



**Mark Alford Design Ltd**

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Our Ref : CJ-57

Sent By : E-Mail

20 June 2025

Dear Mark

**ENERGY STATEMENT (PLANNING)**

Report By :	Joe Solti Accredited Assessor
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Further to receipt of drawings, we are pleased to present our report as follows.

**Development Details**

Site Location :	Crosswinds, Hampers Lane, Storrington RH20 3HZ
Development :	2 New Detached 4 Bedroom Dwellings (Replacement Dwellings)
Local Authority :	Horsham District Council
Planning Policy (36) :	Appropriate Energy Use (Energy Hierarchy)
Planning Policy (37) :	(1) Maximise Energy Efficiency and Integrate Decentralised, Renewable and Low Carbon Energy (2) Limit Water Use to 110 Litres/Person/Day

## CJ-57

Site Location :

Crosswinds, Hampers Lane, Storrington RH20 3HZ

## POLICY 36

### Strategic Policy : Appropriate Energy Use

#### Energy Hierarchy

All development will be required to contribute to clean, efficient energy in Horsham based on the following hierarchy :

- (1) Lean - use less energy - eg through demand reduction
- (2) Clean - supply energy efficiently - eg through heat networks
- (3) Green - use renewable energy sources

#### District Heating & Cooling

Commercial and residential developments in Heat Priority Areas or the strategic development locations will be expected to connect to district heating networks where they exist using the following hierarchy, or incorporate the necessary infrastructure for connection to future network.

Development should demonstrate that the heating and cooling systems have been selected in accordance with the following heating and cooling hierarchy :

- (1) Connection to existing (C)CHP distribution networks (not available)
- (2) Site wide renewable (C)CHP (not suitable - single dwelling)
- (3) Site wide gas-fired (C)CHP (not suitable -single dwelling)
- (4) Site wide renewable community heating/cooling (not suitable - single dwelling)
- (5) Site wide gas-fired community heating/cooling (not suitable - single dwelling)

#### **(6) Individual building renewable heating**

- (7) Individual building heating, with the exception of electric heating

All (C)CHP must be of a scale and operated to maximise the potential for carbon reduction. Where site-wide (C)CHP is proposed, consideration must be given to extending the network to adjacent sites.

#### Energy Statements

All applications for residential or commercial development must include an Energy Statement demonstrating and quantifying how the development will comply with the Energy Hierarchy.

**CJ-57**

Site Location :	Crosswinds, Hampers Lane, Storrington RH20 3HZ
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**BASELINE CO2**

Calculations (SAP) :	Part L1A Compliant
Total Emissions :	4.05 kg CO2 per m2
Total Emissions :	907.20 kg CO2 per year

**BE LEAN CO2**

Calculations (SAP) :	Energy Efficiency Measures
Total Emissions :	3.52 kg CO2 per m2
Total Emissions :	778.48 kg CO2 per year
CO2 Saving :	128.72 kg CO2 per year = 14.19 %

**BE CLEAN CO2**

Calculations (SAP) :	Heat Networks (Not Available)
Total Emissions :	3.52 kg CO2 per m2
Total Emissions :	778.48 kg CO2 per year
CO2 Saving :	0.00 kg CO2 per year = 0.00 %

**BE GREEN CO2**

Calculations (SAP) :	Renewables (Solar PV - min 2.5kW per house with export capable meter)
Total Emissions :	2.76 kg CO2 per m2
Total Emissions :	618.24 kg CO2 per year
CO2 Saving :	160.24 kg CO2 per year = 20.58 %

## CJ-57

Site Location :

Crosswinds, Hampers Lane, Storrington RH20 3HZ

## POLICY 37

### Sustainable Construction

Proposals must seek to improve the sustainability of development. To deliver sustainable design, development should incorporate the following measures where appropriate according to the type of development and location :

(1) Maximise energy efficiency and integrate the use of decentralised, renewable and low carbon energy.

(2) Limit water use to 110 litres/person/day

(3)-(8) By others

All new development will be required to provide satisfactory arrangements for the storage of refuse and recyclable materials as an integral part of the design.

New homes and workplaces should include the provision of high-speed broadband access and enable provision of future technologies where available.

#### **1. Maximise Energy Efficiency & Integrate Decentralised, Renewables and Low Carbon Energy**

The building is to be designed with a "fabric first approach" to minimise energy requirements, incorporating excellent fabric insulation and air-tightness, advanced detailing, and low energy use ventilation and lighting (ie LEDs).

Heating is to be by air source heat pump (preferably Products Characteristic Database listed), MCS certified installer, with advanced heating controls.

Solar PV (min 2.5kW per house) is then added to reduce energy use and carbon emissions.

See SAP Calculations attached to this report.

#### **2. Limit Water Use to 110 Litres/Person/Day**

Water use is to be reduced and suitably minimised by the fitting of low water use sanitary fittings (taps/showers), dual flush WCs, and low water use (and energy efficient) dishwashers and washing machines.

See Water Efficiency Calculation attached to this report.

**Construction and Insulation**

<u>Element</u>	<u>U-Value</u> (W/m <sup>2</sup> K)
<u>Exposed Wall</u> 102.5mm facing brick outer leaf (or clad 100mm concrete block) + 10mm clear cavity + 90mm Celotex ThermaClass 21 insulation + 100mm standard aircrete 3.6N block inner leaf + plaster or plasterboard on dabs.	0.18
<u>Ground Floor</u> 75mm screed + 150mm PIR insulation + suspended concrete beam and block floor.	0.12
<u>Roof (lofts)</u> 400mm mineral wool insulation quilt (200mm between joists + 200mm cross-laid over, or 100mm + 300mm).	0.11
<u>Roof (skelings)</u> Actis insulation system - Hybris between rafters + multi-foil(s).	0.15
<u>Windows, Doors &amp; Rooflights</u> Double-glazed + 16mm cavity (argon gas fill) + soft coat low-E glass + warm edge spacer, or similar to achieve a U-value of 1.30W/m <sup>2</sup> K (or better).	1.30

**Heating, Ventilation & Renewables**

<u>Main Heating System</u> Electric air source heat pump (ground floor = underfloor heating, first floor = radiators). MCS installer.
<u>Water Heating</u> From electric air source heat pump. Hot water cylinder (factory PIR insulation, heat loss TBC kWh/day) + thermostat.
<u>Heating Controls</u> Time and temperature zoned heating controls.
<u>Ventilation</u> Background ventilators + intermittent extract fans (Approved Document F1, 2010).
<u>Solar PV</u> Solar PV panels = 2.50 kW/peak per house, on rear facing roof (export capable meter).

**Other**

<u>Detailing</u> Block/insulation construction details (limiting thermal bridging and air leakage) fully adopted in accordance with Recognised Construction Details (RCD).
<u>Lighting</u> Low energy lighting with minimum luminous efficacy of 75 light source lumens/circuit-watt (per light fitting).
<u>Air Tightness</u> Design air permeability is 5m <sup>3</sup> /h/m <sup>2</sup> at 50 Pa - to be achieved by air pressure test.

# Building Regulations England Part L (BREL) Compliance Report

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

Date: Fri 20 Jun 2025 09:04:24

Project Information			
Assessed By	Joe Solti	Building Type	House, Detached
OCDEA Registration	EES/003578	Assessment Date	2025-06-20

Dwelling Details			
Assessment Type	As designed	Total Floor Area	224 m <sup>2</sup>
Site Reference	CJ5701	Plot Reference	CJ5701A
Address	Crosswinds Plot 1 Hampers Lane, Storrington, RH20 3HZ		

Client Details	
Name	.
Company	.
Address	., ., .

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

1a Target emission rate and dwelling emission rate		
Fuel for main heating system	Electricity	
Target carbon dioxide emission rate	7.93 kgCO <sub>2</sub> /m <sup>2</sup>	
Dwelling carbon dioxide emission rate	4.05 kgCO <sub>2</sub> /m <sup>2</sup>	OK
1b Target primary energy rate and dwelling primary energy		
Target primary energy	42.01 kWh <sub>PE</sub> /m <sup>2</sup>	
Dwelling primary energy	41.98 kWh <sub>PE</sub> /m <sup>2</sup>	OK
1c Target fabric energy efficiency and dwelling fabric energy efficiency		
Target fabric energy efficiency	40.5 kWh/m <sup>2</sup>	
Dwelling fabric energy efficiency	40.4 kWh/m <sup>2</sup>	OK

2a Fabric U-values				
Element	Maximum permitted average U-Value [W/m <sup>2</sup> K]	Dwelling average U-Value [W/m <sup>2</sup> K]	Element with highest individual U-Value	
External walls	0.26	0.18	Walls (1) (0.18)	OK
Party walls	0.2	N/A	N/A	N/A
Curtain walls	1.6	N/A	N/A	N/A
Floors	0.18	0.12	Ground Floor (0.12)	OK
Roofs	0.16	0.12	Roof (2) (0.16)	OK
Windows, doors, and roof windows	1.6	1.4	Front Door (1.4)	OK
Rooflights	2.2	N/A	N/A	N/A

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))		
Name	Net area [m <sup>2</sup> ]	U-Value [W/m <sup>2</sup> K]
Exposed wall: Walls (1)	183.9	0.18
Ground floor: Ground Floor, Ground Floor	120	0.12
Exposed roof: Roof (1)	113	0.12
Exposed roof: Roof (2)	8.9	0.16

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	Area [m <sup>2</sup> ]	Orientation	Frame factor	U-Value [W/m <sup>2</sup> K]
Front Door, Doors	2.1	South East	N/A	1.4
Windows (NE), Windows	2	North East	0.7	1.4
Windows (NW), Windows	22.3	North West	0.7	1.4
Windows (SE), Windows	15.1	South East	0.7	1.4
Windows (SW), Windows	3.1	South West	0.7	1.4
Rooflights (NW), Rooflights	1	North West	0.7	1.4
Rooflights (SE), Rooflights	0.6	South East	0.7	1.4

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

Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E2: Other lintels (including other steel lintels)	Calculated by person with suitable expertise	0.05	
External wall	E3: Sill	Calculated by person with suitable expertise	0.02 (!)	
External wall	E4: Jamb	Calculated by person with suitable expertise	0.015 (!)	
External wall	E5: Ground floor (normal)	Calculated by person with suitable expertise	0.053	
External wall	E6: Intermediate floor within a dwelling	Calculated by person with suitable expertise	0.001 (!)	
External wall	E10: Eaves (insulation at ceiling level)	Calculated by person with suitable expertise	0.056	
External wall	E11: Eaves (insulation at rafter level)	Calculated by person with suitable expertise	0.017 (!)	
External wall	E12: Gable (insulation at ceiling level)	Calculated by person with suitable expertise	0.036 (!)	
External wall	E13: Gable (insulation at rafter level)	Calculated by person with suitable expertise	0.038 (!)	
External wall	E16: Corner (normal)	Calculated by person with suitable expertise	0.038 (!)	
Roof	R1: Head of roof window	SAP table default	0.24	
Roof	R2: Sill of roof window	SAP table default	0.24	
Roof	R3: Jamb of roof window	SAP table default	0.24	

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

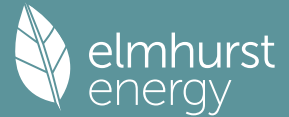
4 Space heating	
<b>Main heating system 1:</b> Heat pump with radiators or underfloor heating - Electricity	
Efficiency	219.3%
Emitter type	Both radiators and underfloor
Flow temperature	
System type	Air source heat pump
Manufacturer	
Model	
Commissioning	
<b>Secondary heating system:</b> Open fire in grate	
Fuel	Dual fuel appliance (mineral and wood)
Efficiency	37.0%
Commissioning	

5 Hot water	
<b>Cylinder/store</b> - type: Cylinder	
Capacity	300 litres
Declared heat loss	2.4 kWh/day
Primary pipework insulated	Yes
Manufacturer	
Model	
Commissioning	
<b>Waste water heat recovery system 1</b> - type: N/A	
Efficiency	
Manufacturer	
Model	

6 Controls	
<b>Main heating 1</b> - type: Time and temperature zone control by arrangement of plumbing and electrical services	
Function	
Ecodesign class	
Manufacturer	
Model	

<b>Water heating</b> - type: Cylinder thermostat and HW separately timed		
Manufacturer		
Model		
<b>7 Lighting</b>		
Minimum permitted light source efficacy	75 lm/W	
Lowest light source efficacy	75 lm/W	OK
External lights control	N/A	
<b>8 Mechanical ventilation</b>		
<b>System type:</b> N/A		
Maximum permitted specific fan power	N/A	
Specific fan power	N/A	N/A
Minimum permitted heat recovery efficiency	N/A	
Heat recovery efficiency	N/A	N/A
Manufacturer/Model		
Commissioning		
<b>9 Local generation</b>		
N/A		
<b>10 Heat networks</b>		
N/A		
<b>11 Supporting documentary evidence</b>		
N/A		
<b>12 Declarations</b>		
<b>a. Assessor Declaration</b>		
This declaration by the assessor is confirmation that the contents of this BREL Compliance Report are a true and accurate reflection based upon the design information submitted for this dwelling for the purpose of carrying out the "As designed" assessment, and that the supporting documentary evidence (SAP Conventions, Appendix 1 (documentary evidence) schedules the minimum documentary evidence required) has been reviewed in the course of preparing this BREL Compliance Report.		
Signed:	Assessor ID:	
Name:	Date:	
<b>b. Client Declaration</b>		
N/A		

# Full SAP Calculation Printout



Property Reference	CJ5701		Issued on Date	20/06/2025	
Assessment Reference	CJ5701A	Prop Type Ref	New House		
Property	Plot 1, Crosswinds, Hampers Lane, Storrington, West Sussex, RH20 3HZ				
SAP Rating	79 C	DER	4.05	TER	7.93
Environmental	96 A	% DER < TER			48.93
CO <sub>2</sub> Emissions (t/year)	0.8	DFEE	40.43	TFEE	40.48
Compliance Check	See BREL	% DFEE < TFEE			0.11
% DPER < TPER	0.08	DPER	41.98	TPER	42.01
Assessor Details	Mr. Joe Solti			Assessor ID	5122-0001
Client	Mark Alford Design, .				

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> )
Main dwelling			
Ground floor	120.0000 (1b)	x 2.4100 (2b)	= 289.2000 (1b) - (3b)
First floor	104.0000 (1c)	x 2.6300 (2c)	= 273.5200 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	224.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 562.7200 (5)

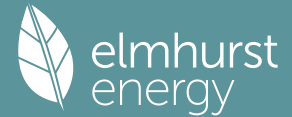
## 2. Ventilation rate

	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	6 * 10 =											60.0000 (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) =	60.0000 / (5) =											0.1066 (8)
Pressure test												Yes
Pressure Test Method												Blower Door
Measured/design AP50												5.0000 (17)
Infiltration rate												0.3566 (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) =											0.3031 (21)
Wind speed	Jan 5.1000	Feb 5.0000	Mar 4.9000	Apr 4.4000	May 4.3000	Jun 3.8000	Jul 3.8000	Aug 3.7000	Sep 4.0000	Oct 4.3000	Nov 4.5000	Dec 4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.3865	0.3789	0.3713	0.3334	0.3259	0.2880	0.2880	0.2804	0.3031	0.3259	0.3410	0.3562 (22b)
Effective ac	0.5747	0.5718	0.5689	0.5556	0.5531	0.5415	0.5415	0.5393	0.5459	0.5531	0.5581	0.5634 (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
Main dwelling							
Doors			2.1000	1.4000	2.9400		(26a)
Windows			42.5000	1.3258	56.3447		(27)
Rooflights			1.6000	1.3258	2.1212		(27a)
Ground Floor			120.0000	0.1200	14.4000	75.0000	9000.0000 (28a)
External Wall	228.5000	44.6000	183.9000	0.1800	33.1020	60.0000	11034.0000 (29a)
Roof (loft)	113.0000		113.0000	0.1200	13.5600	9.0000	1017.0000 (30)
Roof (skelling)	10.5000	1.6000	8.9000	0.1600	1.4240	9.0000	80.1000 (30)
Total net area of external elements Aum(A, m <sup>2</sup> )			472.0000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	123.8919	(33)
Main dwelling							
Internal Wall			165.0000			75.0000	12375.0000 (32c)
Internal Wall			225.0000			9.0000	2025.0000 (32c)
Internal Floor			104.0000			18.0000	1872.0000 (32d)
Internal Ceiling			104.0000			9.0000	936.0000 (32e)
Heat capacity Cm = Sum (A x k)							(28)...(30) + (32) + (32a)...(32e) = 38339.1000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							171.1567 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value		Total

# Full SAP Calculation Printout



E2 Other lintels (including other steel lintels)	39.5000	0.0500	1.9750
E3 Sill	25.8000	0.0200	0.5160
E4 Jamb	56.3000	0.0150	0.8445
E5 Ground floor (normal)	50.1000	0.0530	2.6553
E6 Intermediate floor within a dwelling	43.4000	0.0010	0.0434
E10 Eaves (insulation at ceiling level)	10.2000	0.0560	0.5712
E11 Eaves (insulation at rafter level)	9.6000	0.0170	0.1632
E12 Gable (insulation at ceiling level)	17.5000	0.0360	0.6300
E13 Gable (insulation at rafter level)	7.6000	0.0380	0.2888
E16 Corner (normal)	26.2000	0.0380	0.9956
R1 Head of roof window	1.8000	0.2400	0.4320
R2 Sill of roof window	1.8000	0.2400	0.4320
R3 Jamb of roof window	5.4000	0.2400	1.2960
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			10.8430 (36)
Point Thermal bridges			0.0000 (36a) =
Total fabric heat loss		(33) + (36) + (36a) =	134.7349 (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	106.7182	106.1796	105.6517	103.1722	102.7083	100.5487	100.5487	100.1488	101.3805	102.7083	103.6468	104.6279 (38)
Heat transfer coeff	241.4531	240.9146	240.3867	237.9071	237.4432	235.2836	235.2836	234.8837	236.1154	237.4432	238.3817	239.3628 (39)
Average = Sum(39)m / 12 =												237.9049
HLP	1.0779	1.0755	1.0732	1.0621	1.0600	1.0504	1.0504	1.0486	1.0541	1.0600	1.0642	1.0686 (40)
HLP (average)												1.0621
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

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

Assumed occupancy													3.0331 (42)
Hot water usage for mixer showers	112.6132	110.9209	108.4548	103.7363	100.2543	96.3711	94.1639	96.6113	99.2941	103.4635	108.2833	112.1818	112.1818 (42a)
Hot water usage for baths	32.4081	31.9268	31.2490	29.9993	29.0636	28.0260	27.4655	28.1385	28.8714	29.9816	31.2571	32.2986	32.2986 (42b)
Hot water usage for other uses	45.6923	44.0307	42.3692	40.7077	39.0461	37.3846	37.3846	39.0461	40.7077	42.3692	44.0307	45.6923	45.6923 (42c)
Average daily hot water use (litres/day)													175.4115 (43)
Daily hot water use	190.7136	186.8784	182.0730	174.4434	168.3640	161.7816	159.0140	163.7960	168.8732	175.8143	183.5711	190.1726	190.1726 (44)
Energy content (annual)	302.0438	266.1124	279.8395	238.8042	226.6503	198.9294	192.3136	202.8136	208.2375	238.5784	261.5307	297.7644	297.7644 (45)
Distribution loss (46)m = 0.15 x (45)m	45.3066	39.9169	41.9759	35.8206	33.9975	29.8394	28.8470	30.4220	31.2356	35.7868	39.2296	44.6647	44.6647 (46)
Water storage loss:													
Store volume													300.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):													2.4000 (48)
Temperature factor from Table 2b													0.5400 (49)
Enter (49) or (54) in (55)													1.2960 (55)
Total storage loss	40.1760	36.2880	40.1760	38.8800	40.1760	38.8800	40.1760	40.1760	38.8800	40.1760	38.8800	40.1760	40.1760 (56)
If cylinder contains dedicated solar storage	40.1760	36.2880	40.1760	38.8800	40.1760	38.8800	40.1760	40.1760	38.8800	40.1760	38.8800	40.1760	40.1760 (57)
Primary loss	23.2624	21.0112	23.2624	22.5120	22.5120	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	365.4822	323.4116	343.2779	300.1962	290.0887	260.3214	255.7520	266.2520	269.6295	302.0168	322.9227	361.2028	361.2028 (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	365.4822	323.4116	343.2779	300.1962	290.0887	260.3214	255.7520	266.2520	269.6295	302.0168	322.9227	361.2028	361.2028 (64)
Total per year (kWh/year)													3660.5537 (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	151.1803	134.3217	143.7973	128.5160	126.1119	115.2576	114.6950	118.1862	118.3526	130.0780	136.0726	149.7574	149.7574 (65)

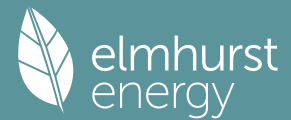
#### 5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	199.9605	221.3849	199.9605	206.6259	199.9605	206.6259	199.9605	199.9605	206.6259	199.9605	206.6259	199.9605 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	393.3198	397.4012	387.1161	365.2205	337.5811	311.6040	294.2496	290.1682	300.4533	322.3490	349.9884	375.9655 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656 (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)	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252 (71)
Water heating gains (Table 5)	203.1993	199.8835	193.2760	178.4945	169.5053	160.0800	154.1599	158.8525	164.3786	174.8361	188.9897	201.2868 (72)
Total internal gains	864.9765	887.1666	848.8496	818.8377	775.5438	746.8068	716.8670	717.4782	739.9547	765.6425	814.1008	845.7097 (73)

#### 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
Northeast	2.0000	11.2829	0.6300	0.7000	0.7700	6.8964 (75)
Southeast	15.1000	36.7938	0.6300	0.7000	0.7700	169.7946 (77)

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Southwest			3.1000		36.7938		0.6300		0.7000		0.7700		34.8585 (79)
Northwest			22.3000		11.2829		0.6300		0.7000		0.7700		76.8952 (81)
Southeast			0.6000		39.9751		0.6300		0.7000		1.0000		9.5197 (82)
Northwest			1.0000		16.3666		0.6300		0.7000		1.0000		6.4959 (82)

Solar gains	304.4602	550.0288	835.6219	1173.9086	1440.8370	1485.6945	1409.3738	1201.8680	951.4976	630.3306	370.4051	256.8402	(83)
Total gains	1169.4368	1437.1953	1684.4715	1992.7463	2216.3808	2232.5013	2126.2409	1919.3462	1691.4523	1395.9731	1184.5059	1102.5499	(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	44.1069	44.2055	44.3026	44.7643	44.8518	45.2635	45.2635	45.3405	45.1040	44.8518	44.6752	44.4921	
alpha	3.9405	3.9470	3.9535	3.9843	3.9901	4.0176	4.0176	4.0227	4.0069	3.9901	3.9783	3.9661	
util living area	0.9946	0.9874	0.9700	0.9154	0.7981	0.6221	0.4726	0.5371	0.7850	0.9526	0.9892	0.9957	(86)
MIT	19.5254	19.7241	20.0198	20.4073	20.7079	20.8658	20.9083	20.8989	20.7754	20.3656	19.8766	19.4962	(87)
Th 2	20.0189	20.0209	20.0228	20.0319	20.0336	20.0416	20.0416	20.0430	20.0385	20.0336	20.0302	20.0266	(88)
util rest of house	0.9933	0.9844	0.9627	0.8948	0.7519	0.5456	0.3759	0.4361	0.7192	0.9369	0.9862	0.9947	(89)
MIT 2	18.2738	18.5284	18.9042	19.3901	19.7385	19.9038	19.9364	19.9328	19.8230	19.3498	18.7312	18.2421	(90)
Living area fraction	FLA = Living area / (4) =												
MIT	18.4274	18.6752	19.0412	19.5150	19.8575	20.0219	20.0557	20.0514	19.9399	19.4745	18.8719	18.3960	(92)
Temperature adjustment	0.0000												
adjusted MIT	18.4274	18.6752	19.0412	19.5150	19.8575	20.0219	20.0557	20.0514	19.9399	19.4745	18.8719	18.3960	(93)

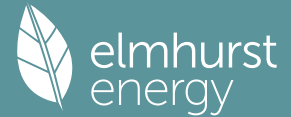
## 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.9903	0.9788	0.9532	0.8816	0.7425	0.5439	0.3774	0.4370	0.7115	0.9251	0.9811	0.9922	(94)
Useful gains	1158.0643	1406.7525	1605.6271	1756.7057	1645.5942	1214.2559	802.4263	838.7494	1203.4341	1291.4567	1162.0595	1093.9416	(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	3411.1090	3318.6548	3014.7332	2525.3746	1936.9461	1275.6791	813.0694	857.6515	1378.8925	2107.1849	2806.1946	3398.0041	(97)
Space heating kWh	1676.2653	1284.7983	1048.3749	553.4416	216.7659	0.0000	0.0000	0.0000	0.0000	606.9018	1183.7773	1714.2225	(98a)
Space heating requirement - total per year (kWh/year)	8284.5476												
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	1676.2653	1284.7983	1048.3749	553.4416	216.7659	0.0000	0.0000	0.0000	0.0000	606.9018	1183.7773	1714.2225	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)	8284.5476												
Space heating per m2	(98c) / (4) = 36.9846 (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 %)													219.3000 (206)
Efficiency of main space heating system 2 (in %)													0.0000 (207)
Efficiency of secondary/supplementary heating system, %													37.0000 (208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1676.2653	1284.7983	1048.3749	553.4416	216.7659	0.0000	0.0000	0.0000	0.0000	606.9018	1183.7773	1714.2225	(98)
Space heating efficiency (main heating system 1)	219.3000	219.3000	219.3000	219.3000	219.3000	0.0000	0.0000	0.0000	0.0000	219.3000	219.3000	219.3000	(210)
Space heating fuel (main heating system)	764.3709	585.8634	478.0551	252.3674	98.8444	0.0000	0.0000	0.0000	0.0000	276.7450	539.7981	781.6792	(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	365.4822	323.4116	343.2779	300.1962	290.0887	260.3214	255.7520	266.2520	269.6295	302.0168	322.9227	361.2028	(64)
Efficiency of water heater (217)m	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	(216)
Fuel for water heating, kWh/month	191.9549	169.8590	180.2930	157.6661	152.3575	136.7234	134.3235	139.8382	141.6121	158.6223	169.6023	189.7073	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(231)
Lighting	42.5103	34.1033	30.7063	22.4967	17.3771	14.1973	15.8520	20.6050	26.7639	35.1157	39.6631	43.6918	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1													3777.7235 (211)
Space heating fuel - main system 2													0.0000 (213)
Space heating fuel - secondary													0.0000 (215)
Efficiency of water heater													190.4000

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Water heating fuel used	1922.5597 (219)
Space cooling fuel	0.0000 (221)
Electricity for pumps and fans:	
Total electricity for the above, kWh/year	0.0000 (231)
Electricity for lighting (calculated in Appendix L)	343.0824 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	0.0000 (233)
Wind generation	0.0000 (234)
Hydro-electric generation (Appendix N)	0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)	0.0000 (235)
Appendix Q - special features	
Energy saved or generated	-0.0000 (236)
Energy used	0.0000 (237)
Total delivered energy for all uses	6043.3656 (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	3777.7235	0.1554	587.1696 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1922.5597	0.1410	271.0685 (264)
Space and water heating			858.2381 (265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (267)
Energy for lighting	343.0824	0.1443	49.5174 (268)
Total CO2, kg/year			907.7555 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			4.0500 (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	3777.7235	1.5754	5951.5401 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1922.5597	1.5213	2924.8821 (278)
Space and water heating			8876.4222 (279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (281)
Energy for lighting	343.0824	1.5338	526.2312 (282)
Total Primary energy kWh/year			9402.6534 (286)
Dwelling Primary energy Rate (DPER)			41.9800 (287)

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

### 1. Overall dwelling characteristics

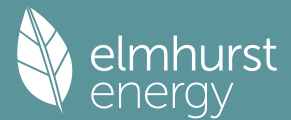
	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Main dwelling			
Ground floor	120.0000 (1b)	x 2.4100 (2b)	= 289.2000 (1b) - (3b)
First floor	104.0000 (1c)	x 2.6300 (2c)	= 273.5200 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	224.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	562.7200 (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	4 * 10 =	40.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)
		Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0711 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.3211 (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) =	0.2729 (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	0.3480	0.3412	0.3343	0.3002	0.2934	0.2593	0.2593	0.2525	0.2729	0.2934	0.3070	0.3207 (22b)
	0.5605	0.5582	0.5559	0.5451	0.5430	0.5336	0.5336	0.5319	0.5372	0.5430	0.5471	0.5514 (25)

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### 3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
Main dwelling							
TER Semi-glazed door			2.1000	1.0000	2.1000		(26a)
TER Opening Type			42.5000	1.1450	48.6641		(27)
TER Roof Window			1.6000	1.1450	2.2642		(27a)
Ground Floor			120.0000	0.1300	15.6000		(28a)
External Wall	228.5000	44.6000	183.9000	0.1800	33.1020		(29a)
Roof (loft)	113.0000		113.0000	0.1100	12.4300		(30)
Roof (skelling)	10.5000	1.6000	8.9000	0.1100	0.9790		(30)
Total net area of external elements Aum(A, m2)			472.0000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	115.1393	(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 171.1567 (35)

#### List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	39.5000	0.0500	1.9750
E3 Sill	25.8000	0.0500	1.2900
E4 Jamb	56.3000	0.0500	2.8150
E5 Ground floor (normal)	50.1000	0.1600	8.0160
E6 Intermediate floor within a dwelling	43.4000	0.0000	0.0000
E10 Eaves (insulation at ceiling level)	10.2000	0.0600	0.6120
E11 Eaves (insulation at rafter level)	9.6000	0.0400	0.3840
E12 Gable (insulation at ceiling level)	17.5000	0.0600	1.0500
E13 Gable (insulation at rafter level)	7.6000	0.0800	0.6080
E16 Corner (normal)	26.2000	0.0900	2.3580
R1 Head of roof window	1.8000	0.0800	0.1440
R2 Sill of roof window	1.8000	0.0600	0.1080
R3 Jamb of roof window	5.4000	0.0800	0.4320

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 19.7920 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 134.9313 (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	104.0915	103.6549	103.2270	101.2171	100.8410	99.0904	99.0904	98.7662	99.7647	100.8410	101.6018	102.3971
Average = Sum(39)m / 12 =	239.0228	238.5862	238.1583	236.1483	235.7723	234.0217	234.0217	233.6975	234.6960	235.7723	236.5330	237.3284

