Access factor Table 6d	Gains W				
East	5.4000	19.6403	0.6300	0.7000	0.7700	0.7700	32.4125 (76)					
West	3.9000	19.6403	0.6300	0.7000	0.7700	0.7700	23.4090 (80)					
West	3.2300	19.6403	0.6300	0.7000	0.7700	0.7700	19.3875 (80)					
Solar gains	75.2091	147.1249	242.2937	353.3710	433.0694	443.3236	422.0621	362.5451	281.7976	174.5761	93.7769	61.8483 (83)
Total gains	618.4201	688.0504	765.8222	844.2922	892.0067	862.5744	824.1984	767.9192	703.7745	636.7907	591.6662	590.7850 (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	8.3934	8.4010	8.4085	8.4439	8.4505	8.4817	8.4817	8.4874	8.4696	8.4505	8.4371	8.4231
alpha	1.5596	1.5601	1.5606	1.5629	1.5634	1.5654	1.5654	1.5658	1.5646	1.5634	1.5625	1.5615
util living area	0.8574	0.8312	0.7865	0.7165	0.6250	0.5190	0.4187	0.4530	0.6058	0.7504	0.8316	0.8657 (86)
MIT	17.6222	17.9055	18.4359	19.1192	19.7678	20.2760	20.5475	20.5003	20.0763	19.2429	18.3067	17.5507 (87)
Th 2	19.7914	19.7924	19.7933	19.7977	19.7986	19.8024	19.8024	19.8031	19.8009	19.7986	19.7969	19.7951 (88)
util rest of house	0.8441	0.8157	0.7662	0.6877	0.5827	0.4552	0.3304	0.3654	0.5467	0.7185	0.8134	0.8532 (89)
MIT 2	16.0389	16.3778	17.0114	17.8207	18.5705	19.1361	19.4086	19.3700	18.9364	17.9863	16.8709	15.9555 (90)
Living area fraction	FLA = Living area / (4) = 0.4066 (91)											
MIT	16.6827	16.9990	17.5906	18.3488	19.0574	19.5996	19.8717	19.8296	19.3999	18.4972	17.4548	16.6042 (92)
Temperature adjustment	0.0000											
adjusted MIT	16.6827	16.9990	17.5906	18.3488	19.0574	19.5996	19.8717	19.8296	19.3999	18.4972	17.4548	16.6042 (93)

## 8. Space heating requirement

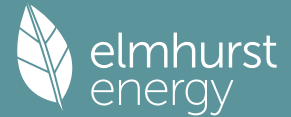
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.7992	0.7694	0.7200	0.6464	0.5529	0.4432	0.3359	0.3676	0.5240	0.6761	0.7676	0.8090 (94)
Useful gains	494.2700	529.3827	551.4226	545.7124	493.1934	382.2859	276.8876	282.2613	368.7853	430.5587	454.1873	477.9580 (95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.6000	14.1000	10.6000	7.1000	4.2000 (96)
Heat loss rate W	1256.8348	1226.9222	1123.6614	953.3000	741.7152	502.1703	328.6186	344.2437	533.0905	796.1387	1045.5513	1254.5720 (97)
Space heating kWh	567.3482	468.7465	425.7457	293.4631	184.9002	0.0000	0.0000	0.0000	0.0000	271.9915	425.7820	577.8009 (98a)
Space heating requirement - total per year (kWh/year)												3215.7781
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (98b)
Solar heating contribution - total per year (kWh/year)												0.0000
Space heating kWh	567.3482	468.7465	425.7457	293.4631	184.9002	0.0000	0.0000	0.0000	0.0000	271.9915	425.7820	577.8009 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3215.7781
Space heating per m <sup>2</sup>												(98c) / (4) = 43.1996 (99)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (201)											
Fraction of space heat from main system(s)	1.0000 (202)											
Fraction of main heating from main system 2	0.0000 (203)											
Fraction of total heating from main system 1	1.0000 (204)											
Fraction of total heating from main system 2	0.0000 (205)											
Efficiency of main space heating system 1 (in %)	170.0000 (206)											
Efficiency of main space heating system 2 (in %)	0.0000 (207)											
Efficiency of secondary/supplementary heating system, %	0.0000 (208)											
Space heating requirement	567.3482	468.7465	425.7457	293.4631	184.9002	0.0000	0.0000	0.0000	0.0000	271.9915	425.7820	577.8009 (98)
Space heating efficiency (main heating system 1)	170.0000	170.0000	170.0000	170.0000	170.0000	0.0000	0.0000	0.0000	0.0000	170.0000	170.0000	170.0000 (210)
Space heating fuel (main heating system)	333.7342	275.7333	250.4386	172.6254	108.7648	0.0000	0.0000	0.0000	0.0000	159.9950	250.4600	339.8829 (211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)
Space heating fuel used, main system 2	0.0000 (213)											