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.0671	1.0651	1.0632	1.0542	1.0526	1.0447	1.0447	1.0433	1.0477	1.0526	1.0560	1.0595
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	75.0755	73.9472	72.3032	69.1576	66.8362	64.2474	62.7759	64.4075	66.1961	68.9757	72.1889	74.7878
Hot water usage for baths	32.4081	31.9268	31.2490	29.9993	29.0636	28.0260	27.4655	28.1385	28.8714	29.9816	31.2571	32.2986
Hot water usage for other uses	45.6923	44.0307	42.3692	40.7077	39.0461	37.3846	37.3846	39.0461	40.7077	42.3692	44.0307	45.6923
Average daily hot water use (litres/day)	36.3890	32.0194	33.6414	28.7201	27.2495	23.9144	23.1529	24.4408	25.1136	28.7668	31.5161	35.8822

Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	153.1759	149.9048	145.9214	139.8646	134.9459	129.6579	127.6260	131.5922	135.7751	141.3265	147.4767	152.7787
Energy content (annual)	242.5932	213.4625	224.2758	191.4676	181.6631	159.4296	154.3526	162.9386	167.4243	191.7787	210.1076	239.2145
Distribution loss (46)m = 0.15 x (45)m	36.3890	32.0194	33.6414	28.7201	27.2495	23.9144	23.1529	24.4408	25.1136	28.7668	31.5161	35.8822

Water storage loss:

Store volume	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
a) If manufacturer declared loss factor is known (kWh/day):												
Temperature factor from Table 2b												
Enter (49) or (54) in (55)												
Total storage loss	35.3664	31.9439	35.3664	34.2256	35.3664	34.2256	35.3664	35.3664	34.2256	35.3664	34.2256	35.3664

Primary loss	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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
Total heat required for water heating calculated for each month	301.2220	266.4175	282.9046	248.2052	240.2919	216.1671	212.9814	221.5674	224.1619	250.4076	266.8451	297.8433
WWHRS	-34.3214	-30.3541	-31.7851	-26.3193	-24.5286	-20.9893	-19.6742	-20.9215	-21.7164	-25.6012	-29.0031	-33.6858
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
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
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
Output from w/h	266.9006	236.0634	251.1196	221.8859	215.7633	195.1778	193.3072	200.6460	202.4455	224.8063	237.8421	264.1575

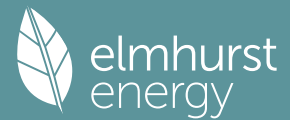
12Total per year (kWh/year)

Electric shower(s)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat gains from water heating, kWh/month	127.5653	113.3403	121.4748	109.0530	107.3060	98.4004	98.2253	101.0801	101.0586	110.6695	115.2508	126.4419

### 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	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	199.9605	221.3849	199.9605	206.6259	199.9605	206.6259	199.9605	199.9605	206.6259	199.9605	206.6259	199.9605
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	393.3198	397.4012	387.1161	365.2205	337.5811	311.6040	294.2496	290.1682	300.4533	322.3490	349.9884	375.9655
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656
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

# Full SAP Calculation Printout



Losses e.g. evaporation (negative values) (Table 5)	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	(71)
Water heating gains (Table 5)	171.4587	168.6612	163.2725	151.4625	144.2285	136.6672	132.0232	135.8604	140.3592	148.7493	160.0706	169.9488	(72)
Total internal gains	836.2360	858.9442	821.8461	794.8058	753.2671	723.3940	694.7303	694.4861	715.9353	742.5557	788.1817	817.3717	(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							
Northeast	2.0000	11.2829	0.6300	0.7000	0.7700	6.8964 (75)							
Southeast	15.1000	36.7938	0.6300	0.7000	0.7700	169.7946 (77)							
Southwest	3.1000	36.7938	0.6300	0.7000	0.7700	34.8585 (79)							
Northwest	22.3000	11.2829	0.6300	0.7000	0.7700	76.8952 (81)							
Southeast	0.6000	39.9751	0.6300	0.7000	1.0000	9.5197 (82)							
Northwest	1.0000	16.3666	0.6300	0.7000	1.0000	6.4959 (82)							
Solar gains	304.4602	550.0288	835.6219	1173.9086	1440.8370	1485.6945	1409.3738	1201.8680	951.4976	630.3306	370.4051	256.8402	(83)
Total gains	1140.6962	1408.9730	1657.4680	1968.7144	2194.1040	2209.0884	2104.1042	1896.3541	1667.4329	1372.8863	1158.5868	1074.2119	(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	44.5554	44.6369	44.7171	45.0977	45.1696	45.5075	45.5075	45.5707	45.3768	45.1696	45.0244	44.8735	
alpha	3.9704	3.9758	3.9811	4.0065	4.0113	4.0338	4.0338	4.0380	4.0251	4.0113	4.0016	3.9916	
util living area	0.9950	0.9882	0.9713	0.9173	0.8002	0.6250	0.4750	0.5406	0.7891	0.9545	0.9900	0.9961	(86)
MIT	19.1415	19.4060	19.7995	20.3137	20.7147	20.9234	20.9802	20.9673	20.8015	20.2546	19.6034	19.0986	(87)
Th 2	20.0278	20.0294	20.0310	20.0384	20.0398	20.0462	20.0462	20.0474	20.0437	20.0398	20.0370	20.0340	(88)
util rest of house	0.9939	0.9854	0.9643	0.8971	0.7544	0.5486	0.3783	0.4395	0.7240	0.9395	0.9872	0.9952	(89)
MIT 2	17.8359	18.1741	18.6737	19.3146	19.7791	19.9937	20.0374	20.0315	19.8862	19.2557	18.4328	17.7851	(90)
Living area fraction													FLA = Living area / (4) =
MIT	17.9962	18.3254	18.8119	19.4373	19.8939	20.1078	20.1532	20.1464	19.9986	19.3783	18.5765	17.9464	(92)
Temperature adjustment													0.0000
adjusted MIT	17.9962	18.3254	18.8119	19.4373	19.8939	20.1078	20.1532	20.1464	19.9986	19.3783	18.5765	17.9464	(93)

## 8. Space heating requirement

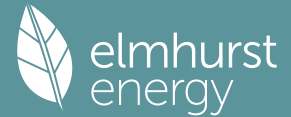
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9900	0.9782	0.9524	0.8817	0.7466	0.5538	0.3895	0.4505	0.7205	0.9256	0.9807	0.9920	(94)
Useful gains	1129.3323	1378.3180	1578.4991	1735.7768	1638.0467	1223.5034	819.5189	854.3012	1201.3863	1270.7583	1136.2649	1065.6293	(95)
Ext temp.	4.3000	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	3273.7006	3203.1089	2932.1913	2488.3590	1931.9028	1288.9510	831.5178	875.5274	1384.3781	2069.6801	2714.5653	3262.4051	(97)
Space heating kWh	1595.4100	1226.2595	1007.1470	541.8592	218.6290	0.0000	0.0000	0.0000	0.0000	594.3978	1136.3763	1634.4012	(98a)
Space heating requirement - total per year (kWh/year)													7954.4800
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	1595.4100	1226.2595	1007.1470	541.8592	218.6290	0.0000	0.0000	0.0000	0.0000	594.3978	1136.3763	1634.4012	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)													7954.4800
Space heating per m <sup>2</sup>													(98c) / (4) = 35.5111 (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	1595.4100	1226.2595	1007.1470	541.8592	218.6290	0.0000	0.0000	0.0000	0.0000	594.3978	1136.3763	1634.4012	(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)	1728.5048	1328.5585	1091.1669	587.0631	236.8678	0.0000	0.0000	0.0000	0.0000	643.9846	1231.1769	1770.7488	(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	266.9006	236.0634	251.1196	221.8859	215.7633	195.1778	193.3072	200.6460	202.4455	224.8063	237.8421	264.1575	(64)
Efficiency of water heater (217)m	87.3875	87.2122	86.8452	85.9827	84.0894	79.8000	79.8000	79.8000	79.8000	86.1342	87.0998	87.4281	(216)
Fuel for water heating, kWh/month	305.4219	270.6771	289.1575	258.0587	256.5880	244.5837	242.2397	251.4360	253.6911	260.9955	273.0683	302.1427	(219)
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	41.5478	33.3312	30.0111	21.9874	16.9837	13.8758	15.4931	20.1385	26.1579	34.3206	38.7651	42.7026	(232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-96.5084	-128.7539	-175.1600	-185.9074	-191.4172	-175.2403	-172.7229	-167.1229	-156.4510	-141.3876	-103.3049	-84.2881	(233a)



# Full SAP Calculation Printout



Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	4 * 10 =	40.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = 40.0000 / (5) = 0.0711 (8)

Pressure test Yes

Pressure Test Method Blower Door

Measured/design AP50 5.0000 (17)

Infiltration rate 0.3211 (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) = 0.2729 (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	0.3480	0.3412	0.3343	0.3002	0.2934	0.2593	0.2593	0.2525	0.2729	0.2934	0.3070	0.3207	(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	0.5605	0.5582	0.5559	0.5451	0.5430	0.5336	0.5336	0.5319	0.5372	0.5430	0.5471	0.5514	(25)

### 3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Main dwelling								
Doors			2.1000	1.4000	2.9400			(26a)
Windows			42.5000	1.3258	56.3447			(27)
Rooflights			1.6000	1.3258	2.1212			(27a)
Ground Floor			120.0000	0.1200	14.4000	75.0000	9000.0000	(28a)
External Wall	228.5000	44.6000	183.9000	0.1800	33.1020	60.0000	11034.0000	(29a)
Roof (loft)	113.0000		113.0000	0.1200	13.5600	9.0000	1017.0000	(30)
Roof (skelting)	10.5000	1.6000	8.9000	0.1600	1.4240	9.0000	80.1000	(30)
Total net area of external elements Aum(A, m2)			472.0000					(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	123.8919		(33)
Main dwelling								
Internal Wall			165.0000			75.0000	12375.0000	(32c)
Internal Wall			225.0000			9.0000	2025.0000	(32c)
Internal Floor			104.0000			18.0000	1872.0000	(32d)
Internal Ceiling			104.0000			9.0000	936.0000	(32e)
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) =	38339.1000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K								171.1567 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	39.5000	0.0500	1.9750
E3 Sill	25.8000	0.0200	0.5160
E4 Jamb	56.3000	0.0150	0.8445
E5 Ground floor (normal)	50.1000	0.0530	2.6553
E6 Intermediate floor within a dwelling	43.4000	0.0010	0.0434
E10 Eaves (insulation at ceiling level)	10.2000	0.0560	0.5712
E11 Eaves (insulation at rafter level)	9.6000	0.0170	0.1632
E12 Gable (insulation at ceiling level)	17.5000	0.0360	0.6300
E13 Gable (insulation at rafter level)	7.6000	0.0380	0.2888
E16 Corner (normal)	26.2000	0.0380	0.9956
R1 Head of roof window	1.8000	0.2400	0.4320
R2 Sill of roof window	1.8000	0.2400	0.4320
R3 Jamb of roof window	5.4000	0.2400	1.2960

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 10.8430 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 134.7349 (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	104.0915	103.6549	103.2270	101.2171	100.8410	99.0904	99.0904	98.7662	99.7647	100.8410	101.6018	102.3971	(38)
Heat transfer coeff	238.8264	238.3898	237.9619	235.9520	235.5759	233.8253	233.8253	233.5011	234.4996	235.5759	236.3367	237.1320	(39)
Average = Sum(39)m / 12 =													235.9502

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0662	1.0642	1.0623	1.0534	1.0517	1.0439	1.0439	1.0424	1.0469	1.0517	1.0551	1.0586	(40)
HLP (average)													1.0533
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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

Assumed occupancy 3.0331 (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)

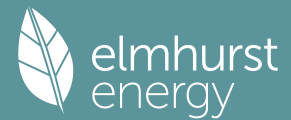
Hot water usage for baths 32.4081 31.9268 31.2490 29.9993 29.0636 28.0260 27.4655 28.1385 28.8714 29.9816 31.2571 32.2986 (42b)

Hot water usage for other uses 45.6923 44.0307 42.3692 40.7077 39.0461 37.3846 37.3846 39.0461 40.7077 42.3692 44.0307 45.6923 (42c)

Average daily hot water use (litres/day) 71.5859 (43)

Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	78.1004	75.9576	73.6183	70.7070	68.1097	65.4106	64.8501	67.1847	69.5790	72.3508	75.2878	77.9909	(44)
Energy conte	123.6920	108.1626	113.1485	96.7944	91.6888	80.4299	78.4306	83.1887	85.7979	98.1794	107.2613	122.1148	(45)
Energy content (annual)													Total = Sum(45)m = 1188.8887
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	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)

# Full SAP Calculation Printout



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	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	0.0000	(61)
Total heat required for water heating calculated for each month															
	105.1382	91.9382	96.1762	82.2752	77.9354	68.3654	66.6660	70.7104	72.9282	83.4525	91.1721	103.7976	103.7976	103.7976	(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	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	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	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	0.0000	(63d)
Output from w/h															
	105.1382	91.9382	96.1762	82.2752	77.9354	68.3654	66.6660	70.7104	72.9282	83.4525	91.1721	103.7976	103.7976	103.7976	(64)
												Total per year (kWh/year) = Sum(64)m =		1010.5554	(64)
														1011	(64)
12Total per year (kWh/year)															
Electric shower(s)															
	60.1230	53.5700	58.4964	55.8224	56.8699	54.2484	56.0567	56.8699	55.8224	58.4964	57.3965	60.1230	60.1230	60.1230	(64a)
												Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		683.8951	(64a)
Heat gains from water heating, kWh/month															
	41.3153	36.3771	38.6682	34.5244	33.7013	30.6535	30.6807	31.8951	32.1877	35.4872	37.1421	40.9801	40.9801	40.9801	(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	
	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	199.9605	221.3849	199.9605	206.6259	199.9605	199.9605	199.9605	199.9605	206.6259	199.9605	206.6259	199.9605	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	393.3198	397.4012	387.1161	365.2205	337.5811	311.6040	294.2496	290.1682	300.4533	322.3490	349.9884	375.9655	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	(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)													
	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	(71)
Water heating gains (Table 5)													
	55.5313	54.1325	51.9733	47.9506	45.2975	42.5742	41.2374	42.8697	44.7051	47.6979	51.5863	55.0808	(72)
Total internal gains													
	717.3085	741.4155	707.5469	688.2938	651.3360	629.3010	603.9446	601.4954	620.2812	638.5043	676.6975	699.5038	(73)

## 6. Solar gains

[Jan]		Area	Solar flux	g	FF	Access	Gains
		m2	Table 6a	or Table 6b	Specific data	factor	W
			W/m2		or Table 6c	Table 6d	
Northeast		2.0000	11.2829	0.6300	0.7000	0.7700	6.8964 (75)
Southeast		15.1000	36.7938	0.6300	0.7000	0.7700	169.7946 (77)
Southwest		3.1000	36.7938	0.6300	0.7000	0.7700	34.8585 (79)
Northwest		22.3000	11.2829	0.6300	0.7000	0.7700	76.8952 (81)
Southeast		0.6000	39.9751	0.6300	0.7000	1.0000	9.5197 (82)
Northwest		1.0000	16.3666	0.6300	0.7000	1.0000	6.4959 (82)
-----							
Solar gains	304.4602	550.0288	835.6219	1173.9086	1440.8370	1485.6945	1409.3738
Total gains	1021.7688	1291.4443	1543.1689	1862.2024	2092.1730	2114.9955	2013.3184
							1803.3634
							1571.7788
							1268.8349
							1047.1025
							256.8402
							956.3439
							(83)
							(84)

## 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	44.5920	44.6737	44.7540	45.1352	45.2073	45.5458	45.5458	45.6090	45.4148	45.2073	45.0618	44.9106	
alpha	3.9728	3.9782	3.9836	4.0090	4.0138	4.0364	4.0364	4.0406	4.0277	4.0138	4.0041	3.9940	
util living area													
	0.9967	0.9913	0.9772	0.9289	0.8186	0.6455	0.4938	0.5636	0.8125	0.9643	0.9930	0.9975	(86)
MIT	19.0673	19.3347	19.7348	20.2655	20.6876	20.9141	20.9773	20.9622	20.7771	20.1990	19.5349	19.0247	(87)
Th 2	20.0285	20.0301	20.0317	20.0391	20.0405	20.0469	20.0469	20.0481	20.0445	20.0405	20.0377	20.0348	(88)
util rest of house													
	0.9959	0.9891	0.9715	0.9109	0.7747	0.5687	0.3943	0.4600	0.7504	0.9520	0.9910	0.9968	(89)
MIT 2	18.2463	18.5136	18.9108	19.4307	19.8158	20.0005	20.0390	20.0336	19.9042	19.3769	18.7196	18.2083	(90)
Living area fraction													
	18.3471	18.6144	19.0120	19.5332	19.9228	20.1127	20.1542	20.1476	20.0113	19.4779	18.8197	18.3085	(91)
fLA = Living area / (4) =													
Temperature adjustment												0.0000	(92)
adjusted MIT	18.3471	18.6144	19.0120	19.5332	19.9228	20.1127	20.1542	20.1476	20.0113	19.4779	18.8197	18.3085	(93)

## 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.9938	0.9848	0.9635	0.8994	0.7686	0.5743	0.4059	0.4714	0.7479	0.9424	0.9872	0.9952	(94)
Useful gains	1015.4364	1271.8411	1486.8139	1674.8081	1608.0381	1214.6504	817.1817	850.1668	1175.5017	1195.7232	1033.7510	951.7408	(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													
	3354.8161	3269.3689	2977.3706	2508.9227	1937.0940	1289.0057	831.0621	875.0684	1386.2030	2091.4087	2769.7877	3345.5728	(97)
Space heating kWh													
	1740.4985	1342.3387	1108.9742	600.5625	244.8176	0.0000	0.0000	0.0000	0.0000	666.3901	1249.9464	1781.0110	(98a)
Space heating requirement - total per year (kWh/year)													
												8734.5389	(98b)
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)													
	1740.4985	1342.3387	1108.9742	600.5625	244.8176	0.0000	0.0000	0.0000	0.0000	666.3901	1249.9464	1781.0110	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)													
												8734.5389	(98c)
Space heating per m2													
												38.9935	(99)

## 8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	2197.9580	1730.3074	1774.6087	0.0000	0.0000	0.0000	0.0000 (100)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1822.1120	1540.8881	1504.6477	0.0000	0.0000	0.0000	0.0000 (101)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2360.7916	2246.7808	2008.3819	0.0000	0.0000	0.0000	0.0000 (102)
Space cooling kWh												
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	387.8493	525.1842	374.7783	0.0000	0.0000	0.0000	0.0000 (103)
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 (104)
Space cooling kWh												
Space cooling requirement	0.0000	0.0000	0.0000	0.0000	0.0000	96.9623	131.2960	93.6946	0.0000	0.0000	0.0000	0.0000 (105)
Energy for space heating												321.9529 (107)
Energy for space cooling												38.9935 (99)
Total												1.4373 (108)
Fabric Energy Efficiency (DFEE)												40.4308 (109)
												40.4 (109)

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

## 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Main dwelling			
Ground floor	120.0000 (1b)	x 2.4100 (2b)	= 289.2000 (1b) - (3b)
First floor	104.0000 (1c)	x 2.6300 (2c)	= 273.5200 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	224.0000		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 562.7200 (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	4 * 10 = 40.0000 (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)	40.0000 / (5) = 0.0711 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.3211 (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) = 0.2729 (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	0.3480	0.3412	0.3343	0.3002	0.2934	0.2593	0.2593	0.2525	0.2729	0.2934	0.3070	0.3207 (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	0.5605	0.5582	0.5559	0.5451	0.5430	0.5336	0.5336	0.5319	0.5372	0.5430	0.5471	0.5514 (25)

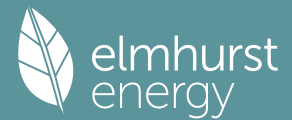
## 3. Heat losses and heat loss parameter

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
Main dwelling							
TER Semi-glazed door			2.1000	1.0000	2.1000		(26a)
TER Opening Type			42.5000	1.1450	48.6641		(27)
TER Roof Window			1.6000	1.1450	2.2642		(27a)
Ground Floor			120.0000	0.1300	15.6000		(28a)
External Wall	228.5000	44.6000	183.9000	0.1800	33.1020		(29a)
Roof (loft)	113.0000		113.0000	0.1100	12.4300		(30)
Roof (skelling)	10.5000	1.6000	8.9000	0.1100	0.9790		(30)
Total net area of external elements Aum(A, m <sup>2</sup> )			472.0000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 115.1393		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							171.1567 (35)

## List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	39.5000	0.0500	1.9750
E3 Sill	25.8000	0.0500	1.2900
E4 Jamb	56.3000	0.0500	2.8150
E5 Ground floor (normal)	50.1000	0.1600	8.0160
E6 Intermediate floor within a dwelling	43.4000	0.0000	0.0000
E10 Eaves (insulation at ceiling level)	10.2000	0.0600	0.6120
E11 Eaves (insulation at rafter level)	9.6000	0.0400	0.3840

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E12 Gable (insulation at ceiling level)	17.5000	0.0600	1.0500
E13 Gable (insulation at rafter level)	7.6000	0.0800	0.6080
E16 Corner (normal)	26.2000	0.0900	2.3580
R1 Head of roof window	1.8000	0.0800	0.1440
R2 Sill of roof window	1.8000	0.0600	0.1080
R3 Jamb of roof window	5.4000	0.0800	0.4320
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			19.7920 (36)
Point Thermal bridges			0.0000
Total fabric heat loss		(33) + (36) + (36a) =	134.9313 (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	104.0915	103.6549	103.2270	101.2171	100.8410	99.0904	99.0904	98.7662	99.7647	100.8410	101.6018	102.3971 (38)
Average = Sum(39)m / 12 =	239.0228	238.5862	238.1583	236.1483	235.7723	234.0217	234.0217	233.6975	234.6960	235.7723	236.5330	237.3284 (39)
												236.1465

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.0671	1.0651	1.0632	1.0542	1.0526	1.0447	1.0447	1.0433	1.0477	1.0526	1.0560	1.0595 (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													3.0331 (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	0.0000 (42a)
Hot water usage for baths	32.4081	31.9268	31.2490	29.9993	29.0636	28.0260	27.4655	28.1385	28.8714	29.9816	31.2571	32.2986 (42b)	
Hot water usage for other uses	45.6923	44.0307	42.3692	40.7077	39.0461	37.3846	37.3846	39.0461	40.7077	42.3692	44.0307	45.6923 (42c)	
Average daily hot water use (litres/day)													71.5859 (43)

Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy conte	78.1004	75.9576	73.6183	70.7070	68.1097	65.4106	64.8501	67.1847	69.5790	72.3508	75.2878	77.9909 (44)	
Energy content (annual)	123.6920	108.1626	113.1485	96.7944	91.6888	80.4299	78.4306	83.1887	85.7979	98.1794	107.2613	122.1148 (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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)	
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)	
Combi loss	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	105.1382	91.9382	96.1762	82.2752	77.9354	68.3654	66.6660	70.7104	72.9282	83.4525	91.1721	103.7976 (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	105.1382	91.9382	96.1762	82.2752	77.9354	68.3654	66.6660	70.7104	72.9282	83.4525	91.1721	103.7976 (64)	
12Total per year (kWh/year)													1010.5554 (64)
Electric shower(s)	60.1230	53.5700	58.4964	55.8224	56.8699	54.2484	56.0567	56.8699	55.8224	58.4964	57.3965	60.1230 (64a)	
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =													683.8951 (64a)
Heat gains from water heating, kWh/month	41.3153	36.3771	38.6682	34.5244	33.7013	30.6535	30.6807	31.8951	32.1877	35.4872	37.1421	40.9801 (65)	

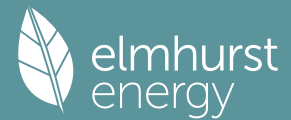
#### 5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	199.9605	221.3849	199.9605	206.6259	199.9605	206.6259	199.9605	199.9605	206.6259	199.9605	206.6259	199.9605 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	393.3198	397.4012	387.1161	365.2205	337.5811	311.6040	294.2496	290.1682	300.4533	322.3490	349.9884	375.9655 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656 (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)	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252 (71)
Water heating gains (Table 5)	55.5313	54.1325	51.9733	47.9506	45.2975	42.5742	41.2374	42.8697	44.7051	47.6979	51.5863	55.0808 (72)
Total internal gains	717.3085	741.4155	707.5469	688.2938	651.3360	629.3010	603.9446	601.4954	620.2812	638.5043	676.6975	699.5038 (73)

#### 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W						
Northeast	2.0000	11.2829	0.6300	0.7000	0.7700	6.8964 (75)						
Southeast	15.1000	36.7938	0.6300	0.7000	0.7700	169.7946 (77)						
Southwest	3.1000	36.7938	0.6300	0.7000	0.7700	34.8585 (79)						
Northwest	22.3000	11.2829	0.6300	0.7000	0.7700	76.8952 (81)						
Southeast	0.6000	39.9751	0.6300	0.7000	1.0000	9.5197 (82)						
Northwest	1.0000	16.3666	0.6300	0.7000	1.0000	6.4959 (82)						
Solar gains	304.4602	550.0288	835.6219	1173.9086	1440.8370	1485.6945	1409.3738	1201.8680	951.4976	630.3306	370.4051	256.8402 (83)
Total gains	1021.7688	1291.4443	1543.1689	1862.2024	2092.1730	2114.9955	2013.3184	1803.3634	1571.7788	1268.8349	1047.1025	956.3439 (84)

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## 7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	44.5554	44.6369	44.7171	45.0977	45.1696	45.5075	45.5075	45.5707	45.3768	45.1696	45.0244	44.8735
alpha	3.9704	3.9758	3.9811	4.0065	4.0113	4.0338	4.0338	4.0380	4.0251	4.0113	4.0016	3.9916
util living area	0.9967	0.9913	0.9772	0.9290	0.8188	0.6458	0.4941	0.5639	0.8128	0.9643	0.9930	0.9975 (86)
MIT	19.0656	19.3330	19.7332	20.2642	20.6868	20.9137	20.9772	20.9620	20.7765	20.1979	19.5334	19.0229 (87)
Th 2	20.0278	20.0294	20.0310	20.0384	20.0398	20.0462	20.0462	20.0474	20.0437	20.0398	20.0370	20.0340 (88)
util rest of house	0.9959	0.9891	0.9715	0.9110	0.7749	0.5689	0.3945	0.4603	0.7506	0.9520	0.9910	0.9968 (89)
MIT 2	18.2441	18.5114	18.9087	19.4289	19.8144	19.9996	20.0382	20.0328	19.9030	19.3753	18.7176	18.2060 (90)
Living area fraction	fLA = Living area / (4) =											
MIT	18.3449	18.6122	19.0099	19.5315	19.9215	20.1118	20.1535	20.1469	20.0103	19.4763	18.8178	18.3063 (92)
Temperature adjustment	0.0000											
adjusted MIT	18.3449	18.6122	19.0099	19.5315	19.9215	20.1118	20.1535	20.1469	20.0103	19.4763	18.8178	18.3063 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9938	0.9848	0.9635	0.8994	0.7688	0.5746	0.4061	0.4717	0.7481	0.9424	0.9872	0.9952 (94)
Useful gains	1015.4330	1271.8401	1486.8353	1674.9509	1608.4479	1215.2331	817.6483	850.6199	1175.8183	1195.7629	1033.7489	951.7377 (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	3357.0561	3271.5493	2979.3475	2510.6005	1938.4093	1289.8919	831.6001	875.6375	1387.1169	2092.7787	2771.6355	3347.8265 (97)
Space heating kWh	1742.1676	1343.8046	1110.4291	601.6677	245.4913	0.0000	0.0000	0.0000	0.0000	667.3798	1251.2783	1782.6901 (98a)
Space heating requirement - total per year (kWh/year)	8744.9084											
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	1742.1676	1343.8046	1110.4291	601.6677	245.4913	0.0000	0.0000	0.0000	0.0000	667.3798	1251.2783	1782.6901 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)	8744.9084											
Space heating per m2	(98c) / (4) = 39.0398 (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	2199.8038	1731.7605	1776.1010	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8286	0.8902	0.8475	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1822.7322	1541.6060	1505.2129	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2360.7916	2246.7808	2008.3819	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	387.4028	524.6500	374.3577	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction	fc = cooled area / (4) = 1.0000 (105)											
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	96.8507	131.1625	93.5894	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement	321.6026 (107)											
Energy for space heating	39.0398 (99)											
Energy for space cooling	1.4357 (108)											
Total	40.4755 (109)											
Fabric Energy Efficiency (TFEE)	40.5 (109)											

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

### CALCULATION OF ENERGY RATING

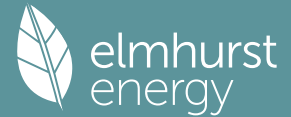
## 1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Main dwelling			
Ground floor	120.0000 (1b)	x 2.4100 (2b)	= 289.2000 (1b) - (3b)
First floor	104.0000 (1c)	x 2.6300 (2c)	= 273.5200 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	224.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	562.7200 (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	6 * 10 = 60.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)

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Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =												Air changes per hour	60.0000 / (5) =	0.1066 (8)
Pressure test													Yes		
Pressure Test Method													Blower Door		
Measured/design AP50													5.0000	(17)	
Infiltration rate													0.3566	(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) =												0.3031	(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	0.3865	0.3789	0.3713	0.3334	0.3259	0.2880	0.2880	0.2804	0.3031	0.3259	0.3410	0.3562	(22b)
	0.5747	0.5718	0.5689	0.5556	0.5531	0.5415	0.5415	0.5393	0.5459	0.5531	0.5581	0.5634	(25)

### 3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Main dwelling								
Doors			2.1000	1.4000	2.9400			(26a)
Windows			42.5000	1.3258	56.3447			(27)
Rooflights			1.6000	1.3258	2.1212			(27a)
Ground Floor			120.0000	0.1200	14.4000	75.0000	9000.0000	(28a)
External Wall	228.5000	44.6000	183.9000	0.1800	33.1020	60.0000	11034.0000	(29a)
Roof (loft)	113.0000		113.0000	0.1200	13.5600	9.0000	1017.0000	(30)
Roof (skelling)	10.5000	1.6000	8.9000	0.1600	1.4240	9.0000	80.1000	(30)
Total net area of external elements Aum(A, m2)			472.0000					(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	123.8919		(33)
Main dwelling								
Internal Wall			165.0000			75.0000	12375.0000	(32c)
Internal Wall			225.0000			9.0000	2025.0000	(32c)
Internal Floor			104.0000			18.0000	1872.0000	(32d)
Internal Ceiling			104.0000			9.0000	936.0000	(32e)
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) =	38339.1000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K								171.1567 (35)

#### List of Thermal Bridges

K1 Element	Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)	39.5000	0.0500	1.9750	
E3 Sill	25.8000	0.0200	0.5160	
E4 Jamb	56.3000	0.0150	0.8445	
E5 Ground floor (normal)	50.1000	0.0530	2.6553	
E6 Intermediate floor within a dwelling	43.4000	0.0010	0.0434	
E10 Eaves (insulation at ceiling level)	10.2000	0.0560	0.5712	
E11 Eaves (insulation at rafter level)	9.6000	0.0170	0.1632	
E12 Gable (insulation at ceiling level)	17.5000	0.0360	0.6300	
E13 Gable (insulation at rafter level)	7.6000	0.0380	0.2888	
E16 Corner (normal)	26.2000	0.0380	0.9956	
R1 Head of roof window	1.8000	0.2400	0.4320	
R2 Sill of roof window	1.8000	0.2400	0.4320	
R3 Jamb of roof window	5.4000	0.2400	1.2960	

Thermal bridges (Sum(L x Psi) calculated using Appendix K)													10.8430 (36)	
Point Thermal bridges													(36a) =	0.0000
Total fabric heat loss													(33) + (36) + (36a) =	134.7349 (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	106.7182	106.1796	105.6517	103.1722	102.7083	100.5487	100.5487	100.1488	101.3805	102.7083	103.6468	104.6279	(38)
Average = Sum(39)m / 12 =	241.4531	240.9146	240.3867	237.9071	237.4432	235.2836	235.2836	234.8837	236.1154	237.4432	238.3817	239.3628	(39)
													237.9049

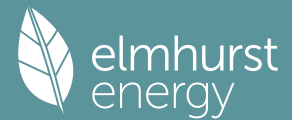
  

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP (average)	1.0779	1.0755	1.0732	1.0621	1.0600	1.0504	1.0504	1.0486	1.0541	1.0600	1.0642	1.0686	(40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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

Assumed occupancy													3.0331 (42)	
Hot water usage for mixer showers													112.6132	(42a)
Hot water usage for baths													32.4081	(42b)
Hot water usage for other uses													45.6923	(42c)
Average daily hot water use (litres/day)													42.3692	(43)
Daily hot water use	190.7136	186.8784	182.0730	174.4434	168.3640	161.7816	159.0140	163.7960	168.8732	175.8143	183.5711	190.1726	(44)	
Energy conte	302.0438	266.1124	279.8395	238.8042	226.6503	198.9294	192.3136	202.8136	208.2375	238.5784	261.5307	297.7644	(45)	
Energy content (annual)													Total = Sum(45)m =	2913.6177
Distribution loss (46)m = 0.15 x (45)m													45.3066	(46)
Water storage loss:														
Store volume													300.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):													2.4000	(48)
Temperature factor from Table 2b													0.5400	(49)
Enter (49) or (54) in (55)													1.2960	(55)
Total storage loss	40.1760	36.2880	40.1760	38.8800	40.1760	38.8800	40.1760	40.1760	38.8800	40.1760	38.8800	40.1760	(56)	
If cylinder contains dedicated solar storage	40.1760	36.2880	40.1760	38.8800	40.1760	38.8800	40.1760	40.1760	38.8800	40.1760	38.8800	40.1760	(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	365.4822	323.4116	343.2779	300.1962	290.0887	260.3214	255.7520	266.2520	269.6295	302.0168	322.9227	361.2028	(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)	

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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	365.4822	323.4116	343.2779	300.1962	290.0887	260.3214	255.7520	266.2520	269.6295	302.0168	322.9227	361.2028	(64)
	Total per year (kWh/year) = Sum(64)m =											3660.5537 (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	151.1803	134.3217	143.7973	128.5160	126.1119	115.2576	114.6950	118.1862	118.3526	130.0780	136.0726	149.7574	(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	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	48.5669	43.1367	35.0811	26.5586	19.8529	16.7607	18.1105	23.5407	31.5962	40.1187	46.8244	49.9167	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	587.0445	593.1361	577.7853	545.1052	503.8523	465.0805	439.1786	433.0869	448.4377	481.1179	522.3707	561.1425	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319	(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)	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	(71)
Water heating gains (Table 5)	203.1993	199.8835	193.2760	178.4945	169.5053	160.0800	154.1599	158.8525	164.3786	174.8361	188.9897	201.2868	(72)
Total internal gains	955.7051	953.0508	923.0369	867.0527	810.1050	758.8157	728.3435	732.3745	761.3070	812.9671	875.0793	929.2405	(73)

## 6. Solar gains

[Jan]	Area	Solar flux	g	FF	Access	Gains							
	m2	Table 6a	Specific data	Specific data	factor	W							
		W/m2	or Table 6b	or Table 6c	Table 6d								
Northeast	2.0000	11.2829	0.6300	0.7000	0.7700	6.8964 (75)							
Southeast	15.1000	36.7938	0.6300	0.7000	0.7700	169.7946 (77)							
Southwest	3.1000	36.7938	0.6300	0.7000	0.7700	34.8585 (79)							
Northwest	22.3000	11.2829	0.6300	0.7000	0.7700	76.8952 (81)							
Southeast	0.6000	39.9751	0.6300	0.7000	1.0000	9.5197 (82)							
Northwest	1.0000	16.3666	0.6300	0.7000	1.0000	6.4959 (82)							
Solar gains	304.4602	550.0288	835.6219	1173.9086	1440.8370	1485.6945	1409.3738	1201.8680	951.4976	630.3306	370.4051	256.8402	(83)
Total gains	1260.1653	1503.0796	1758.6588	2040.9613	2250.9420	2244.5102	2137.7173	1934.2426	1712.8047	1443.2977	1245.4843	1186.0806	(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	44.1069	44.2055	44.3026	44.7643	44.8518	45.2635	45.2635	45.3405	45.1040	44.8518	44.6752	44.4921	(86)
alpha	3.9405	3.9470	3.9535	3.9843	3.9901	4.0176	4.0176	4.0227	4.0069	3.9901	3.9783	3.9661	(87)
util living area	0.9929	0.9853	0.9657	0.9098	0.7919	0.6195	0.4703	0.5336	0.7798	0.9477	0.9872	0.9944	(88)
MIT	19.5683	19.7543	20.0512	20.4233	20.7145	20.8667	20.9086	20.8995	20.7792	20.3841	19.9048	19.5360	(89)
Th 2	20.0189	20.0209	20.0228	20.0319	20.0336	20.0416	20.0416	20.0430	20.0385	20.0336	20.0302	20.0266	(90)
util rest of house	0.9913	0.9819	0.9575	0.8883	0.7451	0.5431	0.3740	0.4330	0.7134	0.9307	0.9836	0.9931	(91)
MIT 2	18.3285	18.5666	18.9431	19.4088	19.7452	19.9044	19.9365	19.9331	19.8264	19.3719	18.7669	18.2929	(92)
Living area fraction	fLA = Living area / (4) =											0.1228 (91)	
MIT	18.4807	18.7124	19.0792	19.5333	19.8642	20.0225	20.0558	20.0517	19.9434	19.4962	18.9066	18.4455	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4807	18.7124	19.0792	19.5333	19.8642	20.0225	20.0558	20.0517	19.9434	19.4962	18.9066	18.4455	(93)

## 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.9876	0.9757	0.9473	0.8750	0.7359	0.5415	0.3755	0.4339	0.7059	0.9185	0.9779	0.9901	(94)
Useful gains	1244.5455	1466.5807	1665.9974	1785.8168	1656.5017	1215.3643	802.6520	839.2971	1209.1507	1325.7091	1217.9069	1174.2825	(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	3423.9677	3327.6147	3023.8611	2529.7448	1938.5250	1275.8327	813.1017	857.7290	1379.7157	2112.3415	2814.4828	3409.8488	(97)
Space heating kWh	1621.4901	1250.6149	1010.2506	535.6281	209.8253	0.0000	0.0000	0.0000	0.0000	585.2545	1149.5347	1663.2613	(98a)
Space heating requirement - total per year (kWh/year)												8025.8595	
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	1621.4901	1250.6149	1010.2506	535.6281	209.8253	0.0000	0.0000	0.0000	0.0000	585.2545	1149.5347	1663.2613	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												8025.8595	
Space heating per m2												(98c) / (4) = 35.8297 (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 %)												219.3000 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												37.0000 (208)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

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Space heating requirement	1621.4901	1250.6149	1010.2506	535.6281	209.8253	0.0000	0.0000	0.0000	0.0000	585.2545	1149.5347	1663.2613	(98)
Space heating efficiency (main heating system 1)	219.3000	219.3000	219.3000	219.3000	219.3000	0.0000	0.0000	0.0000	0.0000	219.3000	219.3000	219.3000	(210)
Space heating fuel (main heating system)	739.3936	570.2758	460.6706	244.2445	95.6796	0.0000	0.0000	0.0000	0.0000	266.8739	524.1836	758.4411	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating requirement	365.4822	323.4116	343.2779	300.1962	290.0887	260.3214	255.7520	266.2520	269.6295	302.0168	322.9227	361.2028	(64)
Efficiency of water heater (217)m	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	(216)
Fuel for water heating, kWh/month	191.9549	169.8590	180.2930	157.6661	152.3575	136.7234	134.3235	139.8382	141.6121	158.6223	169.6023	189.7073	(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 (231)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(231)
Lighting (232)m	42.5103	34.1033	30.7063	22.4967	17.3771	14.1973	15.8520	20.6050	26.7639	35.1157	39.6631	43.6918	(232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity) (233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												3659.7626	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												190.4000	(219)
Water heating fuel used												1922.5597	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
Total electricity for the above, kWh/year												0.0000	(231)
Electricity for lighting (calculated in Appendix L)												343.0824	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												0.0000	(233)
Wind generation												0.0000	(234)
Hydro-electric generation (Appendix N)												0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)												0.0000	(235)
Appendix Q - special features													
Energy saved or generated												-0.0000	(236)
Energy used												0.0000	(237)
Total delivered energy for all uses												5925.4048	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3659.7626	16.4900	603.4949	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1922.5597	16.4900	317.0301	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(249)
Energy for lighting	343.0824	16.4900	56.5743	(250)
Additional standing charges			0.0000	(251)
Total energy cost			977.0992	(255)

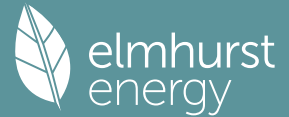
## 11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600	(256)
Energy cost factor (ECF)		1.3076	(257)
SAP value	$[(255) \times (256)] / [(4) + 45.0] =$	78.8031	
SAP rating (Section 12)		79	(258)
SAP band		C	

## 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	3659.7626	0.1554	568.8770	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1922.5597	0.1410	271.0685	(264)
Space and water heating			839.9455	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	343.0824	0.1443	49.5174	(268)
Total CO2, kg/year			889.4629	(272)
CO2 emissions per m2			3.9700	(273)
EI value			95.5692	
EI rating			96	(274)
EI band			A	

# 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

## 1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Main dwelling			
Ground floor	120.0000 (1b)	x 2.4100 (2b)	= 289.2000 (1b) - (3b)
First floor	104.0000 (1c)	x 2.6300 (2c)	= 273.5200 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	224.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	562.7200 (5)

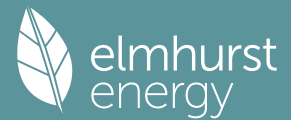
## 2. Ventilation rate

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												6 * 10 = 60.0000 (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) =											60.0000 / (5) = 0.1066 (8)
Pressure test												Yes
Pressure Test Method												Blower Door
Measured/design AP50												5.0000 (17)
Infiltration rate												0.3566 (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) =											0.3031 (21)
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	3.9000	3.5000	3.5000	3.4000	3.4000	3.1000	3.2000	3.0000	2.9000	3.1000	3.0000	3.3000
Wind factor	0.9750	0.8750	0.8750	0.8500	0.8500	0.7750	0.8000	0.7500	0.7250	0.7750	0.7500	0.8250
Adj infilt rate												
	0.2956	0.2652	0.2652	0.2577	0.2577	0.2349	0.2425	0.2273	0.2198	0.2349	0.2273	0.2501
Effective ac	0.5437	0.5352	0.5352	0.5332	0.5332	0.5276	0.5294	0.5258	0.5241	0.5276	0.5258	0.5313

## 3. Heat losses and heat loss parameter

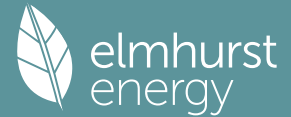
Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K					
Main dwelling												
Doors			2.1000	1.4000	2.9400		(26a)					
Windows			42.5000	1.3258	56.3447		(27)					
Rooflights			1.6000	1.3258	2.1212		(27a)					
Ground Floor			120.0000	0.1200	14.4000	75.0000	9000.0000 (28a)					
External Wall	228.5000	44.6000	183.9000	0.1800	33.1020	60.0000	11034.0000 (29a)					
Roof (loft)	113.0000		113.0000	0.1200	13.5600	9.0000	1017.0000 (30)					
Roof (skelling)	10.5000	1.6000	8.9000	0.1600	1.4240	9.0000	80.1000 (30)					
Total net area of external elements Aum(A, m2)			472.0000				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	123.8919		(33)					
Main dwelling												
Internal Wall			165.0000			75.0000	12375.0000 (32c)					
Internal Wall			225.0000			9.0000	2025.0000 (32c)					
Internal Floor			104.0000			18.0000	1872.0000 (32d)					
Internal Ceiling			104.0000			9.0000	936.0000 (32e)					
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 38339.1000 (34)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							171.1567 (35)					
List of Thermal Bridges												
K1 Element				Length	Psi-value	Total						
E2 Other lintels (including other steel lintels)				39.5000	0.0500	1.9750						
E3 Sill				25.8000	0.0200	0.5160						
E4 Jamb				56.3000	0.0150	0.8445						
E5 Ground floor (normal)				50.1000	0.0530	2.6553						
E6 Intermediate floor within a dwelling				43.4000	0.0010	0.0434						
E10 Eaves (insulation at ceiling level)				10.2000	0.0560	0.5712						
E11 Eaves (insulation at rafter level)				9.6000	0.0170	0.1632						
E12 Gable (insulation at ceiling level)				17.5000	0.0360	0.6300						
E13 Gable (insulation at rafter level)				7.6000	0.0380	0.2888						
E16 Corner (normal)				26.2000	0.0380	0.9956						
R1 Head of roof window				1.8000	0.2400	0.4320						
R2 Sill of roof window				1.8000	0.2400	0.4320						
R3 Jamb of roof window				5.4000	0.2400	1.2960						
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.8430 (36)					
Point Thermal bridges							(36a) = 0.0000					
Total fabric heat loss							(33) + (36) + (36a) = 134.7349 (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	100.9593	99.3809	99.3809	99.0130	99.0130	97.9732	98.3091	97.6479	97.3333	97.9732	97.6479	98.6557
Average = Sum(39)m / 12 =	235.6942	234.1158	234.1158	233.7479	233.7479	232.7081	233.0440	232.3828	232.0682	232.7081	232.3828	233.3906
												233.3422
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.0522	1.0452	1.0452	1.0435	1.0435	1.0389	1.0404	1.0374	1.0360	1.0389	1.0374	1.0419

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Days in mont	31	28	31	30	31	30	31	31	30	31	30	31
<b>4. Water heating energy requirements (kWh/year)</b>												
Assumed occupancy												3.0331 (42)
Hot water usage for mixer showers	112.6132	110.9209	108.4548	103.7363	100.2543	96.3711	94.1639	96.6113	99.2941	103.4635	108.2833	112.1818 (42a)
Hot water usage for baths	32.4081	31.9268	31.2490	29.9993	29.0636	28.0260	27.4655	28.1385	28.8714	29.9816	31.2571	32.2986 (42b)
Hot water usage for other uses	45.6923	44.0307	42.3692	40.7077	39.0461	37.3846	37.3846	39.0461	40.7077	42.3692	44.0307	45.6923 (42c)
Average daily hot water use (litres/day)												175.4115 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	190.7136	186.8784	182.0730	174.4434	168.3640	161.7816	159.0140	163.7960	168.8732	175.8143	183.5711	190.1726 (44)
Energy content (annual)	302.0438	266.1124	279.8395	238.8042	226.6503	198.9294	192.3136	202.8136	208.2375	238.5784	261.5307	297.7644 (45)
Distribution loss (46)m = 0.15 x (45)m												Total = Sum(45)m = 2913.6177
Water storage loss:	45.3066	39.9169	41.9759	35.8206	33.9975	29.8394	28.8470	30.4220	31.2356	35.7868	39.2296	44.6647 (46)
Store volume												300.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												2.4000 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												1.2960 (55)
Total storage loss	40.1760	36.2880	40.1760	38.8800	40.1760	38.8800	40.1760	40.1760	38.8800	40.1760	38.8800	40.1760 (56)
If cylinder contains dedicated solar storage	40.1760	36.2880	40.1760	38.8800	40.1760	38.8800	40.1760	40.1760	38.8800	40.1760	38.8800	40.1760 (57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624 (59)
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	365.4822	323.4116	343.2779	300.1962	290.0887	260.3214	255.7520	266.2520	269.6295	302.0168	322.9227	361.2028 (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	365.4822	323.4116	343.2779	300.1962	290.0887	260.3214	255.7520	266.2520	269.6295	302.0168	322.9227	361.2028 (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	151.1803	134.3217	143.7973	128.5160	126.1119	115.2576	114.6950	118.1862	118.3526	130.0780	136.0726	149.7574 (65)
<b>5. Internal gains (see Table 5 and 5a)</b>												
Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	48.5669	43.1367	35.0811	26.5586	19.8529	16.7607	18.1105	23.5407	31.5962	40.1187	46.8244	49.9167 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	587.0445	593.1361	577.7853	545.1052	503.8523	465.0805	439.1786	433.0869	448.4377	481.1179	522.3707	561.1425 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319 (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)	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252 (71)
Water heating gains (Table 5)	203.1993	199.8835	193.2760	178.4945	169.5053	160.0800	154.1599	158.8525	164.3786	174.8361	188.9897	201.2868 (72)
Total internal gains	955.7051	953.0508	923.0369	867.0527	810.1050	758.8157	728.3435	732.3745	761.3070	812.9671	875.0793	929.2405 (73)
<b>6. Solar gains</b>												
[Jan]	Area	Solar flux	g	FF	Access	Gains						
	m2	Table 6a	W/m2	Specific data	factor	W						
				or Table 6b	Table 6c							
				Specific data	Table 6d							
				or Table 6c								
Northeast	2.0000	14.6130	0.6300	0.7000	0.7700	8.9319 (75)						
Southeast	15.1000	45.0642	0.6300	0.7000	0.7700	207.9602 (77)						
Southwest	3.1000	45.0642	0.6300	0.7000	0.7700	42.6938 (79)						
Northwest	22.3000	14.6130	0.6300	0.7000	0.7700	99.5903 (81)						
Southeast	0.6000	50.1759	0.6300	0.7000	1.0000	11.9489 (82)						
Northwest	1.0000	21.2590	0.6300	0.7000	1.0000	8.4377 (82)						
Solar gains	379.5628	586.2565	895.9789	1302.3655	1550.3589	1731.7068	1617.5059	1385.1320	1090.9617	726.7957	450.1169	314.4068 (83)
Total gains	1335.2680	1539.3074	1819.0158	2169.4182	2360.4639	2490.5225	2345.8494	2117.5065	1852.2688	1539.7628	1325.1962	1243.6472 (84)
<b>7. Mean internal temperature (heating season)</b>												
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	45.1846	45.4892	45.4892	45.5608	45.5608	45.7644	45.6984	45.8285	45.8906	45.7644	45.8285	45.6306
alpha	4.0123	4.0326	4.0326	4.0374	4.0374	4.0510	4.0466	4.0552	4.0594	4.0510	4.0552	4.0420
util living area	0.9897	0.9820	0.9544	0.8744	0.7218	0.5044	0.3635	0.3997	0.6906	0.9164	0.9798	0.9920 (86)
MIT	19.7349	19.8733	20.1901	20.5467	20.7960	20.9008	20.9190	20.9173	20.8454	20.5309	20.0772	19.7073 (87)
Th 2	20.0401	20.0459	20.0459	20.0472	20.0472	20.0511	20.0498	20.0523	20.0534	20.0511	20.0523	20.0485 (88)
util rest of house	0.9872	0.9778	0.9435	0.8459	0.6653	0.4261	0.2721	0.3004	0.6114	0.8898	0.9741	0.9900 (89)
MIT 2	18.5568	18.7366	19.1347	19.5668	19.8418	19.9399	19.9504	19.9523	19.9011	19.5624	19.0022	18.5281 (90)
Living area fraction												fLA = Living area / (4) = 0.1228 (91)

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MIT	18.7015	18.8761	19.2643	19.6871	19.9589	20.0578	20.0693	20.0708	20.0170	19.6813	19.1342	18.6729 (92)
Temperature adjustment												0.0000
adjusted MIT	18.7015	18.8761	19.2643	19.6871	19.9589	20.0578	20.0693	20.0708	20.0170	19.6813	19.1342	18.6729 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9824	0.9709	0.9322	0.8334	0.6596	0.4266	0.2740	0.3024	0.6080	0.8769	0.9665	0.9860	(94)
Useful gains	1311.7786	1494.4613	1695.7442	1807.9562	1556.9488	1062.5418	642.8361	640.2931	1126.2411	1350.2745	1280.8171	1226.2377	(95)
Ext temp.	5.1000	5.4000	7.2000	9.6000	12.6000	15.4000	17.3000	17.3000	14.8000	11.5000	8.0000	5.1000	(96)
Heat loss rate W													
Space heating	3205.7847	3154.9758	2824.4449	2357.8445	1720.1334	1083.9130	645.3633	643.8891	1210.7019	1903.8564	2587.3857	3167.7807	(97)
Space heating requirement - total per year (kWh/year)	1409.1405	1115.8657	839.7533	395.9195	121.4094	0.0000	0.0000	0.0000	0.0000	411.8649	940.7294	1444.5080	(98a)
Solar heating kWh													
Solar heating contribution - total per year (kWh/year)	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)
Space heating requirement after solar contribution - total per year (kWh/year)	1409.1405	1115.8657	839.7533	395.9195	121.4094	0.0000	0.0000	0.0000	0.0000	411.8649	940.7294	1444.5080	(98c)
Space heating per m2										(98c) / (4) =		29.8178	(99)

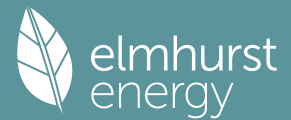
## 9a. Energy requirements - Individual heating systems, including micro-CHP

	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 %)													219.3000 (206)
Efficiency of main space heating system 2 (in %)													0.0000 (207)
Efficiency of secondary/supplementary heating system, %													37.0000 (208)
Space heating requirement	1409.1405	1115.8657	839.7533	395.9195	121.4094	0.0000	0.0000	0.0000	0.0000	411.8649	940.7294	1444.5080	(98)
Space heating efficiency (main heating system 1)	219.3000	219.3000	219.3000	219.3000	219.3000	0.0000	0.0000	0.0000	0.0000	219.3000	219.3000	219.3000	(210)
Space heating fuel (main heating system)	642.5629	508.8307	382.9244	180.5379	55.3622	0.0000	0.0000	0.0000	0.0000	187.8089	428.9692	658.6904	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating requirement	365.4822	323.4116	343.2779	300.1962	290.0887	260.3214	255.7520	266.2520	269.6295	302.0168	322.9227	361.2028	(64)
Efficiency of water heater (217)m	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	(216)
Fuel for water heating, kWh/month	191.9549	169.8590	180.2930	157.6661	152.3575	136.7234	134.3235	139.8382	141.6121	158.6223	169.6023	189.7073	(219)
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(231)
Lighting	42.5103	34.1033	30.7063	22.4967	17.3771	14.1973	15.8520	20.6050	26.7639	35.1157	39.6631	43.6918	(232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity) (233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1													3045.6866 (211)
Space heating fuel - main system 2													0.0000 (213)
Space heating fuel - secondary													0.0000 (215)
Efficiency of water heater													190.4000
Water heating fuel used													1922.5597 (219)
Space cooling fuel													0.0000 (221)
Electricity for pumps and fans:													
Total electricity for the above, kWh/year													0.0000 (231)
Electricity for lighting (calculated in Appendix L)													343.0824 (232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation													0.0000 (233)
Wind generation													0.0000 (234)
Hydro-electric generation (Appendix N)													0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)													0.0000 (235)
Appendix Q - special features													
Energy saved or generated													-0.0000 (236)
Energy used													0.0000 (237)
Total delivered energy for all uses													5311.3287 (238)

## 10a. Fuel costs - using BEDF prices (572)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3045.6866	26.0600	793.7059	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1922.5597	26.0600	501.0191	(247)
Energy for instantaneous electric shower(s)	0.0000	26.0600	0.0000	(247a)

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Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (249)
Energy for lighting	343.0824	26.0600	89.4073 (250)
Additional standing charges			0.0000 (251)
Total energy cost			1384.1323 (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	3045.6866	0.1561	475.5457 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1922.5597	0.1410	271.0685 (264)
Space and water heating			746.6142 (265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (267)
Energy for lighting	343.0824	0.1443	49.5174 (268)
Total CO2, kg/year			796.1316 (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	3045.6866	1.5781	4806.2631 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1922.5597	1.5213	2924.8821 (278)
Space and water heating			7731.1453 (279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (281)
Energy for lighting	343.0824	1.5338	526.2312 (282)
Total Primary energy kWh/year			8257.3765 (286)

## SAP 10 EPC IMPROVEMENTS

CJ5701A

Current energy efficiency rating: C 79  
 Current environmental impact rating: A 96

N Solar water heating		Recommended
U Solar photovoltaic panels		Recommended
V2 Wind turbine		Not applicable

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.1	-£ 96	-46 kg (5.7%)
U Solar photovoltaic panels	+ 3.6	-£ 285	-147 kg (19.6%)

Recommended measures	Typical annual savings	Energy efficiency impact	Environmental impact
Solar water heating	£96	0.20 kg/m <sup>2</sup>	C 80 A 96
Solar photovoltaic panels	£285	0.66 kg/m <sup>2</sup>	B 83 A 96
<b>Total Savings</b>	<b>£381</b>	<b>0.86 kg/m<sup>2</sup></b>	

Potential energy efficiency rating: B 83  
 Potential environmental impact rating: A 96

Fuel prices for cost data on this page from database revision number 572 TEST (30 May 2025)  
 Recommendation texts revision number 6.1 (11 Jun 2019)

Typical heating and lighting costs of this home (per year, South East England):

	Current	Potential	Saving
Electricity	£1384	£1289	£96
Space heating	£794	£815	-£21
Water heating	£501	£384	£117
Lighting	£89	£89	£0
Generated (PV)	-£0	-£285	£285
<b>Total cost of fuels</b>	<b>£1384</b>	<b>£1004</b>	<b>£381</b>
<b>Total cost of uses</b>	<b>£1384</b>	<b>£1003</b>	<b>£381</b>
Delivered energy	24 kWh/m <sup>2</sup>	17 kWh/m <sup>2</sup>	7 kWh/m <sup>2</sup>
Carbon dioxide emissions	0.8 tonnes	0.6 tonnes	0.2 tonnes
CO2 emissions per m <sup>2</sup>	4 kg/m <sup>2</sup>	3 kg/m <sup>2</sup>	1 kg/m <sup>2</sup>
Primary energy	37 kWh/m <sup>2</sup>	27 kWh/m <sup>2</sup>	10 kWh/m <sup>2</sup>

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

### 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Main dwelling			
Ground floor	120.0000 (1b)	x 2.4100 (2b)	= 289.2000 (1b) - (3b)
First floor	104.0000 (1c)	x 2.6300 (2c)	= 273.5200 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	224.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 562.7200 (5)

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## 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	6	*	10	=	60.0000	(7a)																		
Number of passive vents	0	*	10	=	0.0000	(7b)																		
Number of flueless gas fires	0	*	40	=	0.0000	(7c)																		
Air changes per hour																								
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(7a)+(7b)+(7c) =												60.0000 / (5) =	0.1066	(8)										
Pressure test													Yes											
Pressure Test Method													Blower Door											
Measured/design AP50													5.0000	(17)										
Infiltration rate													0.3566	(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) =	0.3031	(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	0.3865	0.3789	0.3713	0.3334	0.3259	0.2880	0.2880	0.2804	0.3031	0.3259	0.3410	0.3562	(22b)											
Effective ac	0.5747	0.5718	0.5689	0.5556	0.5531	0.5415	0.5415	0.5393	0.5459	0.5531	0.5581	0.5634	(25)											

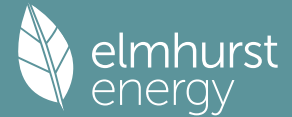
## 3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K						
Main dwelling													
Doors			2.1000	1.4000	2.9400			(26a)					
Windows			42.5000	1.3258	56.3447			(27)					
Rooflights			1.6000	1.3258	2.1212			(27a)					
Ground Floor			120.0000	0.1200	14.4000	75.0000	9000.0000	(28a)					
External Wall	228.5000	44.6000	183.9000	0.1800	33.1020	60.0000	11034.0000	(29a)					
Roof (loft)	113.0000		113.0000	0.1200	13.5600	9.0000	1017.0000	(30)					
Roof (skelling)	10.5000	1.6000	8.9000	0.1600	1.4240	9.0000	80.1000	(30)					
Total net area of external elements Aum(A, m2)			472.0000					(31)					
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	123.8919		(33)					
Main dwelling													
Internal Wall			165.0000			75.0000	12375.0000	(32c)					
Internal Wall			225.0000			9.0000	2025.0000	(32c)					
Internal Floor			104.0000			18.0000	1872.0000	(32d)					
Internal Ceiling			104.0000			9.0000	936.0000	(32e)					
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) =	38339.1000 (34)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K								171.1567 (35)					
List of Thermal Bridges													
K1 Element				Length	Psi-value	Total							
E2 Other lintels (including other steel lintels)				39.5000	0.0500	1.9750							
E3 Sill				25.8000	0.0200	0.5160							
E4 Jamb				56.3000	0.0150	0.8445							
E5 Ground floor (normal)				50.1000	0.0530	2.6553							
E6 Intermediate floor within a dwelling				43.4000	0.0010	0.0434							
E10 Eaves (insulation at ceiling level)				10.2000	0.0560	0.5712							
E11 Eaves (insulation at rafter level)				9.6000	0.0170	0.1632							
E12 Gable (insulation at ceiling level)				17.5000	0.0360	0.6300							
E13 Gable (insulation at rafter level)				7.6000	0.0380	0.2888							
E16 Corner (normal)				26.2000	0.0380	0.9956							
R1 Head of roof window				1.8000	0.2400	0.4320							
R2 Sill of roof window				1.8000	0.2400	0.4320							
R3 Jamb of roof window				5.4000	0.2400	1.2960							
Thermal bridges (Sum(L x Psi) calculated using Appendix K)								10.8430 (36)					
Point Thermal bridges							(36a) =	0.0000					
Total fabric heat loss							(33) + (36) + (36a) =	134.7349 (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	106.7182	106.1796	105.6517	103.1722	102.7083	100.5487	100.5487	100.1488	101.3805	102.7083	103.6468	104.6279	(38)
Average = Sum(39)m / 12 =	241.4531	240.9146	240.3867	237.9071	237.4432	235.2836	235.2836	234.8837	236.1154	237.4432	238.3817	239.3628	(39)
HLP	1.0779	1.0755	1.0732	1.0621	1.0600	1.0504	1.0504	1.0486	1.0541	1.0600	1.0642	1.0686	(40)
HLP (average)												1.0621	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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