# Full SAP Calculation Printout



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 (m <sup>2</sup> )		Storey height (m)		Volume (m <sup>3</sup> )	
Ground floor		74.4400	(1b)	x	2.4000	(2b)	= 178.6560 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	74.4400						(4)
Dwelling volume						(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	178.6560 (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													2 * 10 = 20.0000 (7a)
Number of passive vents													0 * 10 = 0.0000 (7b)
Number of flueless gas fires													0 * 40 = 0.0000 (7c)
													Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =													20.0000 / (5) = 0.1119 (8)
Pressure test													Yes
Pressure Test Method													Blower Door
Measured/design AP50													3.0000 (17)
Infiltration rate													0.2619 (18)
Number of sides sheltered													2 (19)
Shelter factor													(20) = 1 - [0.075 x (19)] = 0.8500 (20)
Infiltration rate adjusted to include shelter factor													(21) = (18) x (20) = 0.2227 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.6000	4.4000	4.4000	4.1000	4.2000	3.8000	3.9000	3.6000	3.7000	4.0000	3.9000	4.2000	(22)
Wind factor	1.1500	1.1000	1.1000	1.0250	1.0500	0.9500	0.9750	0.9000	0.9250	1.0000	0.9750	1.0500	(22a)
Adj infilt rate													
Effective ac	0.2561	0.2449	0.2449	0.2282	0.2338	0.2115	0.2171	0.2004	0.2060	0.2227	0.2171	0.2338	(22b)
	0.5328	0.5300	0.5300	0.5260	0.5273	0.5224	0.5236	0.5201	0.5212	0.5248	0.5236	0.5273	(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	
Front door			2.1700	1.0000	2.1700			(26)
Windows (Uw = 0.80)			9.3000	0.7752	7.2093			(27)
Patio doors (Uw = 1.00)			3.2300	0.9615	3.1058			(27)
Heatloss Floor			74.4400	0.1700	12.6548	0.0000	0.0000	(28a)
External Wall	112.4200	14.7000	97.7200	0.1600	15.6352	14.0000	1368.0800	(29a)
Wall to store	7.4900		7.4900	0.1600	1.1984	14.0000	104.8600	(29a)
External Roof	74.4400		74.4400	0.1100	8.1884	9.0000	669.9600	(30)
Total net area of external elements Aum(A, m <sup>2</sup> )			268.7900					(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	50.1619		(33)
Internal Wall 1			66.0000			14.0000	924.0000	(32c)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 3066.9000 (34)  
Thermal mass parameter (TMP = Cm / TFA) in kJ/m<sup>2</sup>K 41.1996 (35)

### List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	10.0100	0.0060	0.0601
E3 Sill	7.5000	0.0120	0.0900
E4 Jamb	21.0000	0.0230	0.4830
E5 Ground floor (normal)	46.8400	0.3200	14.9888
E14 Flat roof	46.8400	0.0540	2.5294
E16 Corner (normal)	26.4000	0.0750	1.9800
E17 Corner (inverted - internal area greater than external area)	14.4000	-0.0450	-0.6480

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 19.4832 (36)  
Point Thermal bridges (36a) = 0.0000  
Total fabric heat loss (33) + (36) + (36a) = 69.6451 (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	31.4109	31.2465	31.2465	31.0136	31.0894	30.7971	30.8675	30.6620	30.7286	30.9396	30.8675	31.0894	(38)
Average = Sum(39)m / 12 =	101.0560	100.8916	100.8916	100.6587	100.7345	100.4422	100.5126	100.3071	100.3737	100.5847	100.5126	100.7345	(39)
													100.6417

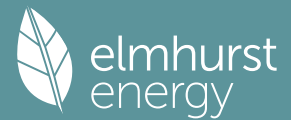
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP (average)	1.3575	1.3553	1.3553	1.3522	1.3532	1.3493	1.3502	1.3475	1.3484	1.3512	1.3502	1.3532	(40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	1.3520
													31

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

Assumed occupancy													2.3489 (42)
Hot water usage for mixer showers													71.2797 (42a)
	71.5538	70.4785	68.9116	65.9135	63.7010	61.2337	59.8312	61.3863	63.0910	65.7401	68.8026	71.2797	