Assumed occupancy													3.0331	(42)
Hot water usage for mixer showers													112.1818	(42a)
Hot water usage for baths													32.2986	(42b)
Hot water usage for other uses													45.6923	(42c)
Average daily hot water use (litres/day)													175.4115	(43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
	190.7136	186.8784	182.0730	174.4434	168.3640	161.7816	159.0140	163.7960	168.8732	175.8143	183.5711	190.1726	(44)	

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Energy content (annual)	302.0438	266.1124	279.8395	238.8042	226.6503	198.9294	192.3136	202.8136	208.2375	238.5784	261.5307	297.7644 (45)
Distribution loss (46)m = 0.15 x (45)m												
Water storage loss:												
Store volume												300.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												2.4000 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												1.2960 (55)
Total storage loss												
If cylinder contains dedicated solar storage	40.1760	36.2880	40.1760	38.8800	40.1760	38.8800	40.1760	40.1760	38.8800	40.1760	38.8800	40.1760 (56)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	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												
WWHRS	365.4822	323.4116	341.8821	293.4426	277.2943	247.7147	242.7251	254.1556	264.2266	300.6211	322.9227	361.2028 (62)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000 (63b)
Aperture area of solar collector												3.0000 (H1)
Zero-loss collector efficiency												0.8000 (H2)
Collector linear heat loss coefficient												1.8000 (H3)
Collector 2nd order heat loss coefficient												0.0000 (H4)
Collector loop efficiency												0.9000 (H5)
Incidence angle modifier												1.0000 (H6)
Overshading factor												0.8000 (H8)
Overall heat loss coefficient of system												6.5000 (H10)
Heat loss coefficient of collector loop												3.9667 (H11)
Dedicated solar storage volume												75.0000 (H12)
Effective solar volume												75.0000 (H14)
Reference volume												225.0000 (H15)
Storage tank correction coefficient												1.3161 (H16)
Heat delivered to hot water												660.5388 (H24)
Heat delivered to space heating												0.0000 (H29)
Solar input												660.5388
Solar input	-0.0000	-16.1561	-60.2428	-84.4818	-112.7404	-104.3688	-103.8395	-89.4643	-60.2861	-28.9590	-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												
Electric shower(s)												
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												0.0000 (64a)
Heat gains from water heating, kWh/month												
Total per year (kWh/year) = Sum(64)m =	151.1803	134.3217	142.6807	123.1131	115.8765	105.1722	104.2734	108.5091	114.0303	128.9614	136.0726	149.7574 (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	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	48.5669	43.1367	35.0811	26.5586	19.8529	16.7607	18.1105	23.5407	31.5962	40.1187	46.8244	49.9167 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	587.0445	593.1361	577.7853	545.1052	503.8523	465.0805	439.1786	433.0869	448.4377	481.1179	522.3707	561.1425 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319 (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)	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252 (71)
Water heating gains (Table 5)	203.1993	199.8835	191.7752	170.9905	155.7479	146.0726	140.1525	145.8455	158.3754	173.3353	188.9897	201.2868 (72)
Total internal gains	955.7051	953.0508	921.5361	859.5487	796.3477	744.8082	714.3360	719.3676	755.3038	811.4663	875.0793	929.2405 (73)

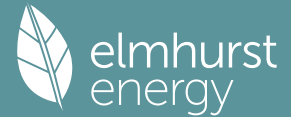
## 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W						
Northeast	2.0000	11.2829	0.6300	0.7000	0.7700	6.8964 (75)						
Southeast	15.1000	36.7938	0.6300	0.7000	0.7700	169.7946 (77)						
Southwest	3.1000	36.7938	0.6300	0.7000	0.7700	34.8585 (79)						
Northwest	22.3000	11.2829	0.6300	0.7000	0.7700	76.8952 (81)						
Southeast	0.6000	39.9751	0.6300	0.7000	1.0000	9.5197 (82)						
Northwest	1.0000	16.3666	0.6300	0.7000	1.0000	6.4959 (82)						
Solar gains	304.4602	550.0288	835.6219	1173.9086	1440.8370	1485.6945	1409.3738	1201.8680	951.4976	630.3306	370.4051	256.8402 (83)
Total gains	1260.1653	1503.0796	1757.1580	2033.4573	2237.1847	2230.5027	2123.7099	1921.2356	1706.8015	1441.7969	1245.4843	1186.0806 (84)

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation factor for gains for living area, nil,m (see Table 9a)												
tau	44.1069	44.2055	44.3026	44.7643	44.8518	45.2635	45.2635	45.3405	45.1040	44.8518	44.6752	44.4921
alpha	3.9405	3.9470	3.9535	3.9843	3.9901	4.0176	4.0176	4.0227	4.0069	3.9901	3.9783	3.9661
util living area	0.9929	0.9853	0.9658	0.9107	0.7944	0.6225	0.4732	0.5367	0.7812	0.9478	0.9872	0.9944 (86)
MIT	19.5683	19.7543	20.0505	20.4209	20.7119	20.8657	20.9082	20.8990	20.7782	20.3836	19.9048	19.5360 (87)
Th 2	20.0189	20.0209	20.0228	20.0319	20.0336	20.0416	20.0416	20.0430	20.0385	20.0336	20.0302	20.0266 (88)
util rest of house	0.9913	0.9819	0.9576	0.8893	0.7478	0.5460	0.3763	0.4357	0.7150	0.9309	0.9836	0.9931 (89)
MIT 2	18.3285	18.5666	18.9423	19.4059	19.7425	19.9037	19.9364	19.9328	19.8255	19.3712	18.7669	18.2929 (90)
Living area fraction												0.1228 (91)
MIT	18.4807	18.7124	19.0784	19.5305	19.8615	20.0218	20.0557	20.0514	19.9424	19.4955	18.9066	18.4455 (92)
Temperature adjustment												0.0000
adjusted MIT	18.4807	18.7124	19.0784	19.5305	19.8615	20.0218	20.0557	20.0514	19.9424	19.4955	18.9066	18.4455 (93)

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## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9876	0.9757	0.9474	0.8760	0.7385	0.5443	0.3778	0.4366	0.7075	0.9187	0.9779	0.9901	(94)
Useful gains	1244.5455	1466.5807	1664.7904	1781.3394	1652.2040	1214.0695	802.3758	838.8198	1207.5608	1324.6371	1217.9069	1174.2825	(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	3423.9677	3327.6147	3023.6784	2529.0729	1937.9033	1275.6532	813.0622	857.6614	1379.4869	2112.1801	2814.4828	3409.8488	(97)
Space heating kWh	1621.4901	1250.6149	1011.0127	538.3682	212.5603	0.0000	0.0000	0.0000	0.0000	585.9320	1149.5347	1663.2613	(98a)
Space heating requirement - total per year (kWh/year)												8032.7741	
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	1621.4901	1250.6149	1011.0127	538.3682	212.5603	0.0000	0.0000	0.0000	0.0000	585.9320	1149.5347	1663.2613	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												8032.7741	
Space heating per m2										(98c) / (4) =		35.8606	(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 %)													219.3000	(206)
Efficiency of main space heating system 2 (in %)													0.0000	(207)
Efficiency of secondary/supplementary heating system, %													37.0000	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement	1621.4901	1250.6149	1011.0127	538.3682	212.5603	0.0000	0.0000	0.0000	0.0000	585.9320	1149.5347	1663.2613	(98)	
Space heating efficiency (main heating system 1)	219.3000	219.3000	219.3000	219.3000	219.3000	0.0000	0.0000	0.0000	0.0000	219.3000	219.3000	219.3000	(210)	
Space heating fuel (main heating system)	739.3936	570.2758	461.0181	245.4939	96.9267	0.0000	0.0000	0.0000	0.0000	267.1828	524.1836	758.4411	(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	365.4822	307.2555	281.6393	208.9608	164.5540	143.3459	138.8855	164.6913	203.9405	271.6620	322.9227	361.2028	(64)	
Efficiency of water heater (217)m	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	(216)	
Fuel for water heating, kWh/month	191.9549	161.3737	147.9198	109.7483	86.4254	75.2867	72.9441	86.4975	107.1116	142.6796	169.6023	189.7073	(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	6.7945	6.1370	6.7945	6.5753	6.7945	6.5753	6.7945	6.7945	6.5753	6.7945	6.5753	6.7945	(231)	
Lighting	42.5103	34.1033	30.7063	22.4967	17.3771	14.1973	15.8520	20.6050	26.7639	35.1157	39.6631	43.6918	(232)	
Electricity generated by PVs (Appendix M) (negative quantity)														
(233a)m	-41.6329	-64.1448	-99.1041	-116.2537	-124.7121	-111.4021	-109.7410	-101.7710	-87.7566	-74.4974	-47.3185	-35.4018	(233a)	
Electricity generated by wind turbines (Appendix M) (negative quantity)														
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)	
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)														
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)	
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)														
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)	
Electricity generated by PVs (Appendix M) (negative quantity)														
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)	
Electricity generated by wind turbines (Appendix M) (negative quantity)														
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)	
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)														
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)	
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)														
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)	
Annual totals kWh/year														
Space heating fuel - main system 1													3662.9157	(211)
Space heating fuel - main system 2													0.0000	(213)
Space heating fuel - secondary													0.0000	(215)
Efficiency of water heater													190.4000	
Water heating fuel used													1541.2513	(219)
Space cooling fuel													0.0000	(221)
Electricity for pumps and fans:														
pump for solar water heating													80.0000	(230g)
Total electricity for the above, kWh/year													80.0000	(231)
Electricity for lighting (calculated in Appendix L)													343.0824	(232)
Energy saving/generation technologies (Appendices M ,N and Q)														
PV generation													-1013.7360	(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													4613.5133	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3662.9157	16.4900	604.0148	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1541.2513	16.4900	254.1523	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(249)
Pump for solar water heating	80.0000	16.4900	13.1920	(249)
Energy for lighting	343.0824	16.4900	56.5743	(250)

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Additional standing charges				0.0000 (251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1013.7360	16.4900		-167.1651
PV Unit electricity exported	0.0000	5.5900		0.0000
Total				-167.1651 (252)
Total energy cost				760.7683 (255)

## 11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):				0.3600 (256)
Energy cost factor (ECF)			$[(255) \times (256)] / [(4) + 45.0] =$	1.0181 (257)
SAP value				83.4961
SAP rating (Section 12)				83 (258)
SAP band				B

## 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	3662.9157	0.1554	569.3155	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1541.2513	0.1445	222.6655	(264)
Space and water heating			791.9810	(265)
Pumps, fans and electric keep-hot	80.0000	0.1387	11.0970	(267)
Energy for lighting	343.0824	0.1443	49.5174	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1013.7360	0.1342	-135.9999	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-135.9999	(269)
Total CO2, kg/year			716.5955	(272)
CO2 emissions per m2			3.2000	(273)
EI value			96.4303	(4)
EI rating			96	(274)
EI band			A	

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

### 1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)	
Main dwelling				
Ground floor	120.0000 (1b)	x 2.4100 (2b)	= 289.2000 (1b) - (3b)	
First floor	104.0000 (1c)	x 2.6300 (2c)	= 273.5200 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	224.0000		(4)	
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 562.7200 (5)	

### 2. Ventilation rate

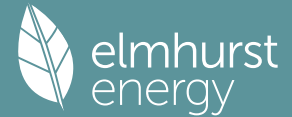
		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000 (6a)	
Number of open flues	0 * 20 =	0.0000 (6b)	
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)	
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)	
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)	
Number of blocked chimneys	0 * 20 =	0.0000 (6f)	
Number of intermittent extract fans	6 * 10 =	60.0000 (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) =	60.0000 / (5) =	0.1066 (8)	
Pressure test	Yes		
Pressure Test Method	Blower Door		
Measured/design AP50	5.0000 (17)		
Infiltration rate	0.3566 (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) =	0.3031 (21)	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	3.9000	3.5000	3.5000	3.4000	3.4000	3.1000	3.2000	3.0000	2.9000	3.1000	3.0000	3.3000	(22)
Wind factor	0.9750	0.8750	0.8750	0.8500	0.8500	0.7750	0.8000	0.7500	0.7250	0.7750	0.7500	0.8250	(22a)
Adj infilt rate	0.2956	0.2652	0.2652	0.2577	0.2577	0.2349	0.2425	0.2273	0.2198	0.2349	0.2273	0.2501	(22b)
Effective ac	0.5437	0.5352	0.5352	0.5332	0.5332	0.5276	0.5294	0.5258	0.5241	0.5276	0.5258	0.5313	(25)

### 3. Heat losses and heat loss parameter

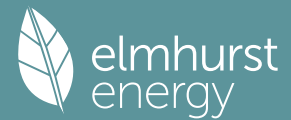
Element	Gross	Openings	NetArea	U-value	A x U	K-value	A x K
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Main dwelling	m2	m2	m2	W/m2K	W/K	kJ/m2K	kJ/K						
Doors			2.1000	1.4000	2.9400			(26a)					
Windows			42.5000	1.3258	56.3447			(27)					
Rooflights			1.6000	1.3258	2.1212			(27a)					
Ground Floor			120.0000	0.1200	14.4000	75.0000	9000.0000	(28a)					
External Wall	228.5000	44.6000	183.9000	0.1800	33.1020	60.0000	11034.0000	(29a)					
Roof (loft)	113.0000		113.0000	0.1200	13.5600	9.0000	1017.0000	(30)					
Roof (skelling)	10.5000	1.6000	8.9000	0.1600	1.4240	9.0000	80.1000	(30)					
Total net area of external elements Aum(A, m2)			472.0000					(31)					
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		123.8919			(33)					
Main dwelling													
Internal Wall			165.0000			75.0000	12375.0000	(32c)					
Internal Wall			225.0000			9.0000	2025.0000	(32c)					
Internal Floor			104.0000			18.0000	1872.0000	(32d)					
Internal Ceiling			104.0000			9.0000	936.0000	(32e)					
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	38339.1000	(34)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							171.1567	(35)					
List of Thermal Bridges													
K1 Element				Length	Psi-value	Total							
E2 Other lintels (including other steel lintels)				39.5000	0.0500	1.9750							
E3 Sill				25.8000	0.0200	0.5160							
E4 Jamb				56.3000	0.0150	0.8445							
E5 Ground floor (normal)				50.1000	0.0530	2.6553							
E6 Intermediate floor within a dwelling				43.4000	0.0010	0.0434							
E10 Eaves (insulation at ceiling level)				10.2000	0.0560	0.5712							
E11 Eaves (insulation at rafter level)				9.6000	0.0170	0.1632							
E12 Gable (insulation at ceiling level)				17.5000	0.0360	0.6300							
E13 Gable (insulation at rafter level)				7.6000	0.0380	0.2888							
E16 Corner (normal)				26.2000	0.0380	0.9956							
R1 Head of roof window				1.8000	0.2400	0.4320							
R2 Sill of roof window				1.8000	0.2400	0.4320							
R3 Jamb of roof window				5.4000	0.2400	1.2960							
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.8430	(36)					
Point Thermal bridges							(36a) =						
Total fabric heat loss							(33) + (36) + (36a) =	134.7349 (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	100.9593	99.3809	99.3809	99.0130	99.0130	97.9732	98.3091	97.6479	97.3333	97.9732	97.6479	98.6557	(38)
Average = Sum(39)m / 12 =	235.6942	234.1158	234.1158	233.7479	233.7479	232.7081	233.0440	232.3828	232.0682	232.7081	232.3828	233.3906	(39)
												233.3422	
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP (average)	1.0522	1.0452	1.0452	1.0435	1.0435	1.0389	1.0404	1.0374	1.0360	1.0389	1.0374	1.0419	(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													3.0331 (42)
Hot water usage for mixer showers													
	112.6132	110.9209	108.4548	103.7363	100.2543	96.3711	94.1639	96.6113	99.2941	103.4635	108.2833	112.1818	(42a)
Hot water usage for baths													
	32.4081	31.9268	31.2490	29.9993	29.0636	28.0260	27.4655	28.1385	28.8714	29.9816	31.2571	32.2986	(42b)
Hot water usage for other uses													
	45.6923	44.0307	42.3692	40.7077	39.0461	37.3846	37.3846	39.0461	40.7077	42.3692	44.0307	45.6923	(42c)
Average daily hot water use (litres/day)													175.4115 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy conte	190.7136	186.8784	182.0730	174.4434	168.3640	161.7816	159.0140	163.7960	168.8732	175.8143	183.5711	190.1726	(44)
Energy content (annual)	302.0438	266.1124	279.8395	238.8042	226.6503	198.9294	192.3136	202.8136	208.2375	238.5784	261.5307	297.7644	(45)
Distribution loss (46)m = 0.15 x (45)m													Total = Sum(45)m = 2913.6177
	45.3066	39.9169	41.9759	35.8206	33.9975	29.8394	28.8470	30.4220	31.2356	35.7868	39.2296	44.6647	(46)
Water storage loss:													
Store volume													300.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):													2.4000 (48)
Temperature factor from Table 2b													0.5400 (49)
Enter (49) or (54) in (55)													1.2960 (55)
Total storage loss													
	40.1760	36.2880	40.1760	38.8800	40.1760	38.8800	40.1760	40.1760	38.8800	40.1760	38.8800	40.1760	(56)
If cylinder contains dedicated solar storage													
	40.1760	36.2880	40.1760	38.8800	40.1760	38.8800	40.1760	40.1760	38.8800	40.1760	38.8800	40.1760	(57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	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													
	365.4822	323.4116	341.8821	293.4426	277.2943	247.7147	242.7251	254.1556	264.2266	300.6211	322.9227	361.2028	(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)
Aperture area of solar collector													3.0000 (H1)
Zero-loss collector efficiency													0.8000 (H2)
Collector linear heat loss coefficient													1.8000 (H3)
Collector 2nd order heat loss coefficient													0.0000 (H4)
Collector loop efficiency													0.9000 (H5)
Incidence angle modifier													1.0000 (H6)
Overshading factor													0.8000 (H8)
Overall heat loss coefficient of system													6.5000 (H10)
Heat loss coefficient of collector loop													3.9667 (H11)
Dedicated solar storage volume													75.0000 (H12)
Effective solar volume													75.0000 (H14)
Reference volume													225.0000 (H15)
Storage tank correction coefficient													1.3161 (H16)
Heat delivered to hot water													790.0423 (H24)
Heat delivered to space heating													0.0000 (H29)
Solar input													790.0423
Solar input	-2.8620	-20.8366	-68.2858	-97.3078	-122.9211	-124.4771	-121.7386	-107.3520	-75.1040	-42.0350	-7.1222	-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													
	362.6202	302.5750	273.5963	196.1349	154.3732	123.2376	120.9864	146.8035	189.1226	258.5861	315.8004	361.2028	(64)
													Total per year (kWh/year) = Sum(64)m = 2805.0390 (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													
	151.1803	134.3217	142.6807	123.1131	115.8765	105.1722	104.2734	108.5091	114.0303	128.9614	136.0726	149.7574	(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	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	48.5669	43.1367	35.0811	26.5586	19.8529	16.7607	18.1105	23.5407	31.5962	40.1187	46.8244	49.9167 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	587.0445	593.1361	577.7853	545.1052	503.8523	465.0805	439.1786	433.0869	448.4377	481.1179	522.3707	561.1425 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319 (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)	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252 (71)
Water heating gains (Table 5)	203.1993	199.8835	191.7752	170.9905	155.7479	146.0726	140.1525	145.8455	158.3754	173.3353	188.9897	201.2868 (72)
Total internal gains	955.7051	953.0508	921.5361	859.5487	796.3477	744.8082	714.3360	719.3676	755.3038	811.4663	875.0793	929.2405 (73)

## 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W						
Northeast	2.0000	14.6130	0.6300	0.7000	0.7700	8.9319 (75)						
Southeast	15.1000	45.0642	0.6300	0.7000	0.7700	207.9602 (77)						
Southwest	3.1000	45.0642	0.6300	0.7000	0.7700	42.6938 (79)						
Northwest	22.3000	14.6130	0.6300	0.7000	0.7700	99.5903 (81)						
Southeast	0.6000	50.1759	0.6300	0.7000	1.0000	11.9489 (82)						
Northwest	1.0000	21.2590	0.6300	0.7000	1.0000	8.4377 (82)						
Solar gains	379.5628	586.2565	895.9789	1302.3655	1550.3589	1731.7068	1617.5059	1385.1320	1090.9617	726.7957	450.1169	314.4068 (83)
Total gains	1335.2680	1539.3074	1817.5150	2161.9142	2346.7065	2476.5151	2331.8419	2104.4996	1846.2656	1538.2620	1325.1962	1243.6472 (84)

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation factor for gains for living area, nil,m (see Table 9a)												21.0000 (85)
tau	45.1846	45.4892	45.4892	45.5608	45.5608	45.7644	45.6984	45.8285	45.8906	45.7644	45.8285	45.6306
alpha	4.0123	4.0326	4.0326	4.0374	4.0374	4.0510	4.0466	4.0552	4.0594	4.0510	4.0552	4.0420
util living area	0.9897	0.9820	0.9545	0.8754	0.7245	0.5070	0.3656	0.4021	0.6921	0.9167	0.9798	0.9920 (86)
MIT	19.7349	19.8733	20.1895	20.5446	20.7942	20.9003	20.9189	20.9171	20.8448	20.5303	20.0772	19.7073 (87)
Th 2	20.0401	20.0459	20.0459	20.0472	20.0472	20.0511	20.0498	20.0523	20.0534	20.0511	20.0523	20.0485 (88)
util rest of house	0.9872	0.9778	0.9436	0.8471	0.6681	0.4283	0.2737	0.3022	0.6129	0.8900	0.9741	0.9900 (89)
MIT 2	18.5568	18.7366	19.1340	19.5645	19.8401	19.9396	19.9503	19.9523	19.9006	19.5618	19.0022	18.5281 (90)
Living area fraction	18.7015	18.8761	19.2636	19.6848	19.9573	20.0575	20.0692	20.0708	20.0165	19.6807	19.1342	18.6729 (92)
MIT	18.7015	18.8761	19.2636	19.6848	19.9573	20.0575	20.0692	20.0708	20.0165	19.6807	19.1342	18.6729 (92)
Temperature adjustment												0.0000
adjusted MIT	18.7015	18.8761	19.2636	19.6848	19.9573	20.0575	20.0692	20.0708	20.0165	19.6807	19.1342	18.6729 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9824	0.9709	0.9324	0.8346	0.6623	0.4289	0.2756	0.3042	0.6095	0.8772	0.9665	0.9860 (94)
Useful gains	1311.7786	1494.4613	1694.6128	1804.2455	1554.1677	1062.0752	642.7702	640.1980	1125.3717	1349.3782	1280.8171	1226.2377 (95)
Ext temp.	5.1000	5.4000	7.2000	9.6000	12.6000	15.4000	17.3000	17.3000	14.8000	11.5000	8.0000	5.1000 (96)
Heat loss rate W	3205.7847	3154.9758	2824.2767	2357.3003	1719.7441	1083.8490	645.3534	643.8750	1210.5808	1903.7239	2587.3857	3167.7807 (97)
Space heating kWh	1409.1405	1115.8657	840.4699	398.1994	123.1888	0.0000	0.0000	0.0000	0.0000	412.4332	940.7294	1444.5080 (98a)
Space heating requirement - total per year (kWh/year)												6684.5350
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	1409.1405	1115.8657	840.4699	398.1994	123.1888	0.0000	0.0000	0.0000	0.0000	412.4332	940.7294	1444.5080 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												6684.5350
Space heating per m2												29.8417 (99)

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

Fraction of space heat from secondary/supplementary system (Table 11)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Fraction of space heat from main system(s)												0.0000 (201)
Efficiency of main space heating system 1 (in %)												1.0000 (202)
Efficiency of main space heating system 2 (in %)												219.3000 (206)
Efficiency of secondary/supplementary heating system, %												0.0000 (207)
												37.0000 (208)
Space heating requirement	1409.1405	1115.8657	840.4699	398.1994	123.1888	0.0000	0.0000	0.0000	0.0000	412.4332	940.7294	1444.5080 (98)
Space heating efficiency (main heating system 1)	219.3000	219.3000	219.3000	219.3000	219.3000	0.0000	0.0000	0.0000	0.0000	219.3000	219.3000	219.3000 (210)
Space heating fuel (main heating system)	642.5629	508.8307	383.2512	181.5775	56.1737	0.0000	0.0000	0.0000	0.0000	188.0680	428.9692	658.6904 (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)

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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	362.6202	302.5750	273.5963	196.1349	154.3732	123.2376	120.9864	146.8035	189.1226	258.5861	315.8004	361.2028	(64)
Efficiency of water heater (217)m	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	(216)
Fuel for water heating, kWh/month	190.4518	158.9154	143.6956	103.0120	81.0784	64.7256	63.5433	77.1027	99.3291	135.8120	165.8616	189.7073	(217)
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	6.7945	6.1370	6.7945	6.5753	6.7945	6.5753	6.7945	6.7945	6.5753	6.7945	6.5753	6.7945	(231)
Lighting	42.5103	34.1033	30.7063	22.4967	17.3771	14.1973	15.8520	20.6050	26.7639	35.1157	39.6631	43.6918	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-50.7611	-67.5405	-103.2250	-121.8085	-126.6875	-120.4982	-117.7084	-110.0800	-95.7746	-81.9431	-55.8412	-42.5954	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												3048.1236	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												190.4000	
Water heating fuel used												1473.2348	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
pump for solar water heating												80.0000	(230g)
Total electricity for the above, kWh/year												80.0000	(231)
Electricity for lighting (calculated in Appendix L)												343.0824	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-1094.4635	(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												3849.9773	(238)

## 10a. Fuel costs - using BEDF prices (572)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3048.1236	26.0600	794.3410	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1473.2348	26.0600	383.9250	(247)
Energy for instantaneous electric shower(s)	0.0000	26.0600	0.0000	(247a)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(249)
Pump for solar water heating	80.0000	26.0600	20.8480	(249)
Energy for lighting	343.0824	26.0600	89.4073	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1094.4635	26.0600	-285.2172	
PV Unit electricity exported	0.0000	5.8100	0.0000	
Total			-285.2172	(252)
Total energy cost			1003.3041	(255)

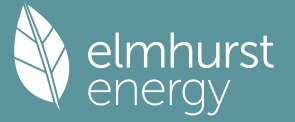
## 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3048.1236	0.1561	475.8867	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1473.2348	0.1452	213.9004	(264)
Space and water heating			689.7872	(265)
Pumps, fans and electric keep-hot	80.0000	0.1387	11.0970	(267)
Energy for lighting	343.0824	0.1443	49.5174	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1094.4635	0.1344	-147.0735	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-147.0735	(269)
Total CO2, kg/year			603.3280	(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	3048.1236	1.5780	4809.9624	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1473.2348	1.5371	2264.4464	(278)
Space and water heating			7074.4088	(279)
Pumps, fans and electric keep-hot	80.0000	1.5128	121.0240	(281)
Energy for lighting	343.0824	1.5338	526.2312	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1094.4635	1.4966	-1638.0126	

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PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-1638.0126 (283)
Total Primary energy kWh/year			6083.6515 (286)

# Building Regulations England Part L (BREL) Compliance Report

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

Date: Fri 20 Jun 2025 09:05:04

Project Information			
Assessed By	Joe Solti	Building Type	House, Detached
OCDEA Registration	EES/003578	Assessment Date	2025-06-20

Dwelling Details			
Assessment Type	As designed	Total Floor Area	224 m <sup>2</sup>
Site Reference	CJ5701	Plot Reference	CJ5701B
Address	Crosswinds Plot 1 Hampers Lane, Storrington, RH20 3HZ		

Client Details	
Name	.
Company	.
Address	., ., .