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Hot water usage for baths	27.4748	27.0667	26.4921	25.4327	24.6393	23.7597	23.2845	23.8551	24.4764	25.4177	26.4989	27.3819 (42b)
Hot water usage for other uses	38.6853	37.2786	35.8719	34.4651	33.0584	31.6516	31.6516	33.0584	34.4651	35.8719	37.2786	38.6853 (42c)
Average daily hot water use (litres/day)												126.6122 (43)
Daily hot water use	137.7139	134.8238	131.2756	125.8113	121.3987	116.6450	114.7674	118.2998	122.0325	127.0297	132.5801	137.3469 (44)
Energy content (annual)	218.1052	191.9874	201.7656	172.2294	163.4260	143.4286	138.8012	146.4798	150.4782	172.3780	188.8847	215.0521 (45)
Distribution loss (46)m = 0.15 x (45)m	32.7158	28.7981	30.2648	25.8344	24.5139	21.5143	20.8202	21.9720	22.5717	25.8567	28.3327	32.2578 (46)
Water storage loss:												
Store volume												200.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6700 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.9018 (55)
Total storage loss	27.9558	25.2504	27.9558	27.0540	27.9558	27.0540	27.9558	27.9558	27.0540	27.9558	27.0540	27.9558 (56)
If cylinder contains dedicated solar storage	27.9558	25.2504	27.9558	27.0540	27.9558	27.0540	27.9558	27.9558	27.0540	27.9558	27.0540	27.9558 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)
Total heat required for water heating calculated for each month	246.0610	217.2378	229.7214	199.2834	191.3818	170.4826	166.7570	174.4356	177.5322	200.3338	215.9387	243.0079 (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 (64c)
Output from w/h	246.0610	217.2378	229.7214	199.2834	191.3818	170.4826	166.7570	174.4356	177.5322	200.3338	215.9387	243.0079 (64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (64a)
Heat gains from water heating, kWh/month	72.5200	63.8358	67.0871	57.2663	54.3392	47.6900	46.1514	48.7045	50.0340	57.3157	62.8042	71.5048 (65)

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

Metabolic gains (Table 5), Watts												
(66)m	140.9354	140.9354	140.9354	140.9354	140.9354	140.9354	140.9354	140.9354	140.9354	140.9354	140.9354	140.9354 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.9999	23.9810	19.5027	14.7648	11.0369	9.3178	10.0682	13.0870	17.5654	22.3033	26.0312	27.7503 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	309.5978	312.8104	304.7146	287.4797	265.7236	245.2760	231.6157	228.4030	236.4988	253.7338	275.4899	295.9375 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	51.4425	51.4425	51.4425	51.4425	51.4425	51.4425	51.4425	51.4425	51.4425	51.4425	51.4425	51.4425 (69)
Pumps, fans	10.7194	10.7194	10.7194	10.7194	10.7194	0.0000	0.0000	0.0000	0.0000	10.7194	10.7194	10.7194 (70)
Losses e.g. evaporation (negative values) (Table 5)	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570	-93.9570 (71)
Water heating gains (Table 5)	97.4731	94.9937	90.1708	79.5365	73.0365	66.2361	62.0314	65.4631	69.4917	77.0372	87.2280	96.1086 (72)
Total internal gains	543.2110	540.9255	523.5284	490.9212	458.9373	419.2508	402.1363	405.3741	421.9768	462.2146	497.8894	528.9367 (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						
East		5.4000	23.7835	0.6300	0.7000	0.7700	39.2501 (76)					
West		3.9000	23.7835	0.6300	0.7000	0.7700	28.3473 (80)					
West		3.2300	23.7835	0.6300	0.7000	0.7700	23.4774 (80)					
Solar gains	91.0748	155.6234	253.9955	386.7973	444.9323	499.3158	458.4932	402.3585	317.0146	192.8835	109.0684	72.4290 (83)
Total gains	634.2859	696.5489	777.5240	877.7185	903.8696	918.5666	860.6295	807.7326	738.9914	655.0981	606.9578	601.3657 (84)

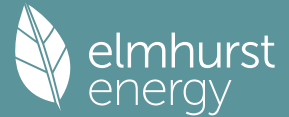
## 7. Mean internal temperature (heating season)

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)												
tau	8.4301	8.4439	8.4439	8.4634	8.4570	8.4817	8.4757	8.4931	8.4874	8.4696	8.4757	8.4570
alpha	1.5620	1.5629	1.5629	1.5642	1.5638	1.5654	1.5650	1.5662	1.5658	1.5646	1.5650	1.5638
util living area	0.8439	0.8195	0.7709	0.6914	0.5970	0.4639	0.3790	0.3965	0.5671	0.7247	0.8125	0.8531 (86)
MIT	17.8682	18.1085	18.6317	19.2960	19.9142	20.4104	20.6055	20.5913	20.1977	19.4326	18.5687	17.8140 (87)
Th 2	19.7960	19.7977	19.7977	19.8002	19.7994	19.8024	19.8017	19.8038	19.8031	19.8009	19.8017	19.7994 (88)
util rest of house	0.8290	0.8024	0.7485	0.6598	0.5504	0.3939	0.2866	0.3016	0.5026	0.6886	0.7915	0.8389 (89)
MIT 2	16.3378	16.6247	17.2470	18.0270	18.7354	19.2698	19.4567	19.4497	19.0656	18.2084	17.1873	16.2758 (90)
Living area fraction	16.9601	17.2281	17.8101	18.5431	19.2148	19.7336	19.9238	19.9139	19.5260	18.7062	17.7490	16.9013 (92)
Temperature adjustment												0.0000
adjusted MIT	16.9601	17.2281	17.8101	18.5431	19.2148	19.7336	19.9238	19.9139	19.5260	18.7062	17.7490	16.9013 (93)

## 8. Space heating requirement

Utilisation	0.7833	0.7560	0.7032	0.6211	0.5247	0.3895	0.2968	0.3111	0.4856	0.6487	0.7457	0.7939 (94)
Useful gains	496.8537	526.5862	546.7280	545.1365	474.2899	357.8016	255.4287	251.3091	358.8905	424.9833	452.6301	477.3984 (95)
Ext temp.	5.1000	5.6000	7.2000	9.5000	12.4000	15.3000	17.0000	17.0000	14.6000	11.3000	8.0000	5.1000 (96)

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Heat loss rate W	1198.5347	1173.1734	1070.4679	910.2622	686.4819	445.3229	293.8825	292.2846	494.4373	744.9491	979.8979	1188.7952 (97)
Space heating kWh	522.0507	434.5066	389.6625	262.8905	157.8708	0.0000	0.0000	0.0000	0.0000	238.0545	379.6328	529.2792 (98a)
Space heating requirement - total per year (kWh/year)												2913.9477
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	522.0507	434.5066	389.6625	262.8905	157.8708	0.0000	0.0000	0.0000	0.0000	238.0545	379.6328	529.2792 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2913.9477
Space heating per m2												(98c) / (4) = 39.1449 (99)

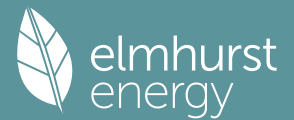
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**9a. Energy requirements - Individual heating systems, including micro-CHP**  
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Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Fraction of main heating from main system 2												0.0000 (203)
Fraction of total heating from main system 1												1.0000 (204)
Fraction of total heating from main system 2												0.0000 (205)
Efficiency of main space heating system 1 (in %)												170.0000 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	522.0507	434.5066	389.6625	262.8905	157.8708	0.0000	0.0000	0.0000	0.0000	238.0545	379.6328	529.2792 (98)
Space heating efficiency (main heating system 1)	170.0000	170.0000	170.0000	170.0000	170.0000	0.0000	0.0000	0.0000	0.0000	170.0000	170.0000	170.0000 (210)
Space heating fuel (main heating system)	307.0887	255.5921	229.2132	154.6415	92.8652	0.0000	0.0000	0.0000	0.0000	140.0321	223.3134	311.3407 (211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)
Space heating fuel used, main system 2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (213)
Water heating												
Water heating requirement	246.0610	217.2378	229.7214	199.2834	191.3818	170.4826	166.7570	174.4356	177.5322	200.3338	215.9387	243.0079 (64)
Efficiency of water heater (217)m	360.1646	360.1646	360.1646	360.1646	360.1646	360.1646	360.1646	360.1646	360.1646	360.1646	360.1646	360.1646 (216)
Fuel for water heating, kWh/month	68.3190	60.3162	63.7823	55.3312	53.1373	47.3346	46.3002	48.4322	49.2920	55.6229	59.9556	67.4713 (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	9.1041	8.2231	9.1041	8.8104	9.1041	8.8104	9.1041	8.8104	9.1041	8.8104	8.8104	9.1041 (231)
Lighting	23.6328	18.9591	17.0706	12.5066	9.6605	7.8927	8.8126	11.4550	14.8789	19.5219	22.0499	24.2896 (232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	-80.2609	-112.4010	-177.3682	-220.6741	-229.9133	-198.0192	-192.4193	-183.4905	-162.6792	-139.2469	-89.1930	-65.6779 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233b)m	-5.4221	-12.6735	-34.4151	-76.9062	-116.1627	-175.4156	-162.8257	-132.8874	-87.5415	-27.9401	-8.4533	-3.6438 (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												1714.0869 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												360.1646
Water heating fuel used												675.2949 (219)
Space cooling fuel												0.0000 (221)
Electricity for pumps and fans:												
warm air heating system fans												107.1936 (230b)
Total electricity for the above, kWh/year												107.1936 (231)
Electricity for lighting (calculated in Appendix L)												190.7304 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-2695.6303 (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												-8.3246 (238)