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

1a Target emission rate and dwelling emission rate		
Fuel for main heating system	Electricity	
Target carbon dioxide emission rate	7.93 kgCO <sub>2</sub> /m <sup>2</sup>	
Dwelling carbon dioxide emission rate	3.52 kgCO <sub>2</sub> /m <sup>2</sup>	OK
1b Target primary energy rate and dwelling primary energy		
Target primary energy	42.01 kWh <sub>PE</sub> /m <sup>2</sup>	
Dwelling primary energy	36.42 kWh <sub>PE</sub> /m <sup>2</sup>	OK
1c Target fabric energy efficiency and dwelling fabric energy efficiency		
Target fabric energy efficiency	40.5 kWh/m <sup>2</sup>	
Dwelling fabric energy efficiency	35.7 kWh/m <sup>2</sup>	OK

2a Fabric U-values				
Element	Maximum permitted average U-Value [W/m <sup>2</sup> K]	Dwelling average U-Value [W/m <sup>2</sup> K]	Element with highest individual U-Value	
External walls	0.26	0.18	Walls (1) (0.18)	OK
Party walls	0.2	N/A	N/A	N/A
Curtain walls	1.6	N/A	N/A	N/A
Floors	0.18	0.12	Ground Floor (0.12)	OK
Roofs	0.16	0.11	Roof (2) (0.15)	OK
Windows, doors, and roof windows	1.6	1.3	Front Door (1.3)	OK
Rooflights	2.2	N/A	N/A	N/A

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))		
Name	Net area [m <sup>2</sup> ]	U-Value [W/m <sup>2</sup> K]
Exposed wall: Walls (1)	183.9	0.18
Ground floor: Ground Floor, Ground Floor	120	0.12
Exposed roof: Roof (1)	113	0.11
Exposed roof: Roof (2)	8.9	0.15

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	Area [m <sup>2</sup> ]	Orientation	Frame factor	U-Value [W/m <sup>2</sup> K]
Front Door, Doors	2.1	South East	N/A	1.3
Windows (NE), Windows	2	North East	1.0	1.3
Windows (NW), Windows	22.3	North West	1.0	1.3
Windows (SE), Windows	15.1	South East	1.0	1.3
Windows (SW), Windows	3.1	South West	1.0	1.3
Rooflights (NW), Rooflights	1	North West	0.7	1.3
Rooflights (SE), Rooflights	0.6	South East	0.7	1.3

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

Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E2: Other lintels (including other steel lintels)	Calculated by person with suitable expertise	0.05	
External wall	E3: Sill	Calculated by person with suitable expertise	0.02 (!)	
External wall	E4: Jamb	Calculated by person with suitable expertise	0.015 (!)	
External wall	E5: Ground floor (normal)	Calculated by person with suitable expertise	0.053	
External wall	E6: Intermediate floor within a dwelling	Calculated by person with suitable expertise	0.001 (!)	
External wall	E10: Eaves (insulation at ceiling level)	Calculated by person with suitable expertise	0.056	
External wall	E11: Eaves (insulation at rafter level)	Calculated by person with suitable expertise	0.017 (!)	
External wall	E12: Gable (insulation at ceiling level)	Calculated by person with suitable expertise	0.036 (!)	
External wall	E13: Gable (insulation at rafter level)	Calculated by person with suitable expertise	0.038 (!)	
External wall	E16: Corner (normal)	Calculated by person with suitable expertise	0.038 (!)	
Roof	R1: Head of roof window	SAP table default	0.24	
Roof	R2: Sill of roof window	SAP table default	0.24	
Roof	R3: Jamb of roof window	SAP table default	0.24	

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

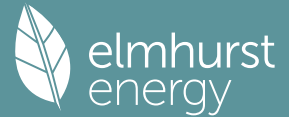
4 Space heating	
<b>Main heating system 1:</b> Heat pump with radiators or underfloor heating - Electricity	
Efficiency	219.3%
Emitter type	Both radiators and underfloor
Flow temperature	
System type	Air source heat pump
Manufacturer	
Model	
Commissioning	
<b>Secondary heating system:</b> Open fire in grate	
Fuel	Dual fuel appliance (mineral and wood)
Efficiency	37.0%
Commissioning	

5 Hot water	
<b>Cylinder/store</b> - type: Cylinder	
Capacity	300 litres
Declared heat loss	2 kWh/day
Primary pipework insulated	Yes
Manufacturer	
Model	
Commissioning	
<b>Waste water heat recovery system 1</b> - type: N/A	
Efficiency	
Manufacturer	
Model	

6 Controls	
<b>Main heating 1</b> - type: Time and temperature zone control by arrangement of plumbing and electrical services	
Function	
Ecodesign class	
Manufacturer	
Model	

<b>Water heating</b> - type: Cylinder thermostat and HW separately timed		
Manufacturer		
Model		
<b>7 Lighting</b>		
Minimum permitted light source efficacy	75 lm/W	
Lowest light source efficacy	75 lm/W	OK
External lights control	N/A	
<b>8 Mechanical ventilation</b>		
<b>System type:</b> N/A		
Maximum permitted specific fan power	N/A	
Specific fan power	N/A	N/A
Minimum permitted heat recovery efficiency	N/A	
Heat recovery efficiency	N/A	N/A
Manufacturer/Model		
Commissioning		
<b>9 Local generation</b>		
N/A		
<b>10 Heat networks</b>		
N/A		
<b>11 Supporting documentary evidence</b>		
N/A		
<b>12 Declarations</b>		
<b>a. Assessor Declaration</b>		
This declaration by the assessor is confirmation that the contents of this BREL Compliance Report are a true and accurate reflection based upon the design information submitted for this dwelling for the purpose of carrying out the "As designed" assessment, and that the supporting documentary evidence (SAP Conventions, Appendix 1 (documentary evidence) schedules the minimum documentary evidence required) has been reviewed in the course of preparing this BREL Compliance Report.		
Signed:	Assessor ID:	
Name:	Date:	
<b>b. Client Declaration</b>		
N/A		

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Property Reference	CJ5701	Issued on Date	20/06/2025
Assessment Reference	CJ5701B	Prop Type Ref	New House
Property	Plot 1, Crosswinds, Hampers Lane, Storrington, West Sussex, RH20 3HZ		
SAP Rating	82 B	DER	3.52
Environmental	96 A	% DER < TER	7.93
CO <sub>2</sub> Emissions (t/year)	0.68	DFEE	35.71
Compliance Check	See BREL	% DFEE < TFEE	40.48
% DPER < TPER	13.30	DPER	36.42
Assessor Details	Mr. Joe Solti	Assessor ID	5122-0001
Client	Mark Alford Design, .		

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> )
Main dwelling			
Ground floor	120.0000 (1b)	x 2.4100 (2b)	= 289.2000 (1b) - (3b)
First floor	104.0000 (1c)	x 2.6300 (2c)	= 273.5200 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	224.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 562.7200 (5)

### 2. Ventilation rate

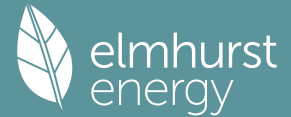
	Value	Reference
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	6 * 10 =	60.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c)	60.0000 / (5) =	0.1066 (8)
Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design AP50	5.0000	(17)
Infiltration rate	0.3566	(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) =	0.3031 (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	0.3865	0.3789	0.3713	0.3334	0.3259	0.2880	0.2880	0.2804	0.3031	0.3259	0.3410	0.3562 (22b)
Effective ac	0.5747	0.5718	0.5689	0.5556	0.5531	0.5415	0.5415	0.5393	0.5459	0.5531	0.5581	0.5634 (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
Main dwelling							
Doors			2.1000	1.3000	2.7300		(26a)
Windows			42.5000	1.2357	52.5190		(27)
Rooflights			1.6000	1.2357	1.9772		(27a)
Ground Floor			120.0000	0.1200	14.4000	75.0000	9000.0000 (28a)
External Wall	228.5000	44.6000	183.9000	0.1800	33.1020	60.0000	11034.0000 (29a)
Roof (loft)	113.0000		113.0000	0.1100	12.4300	9.0000	1017.0000 (30)
Roof (skelling)	10.5000	1.6000	8.9000	0.1500	1.3350	9.0000	80.1000 (30)
Total net area of external elements A <sub>um</sub> (A, m <sup>2</sup> )			472.0000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	118.4932	(33)
Main dwelling							
Internal Wall			165.0000			75.0000	12375.0000 (32c)
Internal Wall			225.0000			9.0000	2025.0000 (32c)
Internal Floor			104.0000			18.0000	1872.0000 (32d)
Internal Ceiling			104.0000			9.0000	936.0000 (32e)
Heat capacity C <sub>m</sub> = Sum (A x k)							(28)...(30) + (32) + (32a)...(32e) = 38339.1000 (34)
Thermal mass parameter (TMP = C <sub>m</sub> / TFA) in kJ/m <sup>2</sup> K							171.1567 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value		Total

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E2 Other lintels (including other steel lintels)	39.5000	0.0500	1.9750
E3 Sill	25.8000	0.0200	0.5160
E4 Jamb	56.3000	0.0150	0.8445
E5 Ground floor (normal)	50.1000	0.0530	2.6553
E6 Intermediate floor within a dwelling	43.4000	0.0010	0.0434
E10 Eaves (insulation at ceiling level)	10.2000	0.0560	0.5712
E11 Eaves (insulation at rafter level)	9.6000	0.0170	0.1632
E12 Gable (insulation at ceiling level)	17.5000	0.0360	0.6300
E13 Gable (insulation at rafter level)	7.6000	0.0380	0.2888
E16 Corner (normal)	26.2000	0.0380	0.9956
R1 Head of roof window	1.8000	0.2400	0.4320
R2 Sill of roof window	1.8000	0.2400	0.4320
R3 Jamb of roof window	5.4000	0.2400	1.2960
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			10.8430 (36)
Point Thermal bridges			0.0000
Total fabric heat loss		(33) + (36) + (36a) =	129.3362 (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	106.7182	106.1796	105.6517	103.1722	102.7083	100.5487	100.5487	100.1488	101.3805	102.7083	103.6468	104.6279 (38)
Heat transfer coeff	236.0544	235.5158	234.9879	232.5084	232.0445	229.8849	229.8849	229.4850	230.7167	232.0445	232.9830	233.9641 (39)
Average = Sum(39)m / 12 =												232.5062
HLP	1.0538	1.0514	1.0491	1.0380	1.0359	1.0263	1.0263	1.0245	1.0300	1.0359	1.0401	1.0445 (40)
HLP (average)												1.0380
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

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

Assumed occupancy													3.0331 (42)
Hot water usage for mixer showers	93.8444	92.4341	90.3790	86.4470	83.5452	80.3092	78.4699	80.5094	82.7451	86.2196	90.2361	93.4848	93.4848 (42a)
Hot water usage for baths	32.4081	31.9268	31.2490	29.9993	29.0636	28.0260	27.4655	28.1385	28.8714	29.9816	31.2571	32.2986	32.2986 (42b)
Hot water usage for other uses	45.6923	44.0307	42.3692	40.7077	39.0461	37.3846	37.3846	39.0461	40.7077	42.3692	44.0307	45.6923	45.6923 (42c)
Average daily hot water use (litres/day)													158.1072 (43)
Daily hot water use	171.9448	168.3916	163.9972	157.1540	151.6549	145.7198	143.3200	147.6941	152.3241	158.5704	165.5239	171.4757	171.4757 (44)
Energy conte	272.3185	239.7874	252.0576	215.1359	204.1567	179.1795	173.3331	182.8761	187.8309	215.1786	235.8191	268.4894	268.4894 (45)
Energy content (annual)													Total = Sum(45)m = 2626.1629
Distribution loss (46)m = 0.15 x (45)m	40.8478	35.9681	37.8086	32.2704	30.6235	26.8769	26.0000	27.4314	28.1746	32.2768	35.3729	40.2734	40.2734 (46)
Water storage loss:													
Store volume													300.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):													2.0000 (48)
Temperature factor from Table 2b													0.5400 (49)
Enter (49) or (54) in (55)													1.0800 (55)
Total storage loss	33.4800	30.2400	33.4800	32.4000	33.4800	32.4000	33.4800	33.4800	32.4000	33.4800	32.4000	33.4800	33.4800 (56)
If cylinder contains dedicated solar storage	33.4800	30.2400	33.4800	32.4000	33.4800	32.4000	33.4800	33.4800	32.4000	33.4800	32.4000	33.4800	33.4800 (57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624 (59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)
Total heat required for water heating calculated for each month	329.0609	291.0386	308.8000	270.0479	260.8991	234.0915	230.0755	239.6185	242.7429	271.9210	290.7311	325.2318	325.2318 (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	329.0609	291.0386	308.8000	270.0479	260.8991	234.0915	230.0755	239.6185	242.7429	271.9210	290.7311	325.2318	325.2318 (64)
Total per year (kWh/year)													Total per year (kWh/year) = Sum(64)m = 3294.2589 (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	135.9398	120.7303	129.2031	115.4623	113.2760	103.5068	103.0272	106.2002	106.3834	116.9408	122.3395	134.6667	134.6667 (65)

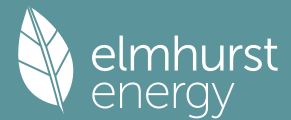
#### 5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	199.9605	221.3849	199.9605	206.6259	199.9605	206.6259	199.9605	199.9605	206.6259	199.9605	206.6259	199.9605 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	393.3198	397.4012	387.1161	365.2205	337.5811	311.6040	294.2496	290.1682	300.4533	322.3490	349.9884	375.9655 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656 (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)	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252 (71)
Water heating gains (Table 5)	182.7148	179.6582	173.6601	160.3643	152.2527	143.7594	138.4774	142.7422	147.7547	157.1785	169.9159	181.0036 (72)
Total internal gains	844.4921	866.9412	829.2337	800.7076	758.2912	730.4862	701.1845	701.3679	723.3308	747.9849	795.0271	825.4265 (73)

#### 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
Northeast	2.0000	11.2829	0.6300	0.0000	0.7700	10.9467 (75)
Southeast	15.1000	36.7938	0.6300	0.0000	0.7700	269.5152 (77)

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Southwest			3.1000		36.7938		0.6300		0.0000		0.7700		55.3309 (79)
Northwest			22.3000		11.2829		0.6300		0.7700		0.7700		122.0558 (81)
Southeast			0.6000		39.9751		0.6300		0.7000		1.0000		9.5197 (82)
Northwest			1.0000		16.3666		0.6300		0.7000		1.0000		6.4959 (82)

Solar gains	473.8642	854.9323	1296.2219	1817.3888	2228.0136	2296.3969	2178.8182	1859.6414	1474.7253	979.0205	576.2887	399.8885	(83)
Total gains	1318.3563	1721.8735	2125.4555	2618.0963	2986.3049	3026.8831	2880.0027	2561.0093	2198.0561	1727.0054	1371.3158	1225.3150	(84)

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	45.1157	45.2188	45.3204	45.8037	45.8953	46.3264	46.3264	46.4072	46.1594	45.8953	45.7104	45.5187	
alpha	4.0077	4.0146	4.0214	4.0536	4.0597	4.0884	4.0884	4.0938	4.0773	4.0597	4.0474	4.0346	
util living area	0.9917	0.9766	0.9378	0.8299	0.6562	0.4726	0.3480	0.4057	0.6577	0.9104	0.9820	0.9937	(86)
MIT	19.6332	19.8894	20.2301	20.6089	20.8263	20.9044	20.9199	20.9163	20.8522	20.5104	19.9944	19.5923	(87)
Th 2	20.0387	20.0407	20.0427	20.0518	20.0535	20.0615	20.0615	20.0630	20.0584	20.0535	20.0500	20.0464	(88)
util rest of house	0.9898	0.9714	0.9245	0.7982	0.6047	0.4081	0.2753	0.3259	0.5873	0.8852	0.9771	0.9923	(89)
MIT 2	18.4258	18.7521	19.1785	19.6368	19.8723	19.9517	19.9627	19.9624	19.9083	19.5364	18.8950	18.3794	(90)
Living area fraction	FLA = Living area / (4) =												0.1228 (91)
MIT	18.5740	18.8917	19.3076	19.7561	19.9894	20.0687	20.0802	20.0795	20.0242	19.6560	19.0300	18.5283	(92)
Temperature adjustment													0.0000
adjusted MIT	18.5740	18.8917	19.3076	19.7561	19.9894	20.0687	20.0802	20.0795	20.0242	19.6560	19.0300	18.5283	(93)

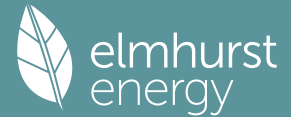
## 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.9857	0.9633	0.9121	0.7872	0.6010	0.4086	0.2767	0.3274	0.5846	0.8724	0.9701	0.9890	(94)
Useful gains	1299.5116	1658.7241	1938.7254	2060.9586	1794.8379	1236.6905	796.9658	838.3478	1284.9854	1506.6065	1330.3475	1211.8280	(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	3369.4418	3295.2642	3009.6432	2524.1414	1923.5085	1257.1611	800.0427	844.3966	1366.8152	2101.3855	2779.4766	3352.3063	(97)
Space heating kWh	1540.0280	1099.7550	796.7628	333.4916	95.7309	0.0000	0.0000	0.0000	0.0000	442.5156	1043.3729	1592.5159	(98a)
Space heating requirement - total per year (kWh/year)													6944.1727
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	1540.0280	1099.7550	796.7628	333.4916	95.7309	0.0000	0.0000	0.0000	0.0000	442.5156	1043.3729	1592.5159	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)													6944.1727
Space heating per m2													(98c) / (4) = 31.0008 (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 %)													219.3000 (206)
Efficiency of main space heating system 2 (in %)													0.0000 (207)
Efficiency of secondary/supplementary heating system, %													37.0000 (208)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement	1540.0280	1099.7550	796.7628	333.4916	95.7309	0.0000	0.0000	0.0000	0.0000	442.5156	1043.3729	1592.5159	(98)
Space heating efficiency (main heating system 1)	219.3000	219.3000	219.3000	219.3000	219.3000	0.0000	0.0000	0.0000	0.0000	219.3000	219.3000	219.3000	(210)
Space heating fuel (main heating system)	702.2472	501.4842	363.3209	152.0710	43.6530	0.0000	0.0000	0.0000	0.0000	201.7855	475.7742	726.1814	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	329.0609	291.0386	308.8000	270.0479	260.8991	234.0915	230.0755	239.6185	242.7429	271.9210	290.7311	325.2318	(64)
Efficiency of water heater (217)m	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	(216)
Fuel for water heating, kWh/month	172.8261	152.8564	162.1849	141.8319	137.0268	122.9472	120.8380	125.8501	127.4910	142.8156	152.6949	170.8150	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(231)
Lighting	42.5103	34.1033	30.7063	22.4967	17.3771	14.1973	15.8520	20.6050	26.7639	35.1157	39.6631	43.6918	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1													3166.5174 (211)
Space heating fuel - main system 2													0.0000 (213)
Space heating fuel - secondary													0.0000 (215)
Efficiency of water heater													190.4000

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Water heating fuel used	1730.1780 (219)
Space cooling fuel	0.0000 (221)
Electricity for pumps and fans:	
Total electricity for the above, kWh/year	0.0000 (231)
Electricity for lighting (calculated in Appendix L)	343.0824 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	0.0000 (233)
Wind generation	0.0000 (234)
Hydro-electric generation (Appendix N)	0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)	0.0000 (235)
Appendix Q - special features	
Energy saved or generated	-0.0000 (236)
Energy used	0.0000 (237)
Total delivered energy for all uses	5239.7778 (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	3166.5174	0.1565	495.4525 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1730.1780	0.1410	243.9500 (264)
Space and water heating			739.4025 (265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (267)
Energy for lighting	343.0824	0.1443	49.5174 (268)
Total CO2, kg/year			788.9199 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			3.5200 (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	3166.5174	1.5792	5000.6688 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1730.1780	1.5214	2632.2251 (278)
Space and water heating			7632.8938 (279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (281)
Energy for lighting	343.0824	1.5338	526.2312 (282)
Total Primary energy kWh/year			8159.1251 (286)
Dwelling Primary energy Rate (DPER)			36.4200 (287)

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

### 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Main dwelling			
Ground floor	120.0000 (1b)	x 2.4100 (2b)	= 289.2000 (1b) - (3b)
First floor	104.0000 (1c)	x 2.6300 (2c)	= 273.5200 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	224.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	562.7200 (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	4 * 10 = 40.0000 (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) =	40.0000 / (5) = 0.0711 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.3211 (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) = 0.2729 (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	0.3480	0.3412	0.3343	0.3002	0.2934	0.2593	0.2593	0.2525	0.2729	0.2934	0.3070	0.3207 (22b)
Effective ac	0.5605	0.5582	0.5559	0.5451	0.5430	0.5336	0.5336	0.5319	0.5372	0.5430	0.5471	0.5514 (25)

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### 3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Main dwelling								
TER Semi-glazed door			2.1000	1.0000	2.1000			(26a)
TER Opening Type			42.5000	1.1450	48.6641			(27)
TER Roof Window			1.6000	1.1450	2.2642			(27a)
Ground Floor			120.0000	0.1300	15.6000			(28a)
External Wall	228.5000	44.6000	183.9000	0.1800	33.1020			(29a)
Roof (loft)	113.0000		113.0000	0.1100	12.4300			(30)
Roof (skelling)	10.5000	1.6000	8.9000	0.1100	0.9790			(30)
Total net area of external elements Aum(A, m2)			472.0000					(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	115.1393		(33)

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

171.1567 (35)

#### List of Thermal Bridges

K1 Element	Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)	39.5000	0.0500	1.9750	
E3 Sill	25.8000	0.0500	1.2900	
E4 Jamb	56.3000	0.0500	2.8150	
E5 Ground floor (normal)	50.1000	0.1600	8.0160	
E6 Intermediate floor within a dwelling	43.4000	0.0000	0.0000	
E10 Eaves (insulation at ceiling level)	10.2000	0.0600	0.6120	
E11 Eaves (insulation at rafter level)	9.6000	0.0400	0.3840	
E12 Gable (insulation at ceiling level)	17.5000	0.0600	1.0500	
E13 Gable (insulation at rafter level)	7.6000	0.0800	0.6080	
E16 Corner (normal)	26.2000	0.0900	2.3580	
R1 Head of roof window	1.8000	0.0800	0.1440	
R2 Sill of roof window	1.8000	0.0600	0.1080	
R3 Jamb of roof window	5.4000	0.0800	0.4320	

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

19.7920 (36)

Point Thermal bridges

(36a) = 0.0000

Total fabric heat loss

(33) + (36) + (36a) = 134.9313 (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	104.0915	103.6549	103.2270	101.2171	100.8410	99.0904	99.0904	98.7662	99.7647	100.8410	101.6018	102.3971	(38)
Average = Sum(39)m / 12 =	239.0228	238.5862	238.1583	236.1483	235.7723	234.0217	234.0217	233.6975	234.6960	235.7723	236.5330	237.3284	(39)
												236.1465	

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP (average)	1.0671	1.0651	1.0632	1.0542	1.0526	1.0447	1.0447	1.0433	1.0477	1.0526	1.0560	1.0595	(40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

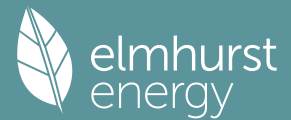
### 4. Water heating energy requirements (kWh/year)

Assumed occupancy													3.0331 (42)
Hot water usage for mixer showers	75.0755	73.9472	72.3032	69.1576	66.8362	64.2474	62.7759	64.4075	66.1961	68.9757	72.1889	74.7878	(42a)
Hot water usage for baths	32.4081	31.9268	31.2490	29.9993	29.0636	28.0260	27.4655	28.1385	28.8714	29.9816	31.2571	32.2986	(42b)
Hot water usage for other uses	45.6923	44.0307	42.3692	40.7077	39.0461	37.3846	37.3846	39.0461	40.7077	42.3692	44.0307	45.6923	(42c)
Average daily hot water use (litres/day)													140.8030 (43)
Daily hot water use	153.1759	149.9048	145.9214	139.8646	134.9459	129.6579	127.6260	131.5922	135.7751	141.3265	147.4767	152.7787	(44)
Energy conte	242.5932	213.4625	224.2758	191.4676	181.6631	159.4296	154.3526	162.9386	167.4243	191.7787	210.1076	239.2145	(45)
Energy content (annual)										Total = Sum(45)m =			2338.7080
Distribution loss (46)m = 0.15 x (45)m	36.3890	32.0194	33.6414	28.7201	27.2495	23.9144	23.1529	24.4408	25.1136	28.7668	31.5161	35.8822	(46)
Water storage loss:													
Store volume													300.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):													2.1127 (48)
Temperature factor from Table 2b													0.5400 (49)
Enter (49) or (54) in (55)													1.1409 (55)
Total storage loss	35.3664	31.9439	35.3664	34.2256	35.3664	34.2256	35.3664	35.3664	34.2256	35.3664	34.2256	35.3664	(56)
If cylinder contains dedicated solar storage													
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	(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	301.2220	266.4175	282.9046	248.2052	240.2919	216.1671	212.9814	221.5674	224.1619	250.4076	266.8451	297.8433	(62)
WWHRS	-34.3214	-30.3541	-31.7851	-26.3193	-24.5286	-20.9893	-19.6742	-20.9215	-21.7164	-25.6012	-29.0031	-33.6858	(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	266.9006	236.0634	251.1196	221.8859	215.7633	195.1778	193.3072	200.6460	202.4455	224.8063	237.8421	264.1575	(64)
12Total per year (kWh/year)													2710.1151 (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	127.5653	113.3403	121.4748	109.0530	107.3060	98.4004	98.2253	101.0801	101.0586	110.6695	115.2508	126.4419	(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	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	199.9605	221.3849	199.9605	206.6259	199.9605	206.6259	199.9605	199.9605	206.6259	199.9605	206.6259	199.9605	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	393.3198	397.4012	387.1161	365.2205	337.5811	311.6040	294.2496	290.1682	300.4533	322.3490	349.9884	375.9655	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	(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)

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Losses e.g. evaporation (negative values) (Table 5)	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	(71)
Water heating gains (Table 5)	171.4587	168.6612	163.2725	151.4625	144.2285	136.6672	132.0232	135.8604	140.3592	148.7493	160.0706	169.9488	(72)
Total internal gains	836.2360	858.9442	821.8461	794.8058	753.2671	723.3940	694.7303	694.4861	715.9353	742.5557	788.1817	817.3717	(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							
Northeast	2.0000	11.2829	0.6300	0.7000	0.7700	6.8964 (75)							
Southeast	15.1000	36.7938	0.6300	0.7000	0.7700	169.7946 (77)							
Southwest	3.1000	36.7938	0.6300	0.7000	0.7700	34.8585 (79)							
Northwest	22.3000	11.2829	0.6300	0.7000	0.7700	76.8952 (81)							
Southeast	0.6000	39.9751	0.6300	0.7000	1.0000	9.5197 (82)							
Northwest	1.0000	16.3666	0.6300	0.7000	1.0000	6.4959 (82)							
Solar gains	304.4602	550.0288	835.6219	1173.9086	1440.8370	1485.6945	1409.3738	1201.8680	951.4976	630.3306	370.4051	256.8402	(83)
Total gains	1140.6962	1408.9730	1657.4680	1968.7144	2194.1040	2209.0884	2104.1042	1896.3541	1667.4329	1372.8863	1158.5868	1074.2119	(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	44.5554	44.6369	44.7171	45.0977	45.1696	45.5075	45.5075	45.5707	45.3768	45.1696	45.0244	44.8735
alpha	3.9704	3.9758	3.9811	4.0065	4.0113	4.0338	4.0338	4.0380	4.0251	4.0113	4.0016	3.9916
util living area	0.9950	0.9882	0.9713	0.9173	0.8002	0.6250	0.4750	0.5406	0.7891	0.9545	0.9900	0.9961 (86)
MIT	19.1415	19.4060	19.7995	20.3137	20.7147	20.9234	20.9802	20.9673	20.8015	20.2546	19.6034	19.0986 (87)
Th 2	20.0278	20.0294	20.0310	20.0384	20.0398	20.0462	20.0462	20.0474	20.0437	20.0398	20.0370	20.0340 (88)
util rest of house	0.9939	0.9854	0.9643	0.8971	0.7544	0.5486	0.3783	0.4395	0.7240	0.9395	0.9872	0.9952 (89)
MIT 2	17.8359	18.1741	18.6737	19.3146	19.7791	19.9937	20.0374	20.0315	19.8862	19.2557	18.4328	17.7851 (90)
Living area fraction	FLA = Living area / (4) =											
MIT	17.9962	18.3254	18.8119	19.4373	19.8939	20.1078	20.1532	20.1464	19.9986	19.3783	18.5765	17.9464 (92)
Temperature adjustment												
adjusted MIT	17.9962	18.3254	18.8119	19.4373	19.8939	20.1078	20.1532	20.1464	19.9986	19.3783	18.5765	17.9464 (93)

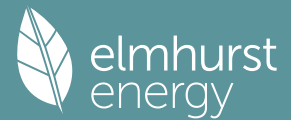
## 8. Space heating requirement

Utilisation	0.9900	0.9782	0.9524	0.8817	0.7466	0.5538	0.3895	0.4505	0.7205	0.9256	0.9807	0.9920 (94)
Useful gains	1129.3323	1378.3180	1578.4991	1735.7768	1638.0467	1223.5034	819.5189	854.3012	1201.3863	1270.7583	1136.2649	1065.6293 (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	3273.7006	3203.1089	2932.1913	2488.3590	1931.9028	1288.9510	831.5178	875.5274	1384.3781	2069.6801	2714.5653	3262.4051 (97)
Space heating kWh	1595.4100	1226.2595	1007.1470	541.8592	218.6290	0.0000	0.0000	0.0000	0.0000	594.3978	1136.3763	1634.4012 (98a)
Space heating requirement - total per year (kWh/year)	7954.4800											
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	1595.4100	1226.2595	1007.1470	541.8592	218.6290	0.0000	0.0000	0.0000	0.0000	594.3978	1136.3763	1634.4012 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)	7954.4800											
Space heating per m <sup>2</sup>	(98c) / (4) =											
	35.5111 (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	1595.4100	1226.2595	1007.1470	541.8592	218.6290	0.0000	0.0000	0.0000	594.3978	1136.3763	1634.4012 (98)	
Space heating efficiency (main heating system 1)	92.3000	92.3000	92.3000	92.3000	92.3000	0.0000	0.0000	0.0000	92.3000	92.3000	92.3000 (210)	
Space heating fuel (main heating system)	1728.5048	1328.5585	1091.1669	587.0631	236.8678	0.0000	0.0000	0.0000	643.9846	1231.1769	1770.7488 (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 (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 (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 (215)	
Water heating												
Water heating requirement	266.9006	236.0634	251.1196	221.8859	215.7633	195.1778	193.3072	200.6460	202.4455	224.8063	237.8421	264.1575 (64)
Efficiency of water heater (217)m	87.3875	87.2122	86.8452	85.9827	84.0894	79.8000	79.8000	79.8000	79.8000	86.1342	87.0998	79.8000 (216)
Fuel for water heating, kWh/month	305.4219	270.6771	289.1575	258.0587	256.5880	244.5837	242.2397	251.4360	253.6911	260.9955	273.0683	302.1427 (219)
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041 (231)
Lighting	41.5478	33.3312	30.0111	21.9874	16.9837	13.8758	15.4931	20.1385	26.1579	34.3206	38.7651	42.7026 (232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-96.5084	-128.7539	-175.1600	-185.9074	-191.4172	-175.2403	-172.7229	-167.1229	-156.4510	-141.3876	-103.3049	-84.2881 (233a)

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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	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	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	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity) (233b)m	-79.1952	-162.9715	-317.6069	-468.3362	-611.3042	-611.6396	-604.7437	-515.8908	-383.1391	-230.4536	-104.8178	-62.9375		(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	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	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	0.0000	(235d)
Annual totals kWh/year														
Space heating fuel - main system 1													8618.0715	(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													3208.0603	(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)													335.3149	(232)
Energy saving/generation technologies (Appendices M ,N and Q)														
PV generation													-5931.3007	(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													6316.1460	(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	8618.0715	0.2100	1809.7950 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	3208.0603	0.2100	673.6927 (264)
Space and water heating			2483.4877 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	335.3149	0.1443	48.3963 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1778.2646	0.1358	-241.5554
PV Unit electricity exported	-4153.0360	0.1264	-525.0906
Total			-766.6460 (269)
Total CO2, kg/year			1777.1673 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			7.9300 (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	8618.0715	1.1300	9738.4208 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	3208.0603	1.1300	3625.1081 (278)
Space and water heating			13363.5289 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	335.3149	1.5338	514.3172 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1778.2646	1.5021	-2671.1348
PV Unit electricity exported	-4153.0360	0.4641	-1927.5393
Total			-4598.6742 (283)
Total Primary energy kWh/year			9409.2727 (286)
Target Primary Energy Rate (TPER)			42.0100 (287)

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

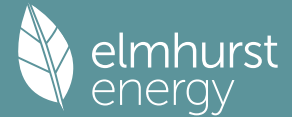
### 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Main dwelling			
Ground floor	120.0000 (1b)	x 2.4100 (2b)	= 289.2000 (1b) - (3b)
First floor	104.0000 (1c)	x 2.6300 (2c)	= 273.5200 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	224.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 562.7200 (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)

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Number of chimneys / flues attached to closed fire 0 \* 10 = 0.0000 (6c)  
 Number of flues attached to solid fuel boiler 0 \* 20 = 0.0000 (6d)  
 Number of flues attached to other heater 0 \* 35 = 0.0000 (6e)  
 Number of blocked chimneys 0 \* 20 = 0.0000 (6f)  
 Number of intermittent extract fans 4 \* 10 = 40.0000 (7a)  
 Number of passive vents 0 \* 10 = 0.0000 (7b)  
 Number of flueless gas fires 0 \* 40 = 0.0000 (7c)

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = 40.0000 / (5) = 0.0711 (8)  
 Pressure test Yes  
 Pressure Test Method Blower Door  
 Measured/design AP50 5.0000 (17)  
 Infiltration rate 0.3211 (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) = 0.2729 (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	0.3480	0.3412	0.3343	0.3002	0.2934	0.2593	0.2593	0.2525	0.2729	0.2934	0.3070	0.3207 (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	0.5605	0.5582	0.5559	0.5451	0.5430	0.5336	0.5336	0.5319	0.5372	0.5430	0.5471	0.5514 (25)

### 3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
Main dwelling							
Doors			2.1000	1.3000	2.7300		(26a)
Windows			42.5000	1.2357	52.5190		(27)
Rooflights			1.6000	1.2357	1.9772		(27a)
Ground Floor			120.0000	0.1200	14.4000	75.0000	9000.0000 (28a)
External Wall	228.5000	44.6000	183.9000	0.1800	33.1020	60.0000	11034.0000 (29a)
Roof (loft)	113.0000		113.0000	0.1100	12.4300	9.0000	1017.0000 (30)
Roof (skelting)	10.5000	1.6000	8.9000	0.1500	1.3350	9.0000	80.1000 (30)
Total net area of external elements Aum(A, m2)			472.0000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 118.4932		(33)
Main dwelling							
Internal Wall			165.0000			75.0000	12375.0000 (32c)
Internal Wall			225.0000			9.0000	2025.0000 (32c)
Internal Floor			104.0000			18.0000	1872.0000 (32d)
Internal Ceiling			104.0000			9.0000	936.0000 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) = 38339.1000	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							171.1567 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	39.5000	0.0500	1.9750
E3 Sill	25.8000	0.0200	0.5160
E4 Jamb	56.3000	0.0150	0.8445
E5 Ground floor (normal)	50.1000	0.0530	2.6553
E6 Intermediate floor within a dwelling	43.4000	0.0010	0.0434
E10 Eaves (insulation at ceiling level)	10.2000	0.0560	0.5712
E11 Eaves (insulation at rafter level)	9.6000	0.0170	0.1632
E12 Gable (insulation at ceiling level)	17.5000	0.0360	0.6300
E13 Gable (insulation at rafter level)	7.6000	0.0380	0.2888
E16 Corner (normal)	26.2000	0.0380	0.9956
R1 Head of roof window	1.8000	0.2400	0.4320
R2 Sill of roof window	1.8000	0.2400	0.4320
R3 Jamb of roof window	5.4000	0.2400	1.2960
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			10.8430 (36)
Point Thermal bridges			(36a) = 0.0000
Total fabric heat loss			(33) + (36) + (36a) = 129.3362 (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	104.0915	103.6549	103.2270	101.2171	100.8410	99.0904	99.0904	98.7662	99.7647	100.8410	101.6018	102.3971 (38)
Heat transfer coeff	233.4277	232.9911	232.5632	230.5533	230.1772	228.4266	228.4266	228.1024	229.1009	230.1772	230.9380	231.7333 (39)
Average = Sum(39)m / 12 =												230.5515

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.0421	1.0401	1.0382	1.0293	1.0276	1.0198	1.0198	1.0183	1.0228	1.0276	1.0310	1.0345 (40)
HLP (average)												1.0292
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

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

Assumed occupancy 3.0331 (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)

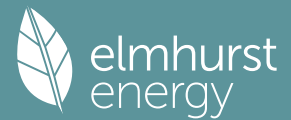
Hot water usage for baths 32.4081 31.9268 31.2490 29.9993 29.0636 28.0260 27.4655 28.1385 28.8714 29.9816 31.2571 32.2986 (42b)

Hot water usage for other uses 45.6923 44.0307 42.3692 40.7077 39.0461 37.3846 37.3846 39.0461 40.7077 42.3692 44.0307 45.6923 (42c)

Average daily hot water use (litres/day) 71.5859 (43)

Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	78.1004	75.9576	73.6183	70.7070	68.1097	65.4106	64.8501	67.1847	69.5790	72.3508	75.2878	77.9909 (44)
Energy conte	123.6920	108.1626	113.1485	96.7944	91.6888	80.4299	78.4306	83.1887	85.7979	98.1794	107.2613	122.1148 (45)
Energy content (annual)												Total = Sum(45)m = 1188.8887
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	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)

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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	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	0.0000	(61)		
Total heat required for water heating calculated for each month																	
	105.1382	91.9382	96.1762	82.2752	77.9354	68.3654	66.6660	70.7104	72.9282	83.4525	91.1721	103.7976	103.7976	103.7976	(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	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	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	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	0.0000	(63d)		
Output from w/h																	
	105.1382	91.9382	96.1762	82.2752	77.9354	68.3654	66.6660	70.7104	72.9282	83.4525	91.1721	103.7976	103.7976	103.7976	(64)		
												Total per year (kWh/year) = Sum(64)m =				1010.5554	(64)
																1011	(64)
12Total per year (kWh/year)																	
Electric shower(s)																	
	60.1230	53.5700	58.4964	55.8224	56.8699	54.2484	56.0567	56.8699	55.8224	58.4964	57.3965	60.1230	60.1230	60.1230	(64a)		
												Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =				683.8951	(64a)
Heat gains from water heating, kWh/month																	
	41.3153	36.3771	38.6682	34.5244	33.7013	30.6535	30.6807	31.8951	32.1877	35.4872	37.1421	40.9801	40.9801	40.9801	(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	
	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	199.9605	221.3849	199.9605	206.6259	199.9605	206.6259	199.9605	199.9605	206.6259	199.9605	206.6259	199.9605	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	393.3198	397.4012	387.1161	365.2205	337.5811	311.6040	294.2496	290.1682	300.4533	322.3490	349.9884	375.9655	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	(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)													
	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	(71)
Water heating gains (Table 5)													
	55.5313	54.1325	51.9733	47.9506	45.2975	42.5742	41.2374	42.8697	44.7051	47.6979	51.5863	55.0808	(72)
Total internal gains													
	717.3085	741.4155	707.5469	688.2938	651.3360	629.3010	603.9446	601.4954	620.2812	638.5043	676.6975	699.5038	(73)

## 6. Solar gains

[Jan]		Area	Solar flux	g	FF	Access	Gains						
		m2	Table 6a	or Table 6b	Specific data	factor	W						
			W/m2		or Table 6c	Table 6d							
Northeast		2.0000	11.2829	0.6300	0.0000	0.7700	10.9467 (75)						
Southeast		15.1000	36.7938	0.6300	0.0000	0.7700	269.5152 (77)						
Southwest		3.1000	36.7938	0.6300	0.0000	0.7700	55.3309 (79)						
Northwest		22.3000	11.2829	0.6300	0.0000	0.7700	122.0558 (81)						
Southeast		0.6000	39.9751	0.6300	0.7000	1.0000	9.5197 (82)						
Northwest		1.0000	16.3666	0.6300	0.7000	1.0000	6.4959 (82)						
-----													
Solar gains	473.8642	854.9323	1296.2219	1817.3888	2228.0136	2296.3969	2178.8182	1859.6414	1474.7253	979.0205	576.2887	399.8885	(83)
Total gains	1191.1728	1596.3479	2003.7688	2505.6826	2879.3497	2925.6979	2782.7627	2461.1368	2095.0065	1617.5248	1252.9862	1099.3923	(84)

## 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	21.0000 (85)
tau	45.6233	45.7088	45.7929	46.1921	46.2676	46.6222	46.6222	46.6885	46.4850	46.2676	46.1152	45.9569	
alpha	4.0416	4.0473	4.0529	4.0795	4.0845	4.1081	4.1081	4.1126	4.0990	4.0845	4.0743	4.0638	
util living area													
	0.9942	0.9817	0.9470	0.8437	0.6705	0.4848	0.3576	0.4189	0.6779	0.9243	0.9867	0.9958	(86)
MIT	19.2234	19.5695	20.0337	20.5563	20.8619	20.9713	20.9935	20.9879	20.8944	20.4095	19.7043	19.1646	(87)
Th 2	20.0484	20.0500	20.0516	20.0590	20.0604	20.0669	20.0669	20.0681	20.0644	20.0604	20.0576	20.0547	(88)
util rest of house													
	0.9929	0.9775	0.9353	0.8136	0.6193	0.4193	0.2834	0.3373	0.6079	0.9020	0.9830	0.9948	(89)
MIT 2	18.4161	18.7602	19.2146	19.7082	19.9676	20.0524	20.0648	20.0638	20.0033	19.5884	18.9018	18.3623	(90)
Living area fraction													
MIT	18.5152	18.8595	19.3151	19.8123	20.0774	20.1653	20.1788	20.1772	20.1127	19.6892	19.0003	18.4608	(92)
Temperature adjustment													
adjusted MIT	18.5152	18.8595	19.3151	19.8123	20.0774	20.1653	20.1788	20.1772	20.1127	19.6892	19.0003	18.4608	(93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9897	0.9706	0.9242	0.8048	0.6202	0.4264	0.2924	0.3470	0.6117	0.8913	0.9774	0.9924	(94)
Useful gains	1178.9513	1549.4455	1851.9769	2016.4640	1785.8968	1247.5002	813.7153	854.0884	1281.6060	1441.7033	1224.6750	1090.9834	(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													
	3318.2248	3252.4493	2980.3255	2515.8768	1928.2825	1271.2525	817.4888	861.5971	1377.5059	2092.1174	2748.2394	3304.6933	(97)
Space heating kWh													
	1591.6194	1144.4186	839.4914	359.5773	105.9350	0.0000	0.0000	0.0000	0.0000	483.9081	1096.9664	1647.0001	(98a)
Space heating requirement - total per year (kWh/year)													
													7268.9163
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													
	1591.6194	1144.4186	839.4914	359.5773	105.9350	0.0000	0.0000	0.0000	0.0000	483.9081	1096.9664	1647.0001	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)													
													7268.9163
Space heating per m2													
													32.4505 (99)

## 8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	2147.2101	1690.3569	1733.5784	0.0000	0.0000	0.0000	0.0000 (100)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.9332	0.9624	0.9406	0.0000	0.0000	0.0000	0.0000 (101)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2003.8416	1626.7511	1630.5202	0.0000	0.0000	0.0000	0.0000 (102)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	3308.3658	3146.1313	2777.2080	0.0000	0.0000	0.0000	0.0000 (103)
Cooled fraction	0.0000	0.0000	0.0000	0.0000	0.0000	939.2575	1130.4189	853.1357	0.0000	0.0000	0.0000	0.0000 (104)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500 (106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	234.8144	282.6047	213.2839	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement												730.7030 (107)
Energy for space heating												32.4505 (99)
Energy for space cooling												3.2621 (108)
Total												35.7126 (109)
Fabric Energy Efficiency (DFEE)												35.7 (109)

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

## 1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Main dwelling			
Ground floor	120.0000 (1b)	x 2.4100 (2b)	= 289.2000 (1b) - (3b)
First floor	104.0000 (1c)	x 2.6300 (2c)	= 273.5200 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	224.0000		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 562.7200 (5)

## 2. Ventilation rate

	m3 per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	4 * 10 = 40.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c)	40.0000 / (5) = 0.0711 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.3211 (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) = 0.2729 (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	0.3480	0.3412	0.3343	0.3002	0.2934	0.2593	0.2593	0.2525	0.2729	0.2934	0.3070	0.3207 (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	0.5605	0.5582	0.5559	0.5451	0.5430	0.5336	0.5336	0.5319	0.5372	0.5430	0.5471	0.5514 (25)

## 3. Heat losses and heat loss parameter

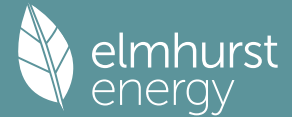
Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
Main dwelling							
TER Semi-glazed door			2.1000	1.0000	2.1000		(26a)
TER Opening Type			42.5000	1.1450	48.6641		(27)
TER Roof Window			1.6000	1.1450	2.2642		(27a)
Ground Floor			120.0000	0.1300	15.6000		(28a)
External Wall	228.5000	44.6000	183.9000	0.1800	33.1020		(29a)
Roof (loft)	113.0000		113.0000	0.1100	12.4300		(30)
Roof (skelling)	10.5000	1.6000	8.9000	0.1100	0.9790		(30)
Total net area of external elements Aum(A, m2)			472.0000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 115.1393		(33)

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

List of Thermal Bridges

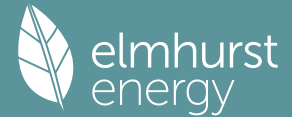
K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	39.5000	0.0500	1.9750
E3 Sill	25.8000	0.0500	1.2900
E4 Jamb	56.3000	0.0500	2.8150
E5 Ground floor (normal)	50.1000	0.1600	8.0160
E6 Intermediate floor within a dwelling	43.4000	0.0000	0.0000
E10 Eaves (insulation at ceiling level)	10.2000	0.0600	0.6120
E11 Eaves (insulation at rafter level)	9.6000	0.0400	0.3840

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E12 Gable (insulation at ceiling level)						17.5000	0.0600	1.0500				
E13 Gable (insulation at rafter level)						7.6000	0.0800	0.6080				
E16 Corner (normal)						26.2000	0.0900	2.3580				
R1 Head of roof window						1.8000	0.0800	0.1440				
R2 Sill of roof window						1.8000	0.0600	0.1080				
R3 Jamb of roof window						5.4000	0.0800	0.4320				
Thermal bridges (Sum(L x Psi) calculated using Appendix K)												19.7920 (36)
Point Thermal bridges												0.0000
Total fabric heat loss												(33) + (36) + (36a) = 134.9313 (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	104.0915	103.6549	103.2270	101.2171	100.8410	99.0904	99.0904	98.7662	99.7647	100.8410	101.6018	102.3971 (38)
Average = Sum(39)m / 12 =	239.0228	238.5862	238.1583	236.1483	235.7723	234.0217	234.0217	233.6975	234.6960	235.7723	236.5330	237.3284 (39)
												236.1465
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.0671	1.0651	1.0632	1.0542	1.0526	1.0447	1.0447	1.0433	1.0477	1.0526	1.0560	1.0595 (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												3.0331 (42)
Hot water usage for mixer showers												0.0000 (42a)
Hot water usage for baths												32.4081 (42b)
Hot water usage for other uses												45.6923 (42c)
Average daily hot water use (litres/day)												71.5859 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	78.1004	75.9576	73.6183	70.7070	68.1097	65.4106	64.8501	67.1847	69.5790	72.3508	75.2878	77.9909 (44)
Energy content (annual)	123.6920	108.1626	113.1485	96.7944	91.6888	80.4299	78.4306	83.1887	85.7979	98.1794	107.2613	122.1148 (45)
Distribution loss (46)m = 0.15 x (45)m												Total = Sum(45)m = 1188.8887
Water storage loss:												0.0000 (46)
Total storage loss												0.0000 (56)
If cylinder contains dedicated solar storage												0.0000 (57)
Primary loss												0.0000 (59)
Combi loss												0.0000 (61)
Total heat required for water heating calculated for each month												
WWHRS	105.1382	91.9382	96.1762	82.2752	77.9354	68.3654	66.6660	70.7104	72.9282	83.4525	91.1721	103.7976 (62)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63a)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (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	105.1382	91.9382	96.1762	82.2752	77.9354	68.3654	66.6660	70.7104	72.9282	83.4525	91.1721	103.7976 (64)
12Total per year (kWh/year)												Total per year (kWh/year) = Sum(64)m = 1010.5554 (64)
Electric shower(s)												1011 (64)
Heat gains from water heating, kWh/month	60.1230	53.5700	58.4964	55.8224	56.8699	54.2484	56.0567	56.8699	55.8224	58.4964	57.3965	60.1230 (64a)
	41.3153	36.3771	38.6682	34.5244	33.7013	30.6535	30.6807	31.8951	32.1877	35.4872	37.1421	683.8951 (64a)
-----												
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	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	199.9605	221.3849	199.9605	206.6259	199.9605	206.6259	199.9605	199.9605	206.6259	199.9605	206.6259	199.9605 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	393.3198	397.4012	387.1161	365.2205	337.5811	311.6040	294.2496	290.1682	300.4533	322.3490	349.9884	375.9655 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656 (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)	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252 (71)
Water heating gains (Table 5)	55.5313	54.1325	51.9733	47.9506	45.2975	42.5742	41.2374	42.8697	44.7051	47.6979	51.5863	55.0808 (72)
Total internal gains	717.3085	741.4155	707.5469	688.2938	651.3360	629.3010	603.9446	601.4954	620.2812	638.5043	676.6975	699.5038 (73)
-----												
6. Solar gains												
[Jan]												
		Area	Solar flux	g	FF	Access	Gains					
		m2	Table 6a	Specific data	factor	factor	W					
			W/m2	or Table 6b	or Table 6c	Table 6d						
Northeast		2.0000	11.2829	0.6300	0.7000	0.7700	6.8964 (75)					
Southeast		15.1000	36.7938	0.6300	0.7000	0.7700	169.7946 (77)					
Southwest		3.1000	36.7938	0.6300	0.7000	0.7700	34.8585 (79)					
Northwest		22.3000	11.2829	0.6300	0.7000	0.7700	76.8952 (81)					
Southeast		0.6000	39.9751	0.6300	0.7000	1.0000	9.5197 (82)					
Northwest		1.0000	16.3666	0.6300	0.7000	1.0000	6.4959 (82)					
-----												
Solar gains	304.4602	550.0288	835.6219	1173.9086	1440.8370	1485.6945	1409.3738	1201.8680	951.4976	630.3306	370.4051	256.8402 (83)
Total gains	1021.7688	1291.4443	1543.1689	1862.2024	2092.1730	2114.9955	2013.3184	1803.3634	1571.7788	1268.8349	1047.1025	956.3439 (84)

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## 7. Mean internal temperature (heating season)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	44.5554	44.6369	44.7171	45.0977	45.1696	45.5075	45.5075	45.5707	45.3768	45.1696	45.0244	44.8735
alpha	3.9704	3.9758	3.9811	4.0065	4.0113	4.0338	4.0338	4.0380	4.0251	4.0113	4.0016	3.9916
util living area	0.9967	0.9913	0.9772	0.9290	0.8188	0.6458	0.4941	0.5639	0.8128	0.9643	0.9930	0.9975 (86)
MIT	19.0656	19.3330	19.7332	20.2642	20.6868	20.9137	20.9772	20.9620	20.7765	20.1979	19.5334	19.0229 (87)
Th 2	20.0278	20.0294	20.0310	20.0384	20.0398	20.0462	20.0462	20.0474	20.0437	20.0398	20.0370	20.0340 (88)
util rest of house	0.9959	0.9891	0.9715	0.9110	0.7749	0.5689	0.3945	0.4603	0.7506	0.9520	0.9910	0.9968 (89)
MIT 2	18.2441	18.5114	18.9087	19.4289	19.8144	19.9996	20.0382	20.0328	19.9030	19.3753	18.7176	18.2060 (90)
Living area fraction	fLA = Living area / (4) =											
MIT	18.3449	18.6122	19.0099	19.5315	19.9215	20.1118	20.1535	20.1469	20.0103	19.4763	18.8178	18.3063 (92)
Temperature adjustment	0.0000											
adjusted MIT	18.3449	18.6122	19.0099	19.5315	19.9215	20.1118	20.1535	20.1469	20.0103	19.4763	18.8178	18.3063 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9938	0.9848	0.9635	0.8994	0.7688	0.5746	0.4061	0.4717	0.7481	0.9424	0.9872	0.9952 (94)
Useful gains	1015.4330	1271.8401	1486.8353	1674.9509	1608.4479	1215.2331	817.6483	850.6199	1175.8183	1195.7629	1033.7489	951.7377 (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	3357.0561	3271.5493	2979.3475	2510.6005	1938.4093	1289.8919	831.6001	875.6375	1387.1169	2092.7787	2771.6355	3347.8265 (97)
Space heating kWh	1742.1676	1343.8046	1110.4291	601.6677	245.4913	0.0000	0.0000	0.0000	0.0000	667.3798	1251.2783	1782.6901 (98a)
Space heating requirement - total per year (kWh/year)	8744.9084											
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	1742.1676	1343.8046	1110.4291	601.6677	245.4913	0.0000	0.0000	0.0000	0.0000	667.3798	1251.2783	1782.6901 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)	8744.9084											
Space heating per m2	(98c) / (4) = 39.0398 (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	2199.8038	1731.7605	1776.1010	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8286	0.8902	0.8475	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1822.7322	1541.6060	1505.2129	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2360.7916	2246.7808	2008.3819	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	387.4028	524.6500	374.3577	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction	fc = cooled area / (4) = 1.0000 (105)											
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	96.8507	131.1625	93.5894	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement	321.6026 (107)											
Energy for space heating	39.0398 (99)											
Energy for space cooling	1.4357 (108)											
Total	40.4755 (109)											
Fabric Energy Efficiency (TFEE)	40.5 (109)											

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

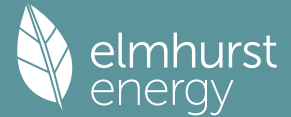
### 1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Main dwelling			
Ground floor	120.0000 (1b)	x 2.4100 (2b)	= 289.2000 (1b) - (3b)
First floor	104.0000 (1c)	x 2.6300 (2c)	= 273.5200 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	224.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	562.7200 (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	6 * 10 = 60.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)

# Full SAP Calculation Printout



Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =											Air changes per hour	60.0000 / (5) =	0.1066 (8)
Pressure test												Yes		
Pressure Test Method												Blower Door		
Measured/design AP50													5.0000 (17)	
Infiltration rate													0.3566 (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) =												0.3031 (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	0.3865	0.3789	0.3713	0.3334	0.3259	0.2880	0.2880	0.2804	0.3031	0.3259	0.3410	0.3562 (22b)	
	0.5747	0.5718	0.5689	0.5556	0.5531	0.5415	0.5415	0.5393	0.5459	0.5531	0.5581	0.5634 (25)	

### 3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Main dwelling								
Doors			2.1000	1.3000	2.7300			(26a)
Windows			42.5000	1.2357	52.5190			(27)
Rooflights			1.6000	1.2357	1.9772			(27a)
Ground Floor			120.0000	0.1200	14.4000	75.0000	9000.0000	(28a)
External Wall	228.5000	44.6000	183.9000	0.1800	33.1020	60.0000	11034.0000	(29a)
Roof (loft)	113.0000		113.0000	0.1100	12.4300	9.0000	1017.0000	(30)
Roof (skelling)	10.5000	1.6000	8.9000	0.1500	1.3350	9.0000	80.1000	(30)
Total net area of external elements Aum(A, m2)			472.0000					(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	118.4932		(33)
Main dwelling								
Internal Wall			165.0000			75.0000	12375.0000	(32c)
Internal Wall			225.0000			9.0000	2025.0000	(32c)
Internal Floor			104.0000			18.0000	1872.0000	(32d)
Internal Ceiling			104.0000			9.0000	936.0000	(32e)
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) =	38339.1000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K								171.1567 (35)

#### List of Thermal Bridges

K1 Element	Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)	39.5000	0.0500	1.9750	
E3 Sill	25.8000	0.0200	0.5160	
E4 Jamb	56.3000	0.0150	0.8445	
E5 Ground floor (normal)	50.1000	0.0530	2.6553	
E6 Intermediate floor within a dwelling	43.4000	0.0010	0.0434	
E10 Eaves (insulation at ceiling level)	10.2000	0.0560	0.5712	
E11 Eaves (insulation at rafter level)	9.6000	0.0170	0.1632	
E12 Gable (insulation at ceiling level)	17.5000	0.0360	0.6300	
E13 Gable (insulation at rafter level)	7.6000	0.0380	0.2888	
E16 Corner (normal)	26.2000	0.0380	0.9956	
R1 Head of roof window	1.8000	0.2400	0.4320	
R2 Sill of roof window	1.8000	0.2400	0.4320	
R3 Jamb of roof window	5.4000	0.2400	1.2960	

Thermal bridges (Sum(L x Psi) calculated using Appendix K)													10.8430 (36)
Point thermal bridges													0.0000 (36a)
Total fabric heat loss													(33) + (36) + (36a) = 129.3362 (37)

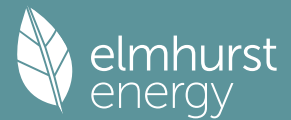
#### Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat transfer coeff	106.7182	106.1796	105.6517	103.1722	102.7083	100.5487	100.5487	100.1488	101.3805	102.7083	103.6468	104.6279 (38)	
Average = Sum(39)m / 12 =	236.0544	235.5158	234.9879	232.5084	232.0445	229.8849	229.8849	229.4850	230.7167	232.0445	232.9830	233.9641 (39)	232.5062
HLP	1.0538	1.0514	1.0491	1.0380	1.0359	1.0263	1.0263	1.0245	1.0300	1.0359	1.0401	1.0445 (40)	
HLP (average)												1.0380	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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

Assumed occupancy												3.0331 (42)	
Hot water usage for mixer showers												93.8444 (42a)	
Hot water usage for baths												32.4081 (42b)	
Hot water usage for other uses												45.6923 (42c)	
Average daily hot water use (litres/day)												158.1072 (43)	
Daily hot water use	171.9448	168.3916	163.9972	157.1540	151.6549	145.7198	143.3200	147.6941	152.3241	158.5704	165.5239	171.4757 (44)	
Energy conte	272.3185	239.7874	252.0576	215.1359	204.1567	179.1795	173.3331	182.8761	187.8309	215.1786	235.8191	268.4894 (45)	
Energy content (annual)												Total = Sum(45)m = 2626.1629	
Distribution loss (46)m = 0.15 x (45)m												40.8478 (46)	
Water storage loss:													
Store volume												300.0000 (47)	
a) If manufacturer declared loss factor is known (kWh/day):												2.0000 (48)	
Temperature factor from Table 2b												0.5400 (49)	
Enter (49) or (54) in (55)												1.0800 (55)	
Total storage loss												33.4800 (56)	
If cylinder contains dedicated solar storage												33.4800 (57)	
Primary loss												23.2624 (59)	
Combi loss												0.0000 (61)	
Total heat required for water heating calculated for each month												329.0609 (62)	
WWHRS												0.0000 (63a)	
PV diverter												0.0000 (63b)	

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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	329.0609	291.0386	308.8000	270.0479	260.8991	234.0915	230.0755	239.6185	242.7429	271.9210	290.7311	325.2318	(64)
	Total per year (kWh/year) = Sum(64)m =											3294.2589 (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	135.9398	120.7303	129.2031	115.4623	113.2760	103.5068	103.0272	106.2002	106.3834	116.9408	122.3395	134.6667	(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	(66)
	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878	
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	48.5669	43.1367	35.0811	26.5586	19.8529	16.7607	18.1105	23.5407	31.5962	40.1187	46.8244	49.9167	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	587.0445	593.1361	577.7853	545.1052	503.8523	465.0805	439.1786	433.0869	448.4377	481.1179	522.3707	561.1425	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319	(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)	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	(71)
Water heating gains (Table 5)	182.7148	179.6582	173.6601	160.3643	152.2527	143.7594	138.4774	142.7422	147.7547	157.1785	169.9159	181.0036	(72)
Total internal gains	935.2206	932.8255	903.4209	848.9226	792.8524	742.4951	712.6609	716.2643	744.6832	795.3096	856.0055	908.9573	(73)

## 6. Solar gains

[Jan]	Area	Solar flux	g	FF	Access	Gains
	m2	Table 6a	Specific data	Specific data	factor	W
		W/m2	or Table 6b	or Table 6c	Table 6d	
Northeast	2.0000	11.2829	0.6300	0.0000	0.7700	10.9467 (75)
Southeast	15.1000	36.7938	0.6300	0.0000	0.7700	269.5152 (77)
Southwest	3.1000	36.7938	0.6300	0.0000	0.7700	55.3309 (79)
Northwest	22.3000	11.2829	0.6300	0.0000	0.7700	122.0558 (81)
Southeast	0.6000	39.9751	0.6300	0.7000	1.0000	9.5197 (82)
Northwest	1.0000	16.3666	0.6300	0.7000	1.0000	6.4959 (82)

Solar gains	473.8642	854.9323	1296.2219	1817.3888	2228.0136	2296.3969	2178.8182	1859.6414	1474.7253	979.0205	576.2887	399.8885	(83)
Total gains	1409.0848	1787.7578	2199.6428	2666.3114	3020.8661	3038.8920	2891.4791	2575.9057	2219.4085	1774.3300	1432.2943	1308.8458	(84)