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**10a. Fuel costs - using BEDF prices (535)**  
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	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1714.0869	25.1600	431.2643	(240)
Space heating - main system 2	0.0000	25.1600	0.0000	(241)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	675.2949	25.1600	169.9042	(247)
Energy for instantaneous electric shower(s)	0.0000	25.1600	0.0000	(247a)
Pumps, fans and electric keep-hot	107.1936	25.1600	26.9699	(249)
Energy for lighting	190.7304	25.1600	47.9878	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1851.3434	25.1600	-465.7980	
PV Unit electricity exported	-844.2869	5.8100	-49.0531	
Total			-514.8511	(252)

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Total energy cost

161.2751 (255)

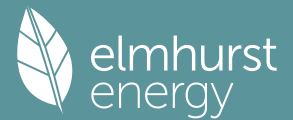
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 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP  
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	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	1714.0869	0.1540	263.9050 (261)
Space heating - main system 2	0.0000	0.0000	0.0000 (262)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	675.2949	0.1412	95.3451 (264)
Space and water heating			359.2501 (265)
Pumps, fans and electric keep-hot	107.1936	0.1387	14.8691 (267)
Energy for lighting	190.7304	0.1443	27.5283 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1851.3434	0.1344	-248.7388
PV Unit electricity exported	-844.2869	0.1158	-97.8092
Total			-346.5481 (269)
Total CO2, kg/year			55.0994 (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	1714.0869	1.5700	2691.1337 (275)
Space heating - main system 2	0.0000	0.0000	0.0000 (276)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	675.2949	1.5221	1027.8563 (278)
Space and water heating			3718.9900 (279)
Pumps, fans and electric keep-hot	107.1936	1.5128	162.1625 (281)
Energy for lighting	190.7304	1.5338	292.5486 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1851.3434	1.4966	-2770.6469
PV Unit electricity exported	-844.2869	0.4244	-358.3290
Total			-3128.9759 (283)
Total Primary energy kWh/year			1044.7251 (286)