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)	
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	45.1157	45.2188	45.3204	45.8037	45.8953	46.3264	46.3264	46.4072	46.1594	45.8953	45.7104	45.5187	
alpha	4.0077	4.0146	4.0214	4.0536	4.0597	4.0884	4.0884	4.0938	4.0773	4.0597	4.0474	4.0346	
util living area	0.9895	0.9736	0.9314	0.8230	0.6507	0.4709	0.3467	0.4035	0.6531	0.9037	0.9791	0.9921	(86)
MIT	19.6757	19.9183	20.2573	20.6197	20.8293	20.9047	20.9200	20.9165	20.8541	20.5258	20.0218	19.6319	(87)
Th 2	20.0387	20.0407	20.0427	20.0518	20.0535	20.0615	20.0615	20.0630	20.0584	20.0535	20.0500	20.0464	(88)
util rest of house	0.9872	0.9678	0.9171	0.7908	0.5992	0.4065	0.2742	0.3241	0.5827	0.8772	0.9736	0.9903	(89)
MIT 2	18.4798	18.7882	19.2114	19.6485	19.8750	19.9519	19.9627	19.9625	19.9098	19.5539	18.9294	18.4299	(90)
Living area fraction	fLA = Living area / (4) =											0.1228 (91)	
MIT	18.6267	18.9269	19.3398	19.7677	19.9921	20.0688	20.0802	20.0796	20.0257	19.6732	19.0635	18.5775	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6267	18.9269	19.3398	19.7677	19.9921	20.0688	20.0802	20.0796	20.0257	19.6732	19.0635	18.5775	(93)

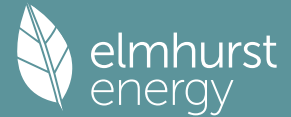
## 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.9823	0.9591	0.9044	0.7800	0.5957	0.4071	0.2756	0.3255	0.5801	0.8644	0.9660	0.9863	(94)
Useful gains	1384.1676	1714.6719	1989.4017	2079.7388	1799.4958	1237.0067	797.0182	838.4931	1287.5493	1533.8091	1383.5593	1290.9530	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	14.1000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	3381.8717	3303.5651	3017.1961	2526.8409	1924.1439	1257.2035	800.0501	844.4169	1367.1665	2105.3881	2787.2885	3363.8137	(97)
Space heating kWh	1486.2918	1067.7362	764.6790	321.9135	92.7382	0.0000	0.0000	0.0000	0.0000	425.2548	1010.6850	1542.2083	(98a)
Space heating requirement - total per year (kWh/year)												6711.5068	
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	1486.2918	1067.7362	764.6790	321.9135	92.7382	0.0000	0.0000	0.0000	0.0000	425.2548	1010.6850	1542.2083	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												6711.5068	
Space heating per m2												(98c) / (4) =	29.9621 (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 %)												219.3000 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												37.0000 (208)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

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Space heating requirement	1486.2918	1067.7362	764.6790	321.9135	92.7382	0.0000	0.0000	0.0000	0.0000	425.2548	1010.6850	1542.2083	(98)
Space heating efficiency (main heating system 1)	219.3000	219.3000	219.3000	219.3000	219.3000	0.0000	0.0000	0.0000	0.0000	219.3000	219.3000	219.3000	(210)
Space heating fuel (main heating system)	677.7436	486.8838	348.6908	146.7914	42.2883	0.0000	0.0000	0.0000	0.0000	193.9146	460.8687	703.2414	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating requirement	329.0609	291.0386	308.8000	270.0479	260.8991	234.0915	230.0755	239.6185	242.7429	271.9210	290.7311	325.2318	(64)
Efficiency of water heater (217)m	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	(216)
Fuel for water heating, kWh/month	172.8261	152.8564	162.1849	141.8319	137.0268	122.9472	120.8380	125.8501	127.4910	142.8156	152.6949	170.8150	(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 (231)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(231)
Lighting (232)m	42.5103	34.1033	30.7063	22.4967	17.3771	14.1973	15.8520	20.6050	26.7639	35.1157	39.6631	43.6918	(232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity) (233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												3060.4226	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												190.4000	(219)
Water heating fuel used												1730.1780	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
Total electricity for the above, kWh/year												0.0000	(231)
Electricity for lighting (calculated in Appendix L)												343.0824	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												0.0000	(233)
Wind generation												0.0000	(234)
Hydro-electric generation (Appendix N)												0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)												0.0000	(235)
Appendix Q - special features													
Energy saved or generated												-0.0000	(236)
Energy used												0.0000	(237)
Total delivered energy for all uses												5133.6830	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3060.4226	16.4900	504.6637	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1730.1780	16.4900	285.3063	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(249)
Energy for lighting	343.0824	16.4900	56.5743	(250)
Additional standing charges			0.0000	(251)
Total energy cost			846.5443	(255)

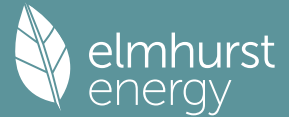
## 11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600	(256)
Energy cost factor (ECF)		1.1329	(257)
SAP value	$[(255) \times (256)] / [(4) + 45.0] =$	81.6353	
SAP rating (Section 12)		82	(258)
SAP band		B	

## 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	3060.4226	0.1565	478.8884	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1730.1780	0.1410	243.9500	(264)
Space and water heating			722.8384	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	343.0824	0.1443	49.5174	(268)
Total CO2, kg/year			772.3558	(272)
CO2 emissions per m2			3.4500	(273)
EI value			96.1526	
EI rating			96	(274)
EI band			A	

# 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

## 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Main dwelling			
Ground floor	120.0000 (1b)	x 2.4100 (2b)	= 289.2000 (1b) - (3b)
First floor	104.0000 (1c)	x 2.6300 (2c)	= 273.5200 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	224.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	562.7200 (5)

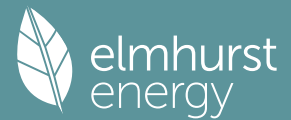
## 2. Ventilation rate

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	6 * 10 =											60.0000 (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) =											60.0000 / (5) =	0.1066 (8)
Pressure test												Yes	
Pressure Test Method												Blower Door	
Measured/design AP50												5.0000 (17)	
Infiltration rate												0.3566 (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) =											0.3031 (21)	
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	3.9000	3.5000	3.5000	3.4000	3.4000	3.1000	3.2000	3.0000	2.9000	3.1000	3.0000	3.3000	
Wind factor	0.9750	0.8750	0.8750	0.8500	0.8500	0.7750	0.8000	0.7500	0.7250	0.7750	0.7500	0.8250	
Adj infiltr rate													
	0.2956	0.2652	0.2652	0.2577	0.2577	0.2349	0.2425	0.2273	0.2198	0.2349	0.2273	0.2501	
Effective ac	0.5437	0.5352	0.5352	0.5332	0.5332	0.5276	0.5294	0.5258	0.5241	0.5276	0.5258	0.5313	

## 3. Heat losses and heat loss parameter

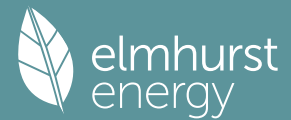
Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K					
Main dwelling												
Doors			2.1000	1.3000	2.7300		(26a)					
Windows			42.5000	1.2357	52.5190		(27)					
Rooflights			1.6000	1.2357	1.9772		(27a)					
Ground Floor			120.0000	0.1200	14.4000	75.0000	9000.0000 (28a)					
External Wall	228.5000	44.6000	183.9000	0.1800	33.1020	60.0000	11034.0000 (29a)					
Roof (loft)	113.0000		113.0000	0.1100	12.4300	9.0000	1017.0000 (30)					
Roof (skelling)	10.5000	1.6000	8.9000	0.1500	1.3350	9.0000	80.1000 (30)					
Total net area of external elements Aum(A, m <sup>2</sup> )			472.0000				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	118.4932		(33)					
Main dwelling												
Internal Wall			165.0000			75.0000	12375.0000 (32c)					
Internal Wall			225.0000			9.0000	2025.0000 (32c)					
Internal Floor			104.0000			18.0000	1872.0000 (32d)					
Internal Ceiling			104.0000			9.0000	936.0000 (32e)					
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	38339.1000 (34)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							171.1567 (35)					
List of Thermal Bridges												
K1 Element				Length	Psi-value	Total						
E2 Other lintels (including other steel lintels)				39.5000	0.0500	1.9750						
E3 Sill				25.8000	0.0200	0.5160						
E4 Jamb				56.3000	0.0150	0.8445						
E5 Ground floor (normal)				50.1000	0.0530	2.6553						
E6 Intermediate floor within a dwelling				43.4000	0.0010	0.0434						
E10 Eaves (insulation at ceiling level)				10.2000	0.0560	0.5712						
E11 Eaves (insulation at rafter level)				9.6000	0.0170	0.1632						
E12 Gable (insulation at ceiling level)				17.5000	0.0360	0.6300						
E13 Gable (insulation at rafter level)				7.6000	0.0380	0.2888						
E16 Corner (normal)				26.2000	0.0380	0.9956						
R1 Head of roof window				1.8000	0.2400	0.4320						
R2 Sill of roof window				1.8000	0.2400	0.4320						
R3 Jamb of roof window				5.4000	0.2400	1.2960						
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.8430 (36)					
Point Thermal bridges						(36a) =	0.0000					
Total fabric heat loss						(33) + (36) + (36a) =	129.3362 (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	100.9593	99.3809	99.3809	99.0130	99.0130	97.9732	98.3091	97.6479	97.3333	97.9732	97.6479	98.6557
Average = Sum(39)m / 12 =	230.2955	228.7171	228.7171	228.3492	228.3492	227.3094	227.6453	226.9841	226.6695	227.3094	226.9841	227.9919
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.0281	1.0211	1.0211	1.0194	1.0194	1.0148	1.0163	1.0133	1.0119	1.0148	1.0133	1.0178

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Days in mont	31	28	31	30	31	30	31	31	30	31	30	31
<b>4. Water heating energy requirements (kWh/year)</b>												
Assumed occupancy												3.0331 (42)
Hot water usage for mixer showers	93.8444	92.4341	90.3790	86.4470	83.5452	80.3092	78.4699	80.5094	82.7451	86.2196	90.2361	93.4848 (42a)
Hot water usage for baths	32.4081	31.9268	31.2490	29.9993	29.0636	28.0260	27.4655	28.1385	28.8714	29.9816	31.2571	32.2986 (42b)
Hot water usage for other uses	45.6923	44.0307	42.3692	40.7077	39.0461	37.3846	37.3846	39.0461	40.7077	42.3692	44.0307	45.6923 (42c)
Average daily hot water use (litres/day)												158.1072 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	171.9448	168.3916	163.9972	157.1540	151.6549	145.7198	143.3200	147.6941	152.3241	158.5704	165.5239	171.4757 (44)
Energy content (annual)	272.3185	239.7874	252.0576	215.1359	204.1567	179.1795	173.3331	182.8761	187.8309	215.1786	235.8191	268.4894 (45)
Distribution loss (46)m = 0.15 x (45)m												Total = Sum(45)m = 2626.1629
Water storage loss:	40.8478	35.9681	37.8086	32.2704	30.6235	26.8769	26.0000	27.4314	28.1746	32.2768	35.3729	40.2734 (46)
Store volume												300.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												2.0000 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												1.0800 (55)
Total storage loss	33.4800	30.2400	33.4800	32.4000	33.4800	32.4000	33.4800	33.4800	32.4000	33.4800	32.4000	33.4800 (56)
If cylinder contains dedicated solar storage	33.4800	30.2400	33.4800	32.4000	33.4800	32.4000	33.4800	33.4800	32.4000	33.4800	32.4000	33.4800 (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	329.0609	291.0386	308.8000	270.0479	260.8991	234.0915	230.0755	239.6185	242.7429	271.9210	290.7311	325.2318 (62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63a)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63d)
Output from w/h	329.0609	291.0386	308.8000	270.0479	260.8991	234.0915	230.0755	239.6185	242.7429	271.9210	290.7311	325.2318 (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	135.9398	120.7303	129.2031	115.4623	113.2760	103.5068	103.0272	106.2002	106.3834	116.9408	122.3395	134.6667 (65)
<b>5. Internal gains (see Table 5 and 5a)</b>												
Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	48.5669	43.1367	35.0811	26.5586	19.8529	16.7607	18.1105	23.5407	31.5962	40.1187	46.8244	49.9167 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	587.0445	593.1361	577.7853	545.1052	503.8523	465.0805	439.1786	433.0869	448.4377	481.1179	522.3707	561.1425 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319 (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)	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252 (71)
Water heating gains (Table 5)	182.7148	179.6582	173.6601	160.3643	152.2527	143.7594	138.4774	142.7422	147.7547	157.1785	169.9159	181.0036 (72)
Total internal gains	935.2206	932.8255	903.4209	848.9226	792.8524	742.4951	712.6609	716.2643	744.6832	795.3096	856.0055	908.9573 (73)
<b>6. Solar gains</b>												
[Jan]												
	Area	Solar flux	g	FF	Access	Gains						
	m2	Table 6a	W/m2	Specific data	factor	W						
				or Table 6b	Table 6c							
				Specific data	Table 6d							
				or Table 6c								
Northeast	2.0000	14.6130	0.6300	0.0000	0.7700	14.1776 (75)						
Southeast	15.1000	45.0642	0.6300	0.0000	0.7700	330.0956 (77)						
Southwest	3.1000	45.0642	0.6300	0.0000	0.7700	67.7680 (79)						
Northwest	22.3000	14.6130	0.6300	0.0000	0.7700	158.0799 (81)						
Southeast	0.6000	50.1759	0.6300	0.7000	1.0000	11.9489 (82)						
Northwest	1.0000	21.2590	0.6300	0.7000	1.0000	8.4377 (82)						
Solar gains	590.5076	910.8155	1389.1928	2015.4983	2396.7268	2676.0702	2499.9805	2142.4936	1690.1303	1128.3062	700.0020	489.3220 (83)
Total gains	1525.7282	1843.6410	2292.6137	2864.4209	3189.5793	3418.5653	3212.6415	2858.7580	2434.8134	1923.6158	1556.0076	1398.2793 (84)
<b>7. Mean internal temperature (heating season)</b>												
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	46.2439	46.5630	46.5630	46.6380	46.6380	46.8513	46.7822	46.9185	46.9836	46.8513	46.9185	46.7111
alpha	4.0829	4.1042	4.1042	4.1092	4.1092	4.1234	4.1188	4.1279	4.1322	4.1234	4.1279	4.1141
util living area	0.9835	0.9667	0.9084	0.7640	0.5693	0.3684	0.2614	0.2925	0.5504	0.8484	0.9650	0.9877 (86)
MIT	19.8595	20.0434	20.3948	20.7201	20.8744	20.9183	20.9238	20.9233	20.8930	20.6643	20.2085	19.8165 (87)
Th 2	20.0600	20.0658	20.0658	20.0672	20.0672	20.0710	20.0698	20.0722	20.0734	20.0710	20.0722	20.0685 (88)
util rest of house	0.9796	0.9595	0.8899	0.7256	0.5148	0.3089	0.1961	0.2198	0.4774	0.8099	0.9558	0.9848 (89)
MIT 2	18.7297	18.9652	19.3977	19.7732	19.9307	19.9712	19.9732	19.9756	19.9565	19.7273	19.1811	18.6819 (90)
Living area fraction												fLA = Living area / (4) = 0.1228 (91)

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MIT	18.8685	19.0975	19.5201	19.8895	20.0466	20.0874	20.0899	20.0920	20.0715	19.8424	19.3072	18.8212 (92)
Temperature adjustment												0.0000
adjusted MIT	18.8685	19.0975	19.5201	19.8895	20.0466	20.0874	20.0899	20.0920	20.0715	19.8424	19.3072	18.8212 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9732	0.9500	0.8772	0.7177	0.5136	0.3099	0.1975	0.2213	0.4772	0.7990	0.9460	0.9795	(94)
Useful gains	1484.7974	1751.3778	2011.1241	2055.7062	1638.0431	1059.4911	634.4591	632.7487	1161.9085	1537.0060	1471.9112	1369.6569	(95)
Ext temp.	5.1000	5.4000	7.2000	9.6000	12.6000	15.4000	17.3000	17.3000	14.8000	11.5000	8.0000	5.1000	(96)
Heat loss rate W													
Space heating	3170.8120	3132.8606	2817.8255	2349.5898	1700.4237	1065.5001	635.1012	633.7315	1194.8861	1896.2951	2566.5633	3128.3156	(97)
Space heating requirement - total per year (kWh/year)	1254.3949	928.3565	600.1858	211.5961	46.4112	0.0000	0.0000	0.0000	0.0000	267.3111	788.1495	1308.4421	(98a)
Solar heating kWh													
Solar heating contribution - total per year (kWh/year)	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)
Space heating requirement after solar contribution - total per year (kWh/year)	1254.3949	928.3565	600.1858	211.5961	46.4112	0.0000	0.0000	0.0000	0.0000	267.3111	788.1495	1308.4421	(98c)
Space heating per m2										(98c) / (4) =		24.1288	(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 %)													219.3000	(206)
Efficiency of main space heating system 2 (in %)													0.0000	(207)
Efficiency of secondary/supplementary heating system, %													37.0000	(208)
Space heating requirement	1254.3949	928.3565	600.1858	211.5961	46.4112	0.0000	0.0000	0.0000	0.0000	267.3111	788.1495	1308.4421	(98)	
Space heating efficiency (main heating system 1)	219.3000	219.3000	219.3000	219.3000	219.3000	0.0000	0.0000	0.0000	0.0000	219.3000	219.3000	219.3000	(210)	
Space heating fuel (main heating system)	571.9995	423.3272	273.6825	96.4871	21.1633	0.0000	0.0000	0.0000	0.0000	121.8929	359.3933	596.6448	(211)	
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)	
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)	
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)	
Water heating requirement	329.0609	291.0386	308.8000	270.0479	260.8991	234.0915	230.0755	239.6185	242.7429	271.9210	290.7311	325.2318	(64)	
Efficiency of water heater (217)m	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	(216)	
Fuel for water heating, kWh/month	172.8261	152.8564	162.1849	141.8319	137.0268	122.9472	120.8380	125.8501	127.4910	142.8156	152.6949	170.8150	(219)	
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)	
Pumps and Fa	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(231)	
Lighting	42.5103	34.1033	30.7063	22.4967	17.3771	14.1973	15.8520	20.6050	26.7639	35.1157	39.6631	43.6918	(232)	
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233a)	
Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)	
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)	
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)	
Electricity generated by PVs (Appendix M) (negative quantity) (233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)	
Electricity generated by wind turbines (Appendix M) (negative quantity) (234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)	
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)	
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)	
Annual totals kWh/year														
Space heating fuel - main system 1													2464.5906	(211)
Space heating fuel - main system 2													0.0000	(213)
Space heating fuel - secondary													0.0000	(215)
Efficiency of water heater													190.4000	
Water heating fuel used													1730.1780	(219)
Space cooling fuel													0.0000	(221)
Electricity for pumps and fans:														
Total electricity for the above, kWh/year													0.0000	(231)
Electricity for lighting (calculated in Appendix L)													343.0824	(232)
Energy saving/generation technologies (Appendices M ,N and Q)														
PV generation													0.0000	(233)
Wind generation													0.0000	(234)
Hydro-electric generation (Appendix N)													0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)													0.0000	(235)
Appendix Q - special features														
Energy saved or generated													-0.0000	(236)
Energy used													0.0000	(237)
Total delivered energy for all uses													4537.8509	(238)

## 10a. Fuel costs - using BEDF prices (572)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	2464.5906	26.0600	642.2723
Total CO2 associated with community systems			0.0000
Water heating (other fuel)	1730.1780	26.0600	450.8844
Energy for instantaneous electric shower(s)	0.0000	26.0600	0.0000

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Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (249)
Energy for lighting	343.0824	26.0600	89.4073 (250)
Additional standing charges			0.0000 (251)
Total energy cost			1182.5640 (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	2464.5906	0.1572	387.5318 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1730.1780	0.1410	243.9500 (264)
Space and water heating			631.4818 (265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (267)
Energy for lighting	343.0824	0.1443	49.5174 (268)
Total CO2, kg/year			680.9992 (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	2464.5906	1.5821	3899.2126 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1730.1780	1.5214	2632.2251 (278)
Space and water heating			6531.4376 (279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (281)
Energy for lighting	343.0824	1.5338	526.2312 (282)
Total Primary energy kWh/year			7057.6689 (286)

## SAP 10 EPC IMPROVEMENTS

CJ5701B

Current energy efficiency rating: B 82  
 Current environmental impact rating: A 96

N Solar water heating Recommended  
 U Solar photovoltaic panels Recommended  
 V2 Wind turbine Not applicable

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.0	-£ 94	-45 kg (6.6%)
U Solar photovoltaic panels	+ 3.6	-£ 280	-144 kg (22.7%)

Recommended measures	Typical annual savings	Energy efficiency impact	Environmental impact
Solar water heating	£94	0.20 kg/m <sup>2</sup>	B 83 A 96
Solar photovoltaic panels	£280	0.64 kg/m <sup>2</sup>	B 86 A 97
<b>Total Savings</b>	<b>£373</b>	<b>0.84 kg/m<sup>2</sup></b>	

Potential energy efficiency rating: B 86  
 Potential environmental impact rating: A 97

Fuel prices for cost data on this page from database revision number 572 TEST (30 May 2025)  
 Recommendation texts revision number 6.1 (11 Jun 2019)

Typical heating and lighting costs of this home (per year, South East England):

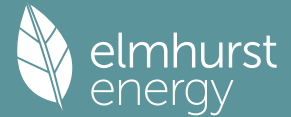
	Current	Potential	Saving
Electricity	£1183	£1089	£94
Space heating	£642	£663	-£21
Water heating	£451	£336	£115
Lighting	£89	£89	£0
Generated (PV)	-£0	-£280	£280
<b>Total cost of fuels</b>	<b>£1183</b>	<b>£809</b>	<b>£374</b>
<b>Total cost of uses</b>	<b>£1182</b>	<b>£808</b>	<b>£374</b>
Delivered energy	20 kWh/m <sup>2</sup>	14 kWh/m <sup>2</sup>	6 kWh/m <sup>2</sup>
Carbon dioxide emissions	0.7 tonnes	0.5 tonnes	0.2 tonnes
CO2 emissions per m <sup>2</sup>	3 kg/m <sup>2</sup>	2 kg/m <sup>2</sup>	1 kg/m <sup>2</sup>
Primary energy	32 kWh/m <sup>2</sup>	22 kWh/m <sup>2</sup>	10 kWh/m <sup>2</sup>

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

### 1. Overall dwelling characteristics

Main dwelling	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	120.0000 (1b)	x 2.4100 (2b)	= 289.2000 (1b) - (3b)
First floor	104.0000 (1c)	x 2.6300 (2c)	= 273.5200 (1c) - (3c)
<b>Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)</b>	<b>224.0000</b>		<b>(4)</b>
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	562.7200 (5)

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## 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												6 * 10 =	60.0000 (7a)
Number of passive vents												0 * 10 =	0.0000 (7b)
Number of flueless gas fires												0 * 40 =	0.0000 (7c)
												Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =												60.0000 / (5) =	0.1066 (8)
Pressure test												Yes	
Pressure Test Method												Blower Door	
Measured/design AP50												5.0000 (17)	
Infiltration rate												0.3566 (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) = 0.3031 (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	0.3865	0.3789	0.3713	0.3334	0.3259	0.2880	0.2880	0.2804	0.3031	0.3259	0.3410	0.3562	(22b)
	0.5747	0.5718	0.5689	0.5556	0.5531	0.5415	0.5415	0.5393	0.5459	0.5531	0.5581	0.5634	(25)

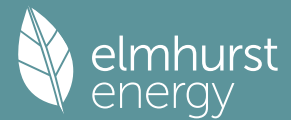
## 3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K						
Main dwelling													
Doors			2.1000	1.3000	2.7300			(26a)					
Windows			42.5000	1.2357	52.5190			(27)					
Rooflights			1.6000	1.2357	1.9772			(27a)					
Ground Floor			120.0000	0.1200	14.4000	75.0000	9000.0000	(28a)					
External Wall	228.5000	44.6000	183.9000	0.1800	33.1020	60.0000	11034.0000	(29a)					
Roof (loft)	113.0000		113.0000	0.1100	12.4300	9.0000	1017.0000	(30)					
Roof (skelling)	10.5000	1.6000	8.9000	0.1500	1.3350	9.0000	80.1000	(30)					
Total net area of external elements Aum(A, m2)			472.0000					(31)					
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	118.4932		(33)					
Main dwelling													
Internal Wall			165.0000			75.0000	12375.0000	(32c)					
Internal Wall			225.0000			9.0000	2025.0000	(32c)					
Internal Floor			104.0000			18.0000	1872.0000	(32d)					
Internal Ceiling			104.0000			9.0000	936.0000	(32e)					
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) =	38339.1000 (34)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K								171.1567 (35)					
List of Thermal Bridges													
K1 Element				Length	Psi-value	Total							
E2 Other lintels (including other steel lintels)				39.5000	0.0500	1.9750							
E3 Sill				25.8000	0.0200	0.5160							
E4 Jamb				56.3000	0.0150	0.8445							
E5 Ground floor (normal)				50.1000	0.0530	2.6553							
E6 Intermediate floor within a dwelling				43.4000	0.0010	0.0434							
E10 Eaves (insulation at ceiling level)				10.2000	0.0560	0.5712							
E11 Eaves (insulation at rafter level)				9.6000	0.0170	0.1632							
E12 Gable (insulation at ceiling level)				17.5000	0.0360	0.6300							
E13 Gable (insulation at rafter level)				7.6000	0.0380	0.2888							
E16 Corner (normal)				26.2000	0.0380	0.9956							
R1 Head of roof window				1.8000	0.2400	0.4320							
R2 Sill of roof window				1.8000	0.2400	0.4320							
R3 Jamb of roof window				5.4000	0.2400	1.2960							
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.8430	(36)					
Point Thermal bridges							(36a) =	0.0000					
Total fabric heat loss							(33) + (36) + (36a) =	129.3362 (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	106.7182	106.1796	105.6517	103.1722	102.7083	100.5487	100.5487	100.1488	101.3805	102.7083	103.6468	104.6279	(38)
Average = Sum(39)m / 12 =													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0538	1.0514	1.0491	1.0380	1.0359	1.0263	1.0263	1.0245	1.0300	1.0359	1.0401	1.0445	(40)
HLP (average)													1.0380
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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

Assumed occupancy													3.0331 (42)
Hot water usage for mixer showers												93.8444	93.4848 (42a)
Hot water usage for baths												32.4081	32.2986 (42b)
Hot water usage for other uses												45.6923	45.6923 (42c)
Average daily hot water use (litres/day)												158.1072	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	171.9448	168.3916	163.9972	157.1540	151.6549	145.7198	143.3200	147.6941	152.3241	158.5704	165.5239	171.4757	(44)

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Energy conte	272.3185	239.7874	252.0576	215.1359	204.1567	179.1795	173.3331	182.8761	187.8309	215.1786	235.8191	268.4894 (45)
Energy content (annual)	Total = Sum(45)m = 2626.1629											
Distribution loss (46)m = 0.15 x (45)m												
	40.8478	35.9681	37.8086	32.2704	30.6235	26.8769	26.0000	27.4314	28.1746	32.2768	35.3729	40.2734 (46)
Water storage loss:												
Store volume												300.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												2.0000 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												1.0800 (55)
Total storage loss												
	33.4800	30.2400	33.4800	32.4000	33.4800	32.4000	33.4800	33.4800	32.4000	33.4800	32.4000	33.4800 (56)
If cylinder contains dedicated solar storage												
	33.4800	30.2400	33.4800	32.4000	33.4800	32.4000	33.4800	33.4800	32.4000	33.4800	32.4000	33.4800 (57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	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												
	329.0609	291.0386	307.4043	263.2943	248.1048	221.4848	217.0485	227.5221	237.3400	270.5252	290.7311	325.2318 (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)
Aperture area of solar collector												3.0000 (H1)
Zero-loss collector efficiency												0.8000 (H2)
Collector linear heat loss coefficient												1.8000 (H3)
Collector 2nd order heat loss coefficient												0.0000 (H4)
Collector loop efficiency												0.9000 (H5)
Incidence angle modifier												1.0000 (H6)
Overshading factor												0.8000 (H8)
Overall heat loss coefficient of system												6.5000 (H10)
Heat loss coefficient of collector loop												3.9667 (H11)
Dedicated solar storage volume												75.0000 (H12)
Effective solar volume												75.0000 (H14)
Reference volume												225.0000 (H15)
Storage tank correction coefficient												1.3161 (H16)
Heat delivered to hot water												647.6800 (H24)
Heat delivered to space heating												0.0000 (H29)
Solar input												647.6800
Solar input	-0.0000	-16.1716	-59.6298	-83.0782	-110.0812	-101.7296	-101.1149	-87.5548	-59.4568	-28.8630	-0.0000	-0.0000 (63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63d)
Output from w/h												
	329.0609	274.8670	247.7745	180.2161	138.0236	119.7551	115.9337	139.9673	177.8832	241.6623	290.7311	325.2318 (64)
	Total per year (kWh/year) = Sum(64)m = 2581.1065 (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												
	135.9398	120.7303	128.0865	110.0594	103.0406	93.4214	92.6056	96.5231	102.0611	115.8242	122.3395	134.6667 (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	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	48.5669	43.1367	35.0811	26.5586	19.8529	16.7607	18.1105	23.5407	31.5962	40.1187	46.8244	49.9167 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	587.0445	593.1361	577.7853	545.1052	503.8523	465.0805	439.1786	433.0869	448.4377	481.1179	522.3707	561.1425 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319 (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)	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252 (71)
Water heating gains (Table 5)	182.7148	179.6582	172.1593	152.8603	138.4954	129.7519	124.4699	129.7353	141.7515	155.6777	169.9159	181.0036 (72)
Total internal gains	935.2206	932.8255	901.9201	841.4186	779.0951	728.4876	698.6535	703.2574	738.6800	793.8088	856.0055	908.9573 (73)