# Predicted Energy Assessment

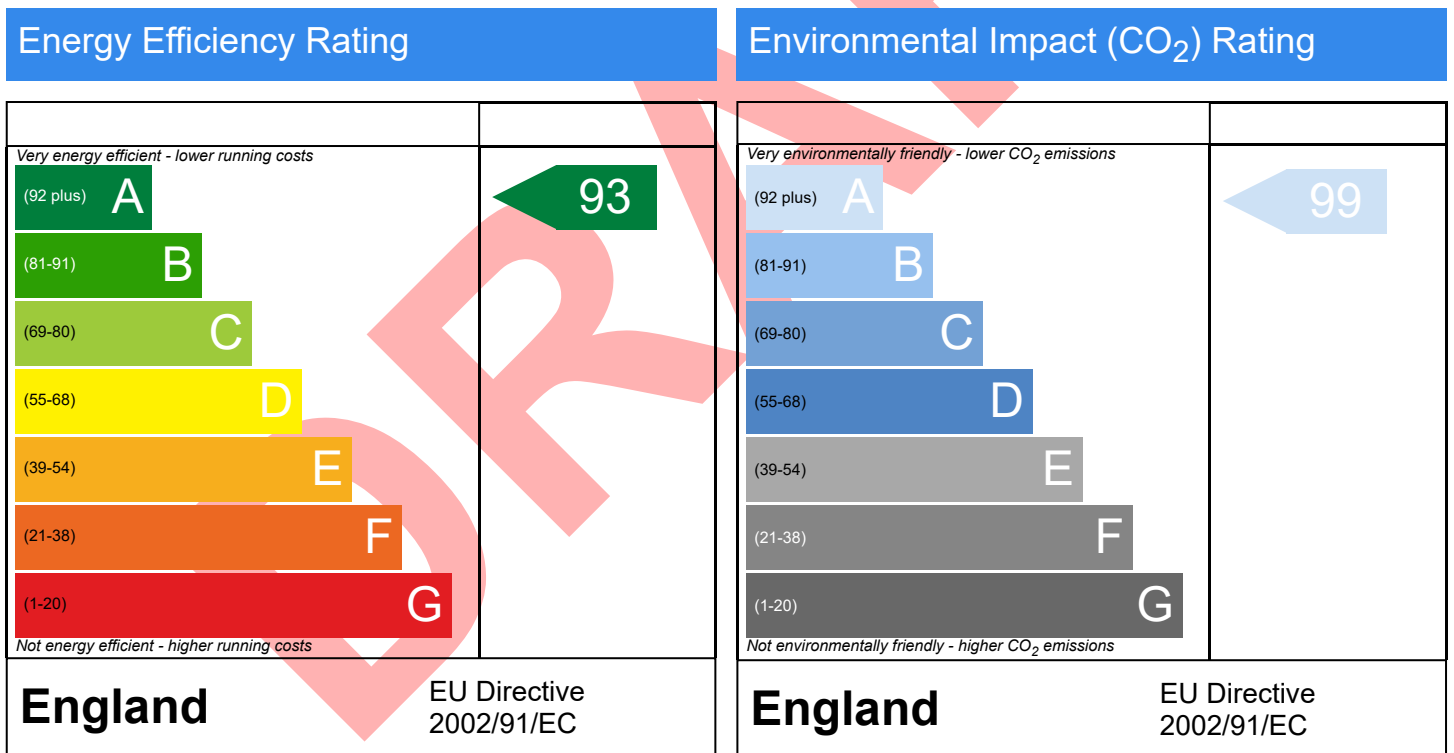


196, Fortfield Road , Bristol, BS14 9NR

Dwelling type: Bungalow, Detached  
 Date of assessment: 25/01/2024  
 Produced by: Natalie Wheeler  
 Total floor area: 75.87 m<sup>2</sup>  
 DRRN:

This document is a Predicted Energy Assessment for properties marketed when they are incomplete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, this rating will be updated and an official Energy Performance Certificate will be created for the property. This will include more detailed information about the energy performance of the completed property.

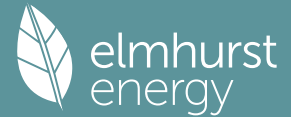
The energy performance has been assessed using the Government approved SAP 10 methodology and is rated in terms of the energy use per square meter of floor area; the energy efficiency is based on fuel costs and the environmental impact is based on carbon dioxide (CO<sub>2</sub>) emissions.



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO<sub>2</sub>) emissions. The higher the rating the less impact it has on the environment.

# Summary for Input Data



Property Reference	Fortfield	Issued on Date	25/01/2024
Assessment Reference	Green_Copy	Prop Type Ref	
Property	196, Fortfield Road , Bristol, BS14 9NR		

SAP Rating	93 A	DER	1.58	TER	10.71
Environmental	99 A	% DER < TER			85.25
CO <sub>2</sub> Emissions (t/year)	0.06	DFEE	47.12	TFEE	47.18
Compliance Check	See BREL	% DFEE < TFEE			0.13
% DPER < TPER	62.66	DPER	21.48	TPER	57.54

Assessor Details	Ms. Natalie Wheeler	Assessor ID	AX45-0001
Client			

## SUMMARY FOR INPUT DATA FOR: New Build (As Designed)

Orientation	East
Property Tenure	ND
Transaction Type	6
Terrain Type	Suburban
1.0 Property Type	Bungalow, Detached
2.0 Number of Storeys	1
3.0 Date Built	2024
4.0 Sheltered Sides	2
5.0 Sunlight/Shade	Average or unknown
6.0 Thermal Mass Parameter	Precise calculation

7.0 Electricity Tariff	Standard
Smart electricity meter fitted	Yes
Smart gas meter fitted	Yes

7.0 Measurements	Heat Loss Perimeter	Internal Floor Area	Unheated Space Floor Area	Average Storey Height
Ground floor:	46.84 m	74.44 m <sup>2</sup>	1.43 m <sup>2</sup>	2.40 m

8.0 Living Area	30.27	m <sup>2</sup>
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9.0 External Walls	Description	Type	Construction	U-Value (W/m <sup>2</sup> K)	Kappa (kJ/m <sup>2</sup> K)	Gross Area(m <sup>2</sup> )	Nett Area (m <sup>2</sup> )	Shelter Res	Shelter	Openings	Area Calculation Type
	External Wall	Steel Frame	Steel frame wall (warm frame or hybrid construction)	0.16	14.00	112.42	97.72	0.00	None	14.70	Enter Gross Area
	Wall to store	Steel Frame	Steel frame wall (warm frame or hybrid construction)	0.16	14.00	7.49	7.49	0.00	None	0.00	Enter Gross Area

9.2 Internal Walls	Description	Construction	Kappa (kJ/m <sup>2</sup> K)	Area (m <sup>2</sup> )
	Internal Wall 1	Other	14.00	66.00

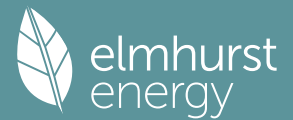
10.0 External Roofs	Description	Type	Construction	U-Value (W/m <sup>2</sup> K)	Kappa (kJ/m <sup>2</sup> K)	Gross Area(m <sup>2</sup> )	Nett Area (m <sup>2</sup> )	Shelter Code	Shelter Factor	Calculation Type	Openings
	External Roof	External Flat Roof	Plasterboard, insulated flat roof	0.11	9.00	74.44	74.44	None	0.00	Enter Gross Area	0.00

11.0 Heat Loss Floors	Description	Type	Storey Index	Construction	U-Value (W/m <sup>2</sup> K)	Shelter Code	Shelter Factor	Kappa (kJ/m <sup>2</sup> K)	Area (m <sup>2</sup> )
	Heatloss Floor	Ground Floor - Solid	Lowest occupied	Other	0.17	None	0.00	0.00	74.44

12.0 Opening Types	Description	Data Source	Type	Glazing	Glazing Gap	Filling Type	G-value	Frame Type	Frame Factor	U Value (W/m <sup>2</sup> K)
	Front door	Manufacturer	Solid Door							1.00
	Windows	Manufacturer	Window	Double Low-E Soft 0.05			0.63		0.70	0.80
	Patio doors	Manufacturer	Window	Double Low-E Soft 0.05			0.63		0.70	1.00

## 13.0 Openings

# Summary for Input Data



Name	Opening Type	Location	Orientation	Area (m <sup>2</sup> )	Pitch
Front door	Front door	External Wall	East	2.17	
East	Windows	External Wall	East	5.40	
Lounge	Patio doors	External Wall	West	3.23	
West	Windows	External Wall	West	3.90	

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**14.0 Conservatory**

**15.0 Draught Proofing**  %

**16.0 Draught Lobby**

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**17.0 Thermal Bridging**

**17.1 List of Bridges**

Bridge Type	Source Type	Length	Psi	Adjusted Reference:	Imported
E1 Steel lintel with perforated steel base plate	Gov Approved Scheme	10.01	0.01	0.01 ROI 5.19	No
E3 Sill	Gov Approved Scheme	7.50	0.01	0.01 ROI 5.21	No
E4 Jamb	Gov Approved Scheme	21.00	0.02	0.02 ROI 5.2	No
E5 Ground floor (normal)	Table K1 - Default	46.84	0.32	0.32	No
E14 Flat roof	Gov Approved Scheme	46.84	0.05	0.05 ROI 5.17	No
E16 Corner (normal)	Gov Approved Scheme	26.40	0.07	0.07 ROI 5.23.1	No
E17 Corner (inverted – internal area greater than external area)	Gov Approved Scheme	14.40	-0.04	-0.04 ROI 5.23.2	No

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Y-value  W/m<sup>2</sup>K

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**18.0 Pressure Testing**

Designed AP<sub>50</sub>  m<sup>3</sup>/(h.m<sup>2</sup>) @ 50 Pa

Test Method

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**19.0 Mechanical Ventilation**

**Mechanical Ventilation**

Mechanical Ventilation System Present

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**20.0 Fans, Open Fireplaces, Flues**

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**21.0 Fixed Cooling System**

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**22.0 Lighting**

No Fixed Lighting

Name	Efficacy	Power	Capacity	Count
Lighting	90.00	6	540	12

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**24.0 Main Heating 1**

Percentage of Heat  %

Fuel Type

SAP Code

In Winter

In Summer

Model Name

Controls SAP Code

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**25.0 Main Heating 2**

Percentage of Heat  %

Database Ref. No.

Fuel Type

In Winter

In Summer

Model Name

Manufacturer

Controls

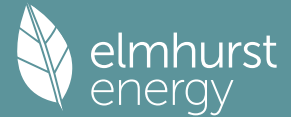
Flow Temperature

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**26.0 Heat Networks**

Heat Source	Fuel Type	Heating Use	Efficiency	Percentage Of Heat	Heat	Heat Power	Electrical	Fuel Factor	Efficiency type
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# Summary for Input Data



Ratio

Heat source 1  
Heat source 2  
Heat source 3  
Heat source 4  
Heat source 5

## 28.0 Water Heating

Water Heating	Main Heating 2
SAP Code	914
Flue Gas Heat Recovery System	No
Waste Water Heat Recovery Instantaneous System 1	No
Waste Water Heat Recovery Instantaneous System 2	No
Waste Water Heat Recovery Storage System	No
Solar Panel	No
Water use <= 125 litres/person/day	Yes
Cold Water Source	From mains
Bath Count	1
Immersion Only Heating Hot Water	No

## 28.1 Showers

Description	Shower Type	Flow Rate [l/min]	Rated Power [kW]	Connected	Connected To
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## 28.3 Waste Water Heat Recovery System

## 29.0 Hot Water Cylinder

Hot Water Cylinder		
Cylinder Stat	Yes	
Cylinder In Heated Space	Yes	
Independent Time Control	Yes	
Insulation Type	Measured Loss	
Cylinder Volume	200.00	L
Loss	1.67	kWh/day
Pipes insulation	Fully insulated primary pipework	
In Airing Cupboard	No	

## 31.0 Thermal Store

Thermal Store	Integrated
Thermal Store Pipework	within a single casing

## 32.0 Photovoltaic Unit

Photovoltaic Unit	One Dwelling
Export Capable Meter?	Yes
Connected To Dwelling	Yes
Diverter	Yes
Battery Capacity [kWh]	5.00

PV Cells kWp	Orientation	Elevation	Overshading	FGHRS	MCS Certificate	Overshading Factor	MCS Certificate Reference	Panel Manufacturer
2.87	South	30°	None Or Little		No	1.00		

## 34.0 Small-scale Hydro

Small-scale Hydro	None										
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

## Recommendations

Lower cost measures

None

Further measures to achieve even higher standards

Typical Cost	Typical savings per year	Ratings after improvement	
		SAP rating	Environmental Impact
		A 94	A 99
		0	0
		0	0

## Part G Compliance Report

### PROJECT DETAILS

Project Reference: RS2063  
Client: MMC Homebuilding Ltd  
Property: 196 Fortfield Road  
  
Bristol BS14 9NR

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Local Authority:  
Agent:

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Assessor: Natalie Wheeler  
Address: RS Energy  
Contact: info@rsenergy.co.uk  
Software: G-Calc 2015 version 3.0.2  
Prepared on: 25-Jan-24

### RESULT SUMMARY

By following the Government's national calculation methodology for assessing water efficiency in new dwellings this 3 bed dwelling, as designed, achieves a water consumption of 108.3 litres per person per day.

Compliance with Building Regulation 36(1) has been demonstrated.



**Table 1: The Water Calculator for New Dwellings**

Installation Type	Unit of measure	Value	Use factor	Fixed use	litres/person/day
WC(single flush)	Flush volume (litres)		4.42	0.00	
WC(dual flush)	Full flush vol.	6	1.46	0.00	8.76
	Part flush vol.	2.6	2.96	0.00	7.7
WC(multiple fittings)	Average effective Flush vol. (litres)	0	4.42	0.00	0
Taps(excl. Kitchen)	Flow rate (litres/min)	5	1.58	1.58	9.48
Bath (shower also present)	Capacity to overflow (litres)	170	0.11	0.00	18.7
Shower (bath also present)	Flow rate (litres/min)	8	4.37	0.00	34.96
Bath only	Capacity to overflow (litres)		0.50	0.00	0
Shower only	Flow rate (litres/minute)		5.6	0.00	0
Kitchen sink taps	Flow rate (litres/minute)	4.2	0.44	10.36	12.21
Washing Machine	litres/kg dry load	8.17	2.1	0.0	17.16
Dishwasher	litres/place setting	1.25	3.6	0.0	4.5
Waste disposal	litres/use	0	3.08	0.0	0
Water softener	litres/person/day	0	1.0	0.0	0
Total calculated use (litres/person/day)					113.47
Contribution from greywater (litres/person/day)					-
Contribution from rainwater (litres/person/day)					-
Normalisation factor					0.91
Total Water Consumption. Code for Sustainable Homes (litres/person/day)					<b>103.3</b>
External water use					5.0
Total Water Consumption. (36(1)) (litres/person/day)					<b>108.3</b>

<b>Table 2: Consumption Calculator for multiple fittings for New Dwellings</b>			
2.3: Taps (kitchen/utility sink taps)			
	Flow Rate (l/min)	Quantity (No.)	Total per fitting type
1 TBC	6		0
2			
3			
4			
Total (Sum of all Quantities)		1	
Total (Sum of all totals per fitting type)			0
Average Flow Rate (l/min)			0
Maximum Flow Rate (l/min)			6
Proportionate flow Rate (l/min)			4.2

<b>Summary of fitting types "As Designed"</b>			
Type	Description	Flow rates, volumes etc.	Qty
Taps	TBC	5 litres/min	1
Baths	TBC	170 litres to overflow	1
Dishwashers	TBC	1.25 litres/place	1
Washing Machines	TBC	8.17 litres/kg	1
Showers		8 litres/min	1
WC's	TBC	6 / 2.6 litres flush vols.	1
Kitchen/Utility taps	TBC	6 litres/min	1

The lower section of this table is to be filled in by the builder prior to completion. The descriptions, values and quantities should represent the 'as built' specification. Please note the values above represent design values and should not be exceeded without prior consultation with the agent/designer ().  
The completed table should be returned to the assessor: Natalie Wheeler (Contact: info@rsenergy.co.uk).

<b>Declaration of fitting types "As Built"</b>			
Type	Make and Model	Flow rates, volumes etc.	Qty
Taps			
Baths			
Dishwashers			
Washing Machines			
Showers			
WC's			
Kitchen/Utility taps			

Project ref: RS2063 - 196 Fortfield Road

The above declaration of fittings, values and quantities is a true reflection of those installed on this project.

Name: ..... Signature: ..... Date: .....

-----End of Report-----