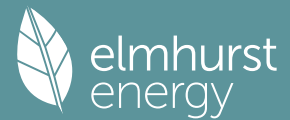
## 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W						
Northeast	2.0000	11.2829	0.6300	0.0000	0.7700	10.9467 (75)						
Southeast	15.1000	36.7938	0.6300	0.0000	0.7700	269.5152 (77)						
Southwest	3.1000	36.7938	0.6300	0.0000	0.7700	55.3309 (79)						
Northwest	22.3000	11.2829	0.6300	0.0000	0.7700	122.0558 (81)						
Southeast	0.6000	39.9751	0.6300	0.7000	1.0000	9.5197 (82)						
Northwest	1.0000	16.3666	0.6300	0.7000	1.0000	6.4959 (82)						
Solar gains	473.8642	854.9323	1296.2219	1817.3888	2228.0136	2296.3969	2178.8182	1859.6414	1474.7253	979.0205	576.2887	399.8885 (83)
Total gains	1409.0848	1787.7578	2198.1420	2658.8074	3007.1087	3024.8845	2877.4717	2562.8988	2213.4053	1772.8292	1432.2943	1308.8458 (84)

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation factor for gains for living area, nil,m (see Table 9a)												21.0000 (85)
tau	45.1157	45.2188	45.3204	45.8037	45.8953	46.3264	46.3264	46.4072	46.1594	45.8953	45.7104	45.5187
alpha	4.0077	4.0146	4.0214	4.0536	4.0597	4.0884	4.0884	4.0938	4.0773	4.0597	4.0474	4.0346
util living area	0.9895	0.9736	0.9315	0.8241	0.6529	0.4729	0.3483	0.4054	0.6544	0.9039	0.9791	0.9921 (86)
MIT	19.6757	19.9183	20.2568	20.6180	20.8281	20.9044	20.9199	20.9164	20.8536	20.5253	20.0218	19.6319 (87)
Th 2	20.0387	20.0407	20.0427	20.0518	20.0535	20.0615	20.0615	20.0630	20.0584	20.0535	20.0500	20.0464 (88)
util rest of house	0.9872	0.9678	0.9172	0.7919	0.6014	0.4083	0.2755	0.3257	0.5840	0.8775	0.9736	0.9903 (89)
MIT 2	18.4798	18.7882	19.2107	19.6467	19.8739	19.9517	19.9627	19.9624	19.9094	19.5534	18.9294	18.4299 (90)
Living area fraction												FLA = Living area / (4) = 0.1228 (91)
MIT	18.6267	18.9269	19.3392	19.7660	19.9911	20.0686	20.0802	20.0795	20.0253	19.6727	19.0635	18.5775 (92)
Temperature adjustment												0.0000
adjusted MIT	18.6267	18.9269	19.3392	19.7660	19.9911	20.0686	20.0802	20.0795	20.0253	19.6727	19.0635	18.5775 (93)

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## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9823	0.9591	0.9046	0.7811	0.5978	0.4088	0.2770	0.3271	0.5814	0.8647	0.9660	0.9863	(94)
Useful gains	1384.1676	1714.6719	1988.3927	2076.8590	1797.6618	1236.6374	796.9541	838.3664	1286.8365	1532.9608	1383.5593	1290.9530	(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	3381.8717	3303.5651	3017.0457	2526.4273	1923.8938	1257.1540	800.0410	844.3992	1367.0689	2105.2633	2787.2885	3363.8137	(97)
Space heating kWh	1486.2918	1067.7362	765.3178	323.6892	93.9166	0.0000	0.0000	0.0000	0.0000	425.7931	1010.6850	1542.2083	(98a)
Space heating requirement - total per year (kWh/year)												6715.6381	
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	1486.2918	1067.7362	765.3178	323.6892	93.9166	0.0000	0.0000	0.0000	0.0000	425.7931	1010.6850	1542.2083	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												6715.6381	
Space heating per m2										(98c) / (4) =		29.9805	(99)

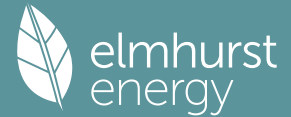
## 9a. Energy requirements - Individual heating systems, including micro-CHP

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 %)													219.3000	(206)
Efficiency of main space heating system 2 (in %)													0.0000	(207)
Efficiency of secondary/supplementary heating system, %													37.0000	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement	1486.2918	1067.7362	765.3178	323.6892	93.9166	0.0000	0.0000	0.0000	0.0000	425.7931	1010.6850	1542.2083	(98)	
Space heating efficiency (main heating system 1)	219.3000	219.3000	219.3000	219.3000	219.3000	0.0000	0.0000	0.0000	0.0000	219.3000	219.3000	219.3000	(210)	
Space heating fuel (main heating system)	677.7436	486.8838	348.9821	147.6011	42.8256	0.0000	0.0000	0.0000	0.0000	194.1601	460.8687	703.2414	(211)	
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)	
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)	
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)	
Water heating														
Water heating requirement	329.0609	274.8670	247.7745	180.2161	138.0236	119.7551	115.9337	139.9673	177.8832	241.6623	290.7311	325.2318	(64)	
Efficiency of water heater (217)m	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	(216)	
Fuel for water heating, kWh/month	172.8261	144.3629	130.1336	94.6513	72.4914	62.8966	60.8895	73.5122	93.4260	126.9235	152.6949	170.8150	(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	6.7945	6.1370	6.7945	6.5753	6.7945	6.5753	6.7945	6.7945	6.5753	6.7945	6.5753	6.7945	(231)	
Lighting	42.5103	34.1033	30.7063	22.4967	17.3771	14.1973	15.8520	20.6050	26.7639	35.1157	39.6631	43.6918	(232)	
Electricity generated by PVs (Appendix M) (negative quantity)														
(233a)m	-41.4025	-63.3657	-96.7430	-111.6558	-119.7892	-110.2340	-108.5987	-100.7531	-87.0069	-72.9129	-46.9090	-35.2380	(233a)	
Electricity generated by wind turbines (Appendix M) (negative quantity)														
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)	
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)														
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)	
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)														
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)	
Electricity generated by PVs (Appendix M) (negative quantity)														
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)	
Electricity generated by wind turbines (Appendix M) (negative quantity)														
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)	
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)														
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)	
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)														
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)	
Annual totals kWh/year														
Space heating fuel - main system 1													3062.3065	(211)
Space heating fuel - main system 2													0.0000	(213)
Space heating fuel - secondary													0.0000	(215)
Efficiency of water heater													190.4000	
Water heating fuel used													1355.6232	(219)
Space cooling fuel													0.0000	(221)
Electricity for pumps and fans:														
pump for solar water heating													80.0000	(230g)
Total electricity for the above, kWh/year													80.0000	(231)
Electricity for lighting (calculated in Appendix L)													343.0824	(232)
Energy saving/generation technologies (Appendices M ,N and Q)														
PV generation													-994.6087	(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													3846.4033	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3062.3065	16.4900	504.9743	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1355.6232	16.4900	223.5423	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(249)
Pump for solar water heating	80.0000	16.4900	13.1920	(249)
Energy for lighting	343.0824	16.4900	56.5743	(250)

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Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-994.6087	16.4900	-164.0110
PV Unit electricity exported	0.0000	5.5900	0.0000
Total			-164.0110 (252)
Total energy cost			634.2719 (255)

## 11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600 (256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	0.8488 (257)
SAP value		86.2403
SAP rating (Section 12)		86 (258)
SAP band		B

## 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	3062.3065	0.1565	479.1531 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1355.6232	0.1449	196.3822 (264)
Space and water heating			675.5353 (265)
Pumps, fans and electric keep-hot	80.0000	0.1387	11.0970 (267)
Energy for lighting	343.0824	0.1443	49.5174 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-994.6087	0.1341	-133.3927
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-133.3927 (269)
Total CO2, kg/year			602.7570 (272)
CO2 emissions per m2			2.6900 (273)
EI value			96.9974
EI rating			97 (274)
EI band			A

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

### 1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Main dwelling			
Ground floor	120.0000 (1b)	x 2.4100 (2b)	= 289.2000 (1b) - (3b)
First floor	104.0000 (1c)	x 2.6300 (2c)	= 273.5200 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	224.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	562.7200 (5)

### 2. Ventilation rate

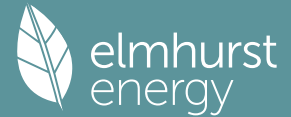
		m3 per hour
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	6 * 10 =	60.0000 (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	$= (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =$	60.0000 / (5) =
Pressure test		0.1066 (8)
Pressure Test Method		Yes
Measured/design AP50		Blower Door
Infiltration rate		5.0000 (17)
Number of sides sheltered		0.3566 (18)
		2 (19)
Shelter factor	(20) = $1 - [0.075 \times (19)] =$	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3031 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	3.9000	3.5000	3.5000	3.4000	3.4000	3.1000	3.2000	3.0000	2.9000	3.1000	3.0000	3.3000 (22)
Wind factor	0.9750	0.8750	0.8750	0.8500	0.8500	0.7750	0.8000	0.7500	0.7250	0.7750	0.7500	0.8250 (22a)
Adj infilt rate												
Effective ac	0.2956	0.2652	0.2652	0.2577	0.2577	0.2349	0.2425	0.2273	0.2198	0.2349	0.2273	0.2501 (22b)
	0.5437	0.5352	0.5352	0.5332	0.5332	0.5276	0.5294	0.5258	0.5241	0.5276	0.5258	0.5313 (25)

### 3. Heat losses and heat loss parameter

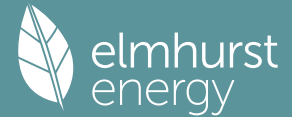
Element	Gross	Openings	NetArea	U-value	A x U	K-value	A x K
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Main dwelling		m2	m2	m2	W/m2K	W/K		kJ/m2K	kJ/K			
Doors				2.1000	1.3000	2.7300				(26a)		
Windows				42.5000	1.2357	52.5190				(27)		
Rooflights				1.6000	1.2357	1.9772				(27a)		
Ground Floor				120.0000	0.1200	14.4000	75.0000	9000.0000		(28a)		
External Wall	228.5000		44.6000	183.9000	0.1800	33.1020	60.0000	11034.0000		(29a)		
Roof (loft)	113.0000			113.0000	0.1100	12.4300	9.0000	1017.0000		(30)		
Roof (skelling)	10.5000		1.6000	8.9000	0.1500	1.3350	9.0000	80.1000		(30)		
Total net area of external elements Aum(A, m2)				472.0000						(31)		
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =		118.4932				(33)		
Main dwelling												
Internal Wall				165.0000			75.0000	12375.0000		(32c)		
Internal Wall				225.0000			9.0000	2025.0000		(32c)		
Internal Floor				104.0000			18.0000	1872.0000		(32d)		
Internal Ceiling				104.0000			9.0000	936.0000		(32e)		
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) =	38339.1000		(34)		
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K								171.1567		(35)		
List of Thermal Bridges												
K1 Element					Length	Psi-value	Total					
E2 Other lintels (including other steel lintels)					39.5000	0.0500	1.9750					
E3 Sill					25.8000	0.0200	0.5160					
E4 Jamb					56.3000	0.0150	0.8445					
E5 Ground floor (normal)					50.1000	0.0530	2.6553					
E6 Intermediate floor within a dwelling					43.4000	0.0010	0.0434					
E10 Eaves (insulation at ceiling level)					10.2000	0.0560	0.5712					
E11 Eaves (insulation at rafter level)					9.6000	0.0170	0.1632					
E12 Gable (insulation at ceiling level)					17.5000	0.0360	0.6300					
E13 Gable (insulation at rafter level)					7.6000	0.0380	0.2888					
E16 Corner (normal)					26.2000	0.0380	0.9956					
R1 Head of roof window					1.8000	0.2400	0.4320					
R2 Sill of roof window					1.8000	0.2400	0.4320					
R3 Jamb of roof window					5.4000	0.2400	1.2960					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)								10.8430		(36)		
Point Thermal bridges								(36a) =	0.0000			
Total fabric heat loss								(33) + (36) + (36a) =	129.3362	(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	100.9593	99.3809	99.3809	99.0130	99.0130	97.9732	98.3091	97.6479	97.3333	97.9732	97.6479	98.6557
Average = Sum(39)m / 12 =	230.2955	228.7171	228.7171	228.3492	228.3492	227.3094	227.6453	226.9841	226.6695	227.3094	226.9841	227.9919
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.0281	1.0211	1.0211	1.0194	1.0194	1.0148	1.0163	1.0133	1.0119	1.0148	1.0133	1.0178
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31
-----												
4. Water heating energy requirements (kWh/year)												
-----												
Assumed occupancy												3.0331 (42)
Hot water usage for mixer showers												
Hot water usage for baths												
Hot water usage for other uses												
Average daily hot water use (litres/day)												158.1072 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	171.9448	168.3916	163.9972	157.1540	151.6549	145.7198	143.3200	147.6941	152.3241	158.5704	165.5239	171.4757
Energy content (annual)	272.3185	239.7874	252.0576	215.1359	204.1567	179.1795	173.3331	182.8761	187.8309	215.1786	235.8191	268.4894
Distribution loss (46)m = 0.15 x (45)m												2626.1629
Water storage loss:												
Store volume												300.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												2.0000 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												1.0800 (55)
Total storage loss												
If cylinder contains dedicated solar storage												
Primary loss	33.4800	30.2400	33.4800	32.4000	33.4800	32.4000	33.4800	33.4800	32.4000	33.4800	32.4000	33.4800
Combi loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624
Total heat required for water heating calculated for each month	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
WWHRS	329.0609	291.0386	307.4043	263.2943	248.1048	221.4848	217.0485	227.5221	237.3400	270.5252	290.7311	325.2318
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
Aperture area of solar collector	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000
Zero-loss collector efficiency												3.0000 (H1)
Collector linear heat loss coefficient												0.8000 (H2)
Collector 2nd order heat loss coefficient												1.8000 (H3)
Collector loop efficiency												0.9000 (H5)
Incidence angle modifier												1.0000 (H6)
Overshading factor												0.8000 (H8)
Overall heat loss coefficient of system												6.5000 (H10)
Heat loss coefficient of collector loop												3.9667 (H11)
Dedicated solar storage volume												75.0000 (H12)
Effective solar volume												75.0000 (H14)
Reference volume												225.0000 (H15)
Storage tank correction coefficient												1.3161 (H16)
Heat delivered to hot water												773.0287 (H24)
Heat delivered to space heating												0.0000 (H29)
Solar input												773.0287
Solar input	-3.0056	-20.7991	-67.5165	-95.4999	-119.8214	-120.8181	-118.0714	-104.6856	-73.8426	-41.7067	-7.2618	-0.0000
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
Output from w/h	326.0552	270.2395	239.8878	167.7945	128.2833	100.6667	98.9772	122.8365	163.4974	228.8185	283.4693	325.2318
Electric shower(s)												
Total Energy used by instantaneous electric shower (s) (kWh/year) = Sum(64a)m =												2455.7578 (64)
Heat gains from water heating, kWh/month												
	135.9398	120.7303	128.0865	110.0594	103.0406	93.4214	92.6056	96.5231	102.0611	115.8242	122.3395	134.6667

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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	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	48.5669	43.1367	35.0811	26.5586	19.8529	16.7607	18.1105	23.5407	31.5962	40.1187	46.8244	49.9167 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	587.0445	593.1361	577.7853	545.1052	503.8523	465.0805	439.1786	433.0869	448.4377	481.1179	522.3707	561.1425 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319 (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)	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252 (71)
Water heating gains (Table 5)	182.7148	179.6582	172.1593	152.8603	138.4954	129.7519	124.4699	129.7353	141.7515	155.6777	169.9159	181.0036 (72)
Total internal gains	935.2206	932.8255	901.9201	841.4186	779.0951	728.4876	698.6535	703.2574	738.6800	793.8088	856.0055	908.9573 (73)

## 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W						
Northeast	2.0000	14.6130	0.6300	0.0000	0.7700	14.1776 (75)						
Southeast	15.1000	45.0642	0.6300	0.0000	0.7700	330.0956 (77)						
Southwest	3.1000	45.0642	0.6300	0.0000	0.7700	67.7680 (79)						
Northwest	22.3000	14.6130	0.6300	0.0000	0.7700	158.0799 (81)						
Southeast	0.6000	50.1759	0.6300	0.7000	1.0000	11.9489 (82)						
Northwest	1.0000	21.2590	0.6300	0.7000	1.0000	8.4377 (82)						
Solar gains	590.5076	910.8155	1389.1928	2015.4983	2396.7268	2676.0702	2499.9805	2142.4936	1690.1303	1128.3062	700.0020	489.3220 (83)
Total gains	1525.7282	1843.6410	2291.1129	2856.9169	3175.8219	3404.5579	3198.6340	2845.7510	2428.8102	1922.1150	1556.0076	1398.2793 (84)

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation factor for gains for living area, nil,m (see Table 9a)												21.0000 (85)
tau	46.2439	46.5630	46.5630	46.6380	46.6380	46.8513	46.7822	46.9185	46.9836	46.8513	46.9185	46.7111
alpha	4.0829	4.1042	4.1042	4.1092	4.1092	4.1234	4.1188	4.1279	4.1322	4.1234	4.1279	4.1141
util living area	0.9835	0.9667	0.9086	0.7652	0.5714	0.3698	0.2625	0.2938	0.5516	0.8486	0.9650	0.9877 (86)
MIT	19.8595	20.0434	20.3943	20.7189	20.8737	20.9182	20.9237	20.9233	20.8927	20.6639	20.2085	19.8165 (87)
Th 2	20.0600	20.0658	20.0658	20.0672	20.0672	20.0710	20.0698	20.0722	20.0734	20.0710	20.0722	20.0685 (88)
util rest of house	0.9796	0.9595	0.8901	0.7268	0.5168	0.3101	0.1969	0.2208	0.4784	0.8102	0.9558	0.9848 (89)
MIT 2	18.7297	18.9652	19.3971	19.7720	19.9302	19.9711	19.9732	19.9756	19.9564	19.7269	19.1811	18.6819 (90)
Living area fraction									FLA = Living area / (4) =			0.1228 (91)
MIT	18.8685	19.0975	19.5196	19.8882	20.0460	20.0874	20.0899	20.0920	20.0713	19.8420	19.3072	18.8212 (92)
Temperature adjustment												0.0000
adjusted MIT	18.8685	19.0975	19.5196	19.8882	20.0460	20.0874	20.0899	20.0920	20.0713	19.8420	19.3072	18.8212 (93)

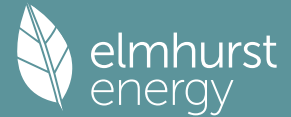
## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9732	0.9500	0.8774	0.7188	0.5155	0.3112	0.1983	0.2223	0.4783	0.7993	0.9460	0.9795 (94)
Useful gains	1484.7974	1751.3778	2010.2312	2053.6424	1637.0709	1059.3858	634.4463	632.7283	1161.6023	1536.3824	1471.9112	1369.6569 (95)
Ext temp.	5.1000	5.4000	7.2000	9.6000	12.6000	15.4000	17.3000	17.3000	14.8000	11.5000	8.0000	5.1000 (96)
Heat loss rate W	3170.8120	3132.8606	2817.6957	2349.3033	1700.2945	1065.4860	635.0993	633.7285	1194.8451	1896.2063	2566.5633	3128.3156 (97)
Space heating kWh	1254.3949	928.3565	600.7536	212.8758	47.0383	0.0000	0.0000	0.0000	0.0000	267.7090	788.1495	1308.4421 (98a)
Space heating requirement - total per year (kWh/year)												5407.7196
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	1254.3949	928.3565	600.7536	212.8758	47.0383	0.0000	0.0000	0.0000	0.0000	267.7090	788.1495	1308.4421 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												5407.7196
Space heating per m2												(98c) / (4) = 24.1416 (99)

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

Fraction of space heat from secondary/supplementary system (Table 11)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Fraction of space heat from main system(s)												0.0000 (201)
Efficiency of main space heating system 1 (in %)												1.0000 (202)
Efficiency of main space heating system 2 (in %)												219.3000 (206)
Efficiency of secondary/supplementary heating system, %												0.0000 (207)
												37.0000 (208)
Space heating requirement	1254.3949	928.3565	600.7536	212.8758	47.0383	0.0000	0.0000	0.0000	0.0000	267.7090	788.1495	1308.4421 (98)
Space heating efficiency (main heating system 1)	219.3000	219.3000	219.3000	219.3000	219.3000	0.0000	0.0000	0.0000	0.0000	219.3000	219.3000	219.3000 (210)
Space heating fuel (main heating system)	571.9995	423.3272	273.9414	97.0706	21.4493	0.0000	0.0000	0.0000	0.0000	122.0743	359.3933	596.6448 (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)

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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	0.0000	(215)
Water heating														
Water heating requirement	326.0552	270.2395	239.8878	167.7945	128.2833	100.6667	98.9772	122.8365	163.4974	228.8185	283.4693	325.2318		(64)
Efficiency of water heater														
(217)m	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000		(216)
Fuel for water heating, kWh/month	171.2475	141.9325	125.9915	88.1273	67.3757	52.8711	51.9838	64.5150	85.8705	120.1778	148.8810	170.8150		(217)
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	6.7945	6.1370	6.7945	6.5753	6.7945	6.5753	6.7945	6.7945	6.5753	6.7945	6.5753	6.7945		(231)
Lighting	42.5103	34.1033	30.7063	22.4967	17.3771	14.1973	15.8520	20.6050	26.7639	35.1157	39.6631	43.6918		(232)
Electricity generated by PVs (Appendix M) (negative quantity)														
(233a)m	-50.3676	-66.5932	-100.4103	-116.7102	-122.6110	-119.1503	-116.4131	-108.9011	-94.8920	-79.9052	-55.1717	-42.3263		(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)														
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)														
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)														
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		(235c)
Electricity generated by PVs (Appendix M) (negative quantity)														
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)														
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)														
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)														
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		(235d)
Annual totals kWh/year														
Space heating fuel - main system 1													2465.9004	(211)
Space heating fuel - main system 2													0.0000	(213)
Space heating fuel - secondary													0.0000	(215)
Efficiency of water heater													190.4000	
Water heating fuel used													1289.7887	(219)
Space cooling fuel													0.0000	(221)
Electricity for pumps and fans:														
pump for solar water heating													80.0000	(230g)
Total electricity for the above, kWh/year													80.0000	(231)
Electricity for lighting (calculated in Appendix L)													343.0824	(232)
Energy saving/generation technologies (Appendices M ,N and Q)														
PV generation													-1073.4520	(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													3105.3195	(238)

## 10a. Fuel costs - using BEDF prices (572)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2465.9004	26.0600	642.6136	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1289.7887	26.0600	336.1189	(247)
Energy for instantaneous electric shower(s)	0.0000	26.0600	0.0000	(247a)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(249)
Pump for solar water heating	80.0000	26.0600	20.8480	(249)
Energy for lighting	343.0824	26.0600	89.4073	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1073.4520	26.0600	-279.7416	
PV Unit electricity exported	0.0000	5.8100	0.0000	
Total			-279.7416	(252)
Total energy cost			809.2463	(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	2465.9004	0.1572	387.1713	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1289.7887	0.1457	187.8797	(264)
Space and water heating			575.5970	(265)
Pumps, fans and electric keep-hot	80.0000	0.1387	11.0970	(267)
Energy for lighting	343.0824	0.1443	49.5174	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1073.4520	0.1343	-144.1927	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-144.1927	(269)
Total CO2, kg/year			492.0187	(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	2465.9004	1.5821	3901.2095	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1289.7887	1.5388	1984.7759	(278)
Space and water heating			5885.9853	(279)
Pumps, fans and electric keep-hot	80.0000	1.5128	121.0240	(281)
Energy for lighting	343.0824	1.5338	526.2312	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1073.4520	1.4964	-1606.3445	

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PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-1606.3445 (283)
Total Primary energy kWh/year			4926.8960 (286)

# Building Regulations England Part L (BREL) Compliance Report

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

Date: Fri 20 Jun 2025 09:05:32

Project Information			
Assessed By	Joe Solti	Building Type	House, Detached
OCDEA Registration	EES/003578	Assessment Date	2025-06-20

Dwelling Details			
Assessment Type	As designed	Total Floor Area	224 m <sup>2</sup>
Site Reference	CJ5701	Plot Reference	CJ5701C
Address	Crosswinds Plot 1 Hampers Lane, Storrington, RH20 3HZ		

Client Details	
Name	.
Company	.
Address	., ., .

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

1a Target emission rate and dwelling emission rate		
Fuel for main heating system	Electricity	
Target carbon dioxide emission rate	7.93 kgCO <sub>2</sub> /m <sup>2</sup>	
Dwelling carbon dioxide emission rate	2.76 kgCO <sub>2</sub> /m <sup>2</sup>	OK
1b Target primary energy rate and dwelling primary energy		
Target primary energy	42.01 kWh <sub>PE</sub> /m <sup>2</sup>	
Dwelling primary energy	30.02 kWh <sub>PE</sub> /m <sup>2</sup>	OK
1c Target fabric energy efficiency and dwelling fabric energy efficiency		
Target fabric energy efficiency	40.5 kWh/m <sup>2</sup>	
Dwelling fabric energy efficiency	35.7 kWh/m <sup>2</sup>	OK

2a Fabric U-values				
Element	Maximum permitted average U-Value [W/m <sup>2</sup> K]	Dwelling average U-Value [W/m <sup>2</sup> K]	Element with highest individual U-Value	
External walls	0.26	0.18	Walls (1) (0.18)	OK
Party walls	0.2	N/A	N/A	N/A
Curtain walls	1.6	N/A	N/A	N/A
Floors	0.18	0.12	Ground Floor (0.12)	OK
Roofs	0.16	0.11	Roof (2) (0.15)	OK
Windows, doors, and roof windows	1.6	1.3	Front Door (1.3)	OK
Rooflights	2.2	N/A	N/A	N/A

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))		
Name	Net area [m <sup>2</sup> ]	U-Value [W/m <sup>2</sup> K]
Exposed wall: Walls (1)	183.9	0.18
Ground floor: Ground Floor, Ground Floor	120	0.12
Exposed roof: Roof (1)	113	0.11
Exposed roof: Roof (2)	8.9	0.15

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	Area [m <sup>2</sup> ]	Orientation	Frame factor	U-Value [W/m <sup>2</sup> K]
Front Door, Doors	2.1	South East	N/A	1.3
Windows (NE), Windows	2	North East	1.0	1.3
Windows (NW), Windows	22.3	North West	1.0	1.3
Windows (SE), Windows	15.1	South East	1.0	1.3
Windows (SW), Windows	3.1	South West	1.0	1.3
Rooflights (NW), Rooflights	1	North West	0.7	1.3
Rooflights (SE), Rooflights	0.6	South East	0.7	1.3

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

Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E2: Other lintels (including other steel lintels)	Calculated by person with suitable expertise	0.05	
External wall	E3: Sill	Calculated by person with suitable expertise	0.02 (!)	
External wall	E4: Jamb	Calculated by person with suitable expertise	0.015 (!)	
External wall	E5: Ground floor (normal)	Calculated by person with suitable expertise	0.053	
External wall	E6: Intermediate floor within a dwelling	Calculated by person with suitable expertise	0.001 (!)	
External wall	E10: Eaves (insulation at ceiling level)	Calculated by person with suitable expertise	0.056	
External wall	E11: Eaves (insulation at rafter level)	Calculated by person with suitable expertise	0.017 (!)	
External wall	E12: Gable (insulation at ceiling level)	Calculated by person with suitable expertise	0.036 (!)	
External wall	E13: Gable (insulation at rafter level)	Calculated by person with suitable expertise	0.038 (!)	
External wall	E16: Corner (normal)	Calculated by person with suitable expertise	0.038 (!)	
Roof	R1: Head of roof window	SAP table default	0.24	
Roof	R2: Sill of roof window	SAP table default	0.24	
Roof	R3: Jamb of roof window	SAP table default	0.24	

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

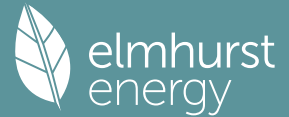
4 Space heating	
<b>Main heating system 1:</b> Heat pump with radiators or underfloor heating - Electricity	
Efficiency	219.3%
Emitter type	Both radiators and underfloor
Flow temperature	
System type	Air source heat pump
Manufacturer	
Model	
Commissioning	
<b>Secondary heating system:</b> Open fire in grate	
Fuel	Dual fuel appliance (mineral and wood)
Efficiency	37.0%
Commissioning	

5 Hot water	
<b>Cylinder/store</b> - type: Cylinder	
Capacity	300 litres
Declared heat loss	2 kWh/day
Primary pipework insulated	Yes
Manufacturer	
Model	
Commissioning	
<b>Waste water heat recovery system 1</b> - type: N/A	
Efficiency	
Manufacturer	
Model	

6 Controls	
<b>Main heating 1</b> - type: Time and temperature zone control by arrangement of plumbing and electrical services	
Function	
Ecodesign class	
Manufacturer	
Model	

<b>Water heating</b> - type: Cylinder thermostat and HW separately timed		
Manufacturer		
Model		
<b>7 Lighting</b>		
Minimum permitted light source efficacy	75 lm/W	
Lowest light source efficacy	75 lm/W	OK
External lights control	N/A	
<b>8 Mechanical ventilation</b>		
<b>System type:</b> N/A		
Maximum permitted specific fan power	N/A	
Specific fan power	N/A	N/A
Minimum permitted heat recovery efficiency	N/A	
Heat recovery efficiency	N/A	N/A
Manufacturer/Model		
Commissioning		
<b>9 Local generation</b>		
Technology type: <b>Photovoltaic system (1)</b>		
Peak power	2.5 kWp	
Orientation	North West	
Pitch	45°	
Overshading	None or very little	
Manufacturer		
MCS certificate		
<b>10 Heat networks</b>		
N/A		
<b>11 Supporting documentary evidence</b>		
N/A		
<b>12 Declarations</b>		
<b>a. Assessor Declaration</b>		
This declaration by the assessor is confirmation that the contents of this BREL Compliance Report are a true and accurate reflection based upon the design information submitted for this dwelling for the purpose of carrying out the "As designed" assessment, and that the supporting documentary evidence (SAP Conventions, Appendix 1 (documentary evidence) schedules the minimum documentary evidence required) has been reviewed in the course of preparing this BREL Compliance Report.		
Signed:	Assessor ID:	
Name:	Date:	
<b>b. Client Declaration</b>		
N/A		

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Property Reference	CJ5701	Issued on Date	20/06/2025
Assessment Reference	CJ5701C	Prop Type Ref	New House
Property	Plot 1, Crosswinds, Hampers Lane, Storrington, West Sussex, RH20 3HZ		
SAP Rating	85 B	DER	2.76
Environmental	97 A	% DER < TER	7.93
CO <sub>2</sub> Emissions (t/year)	0.48	DFEE	35.71
Compliance Check	See BREL	% DFEE < TFEE	40.48
% DPER < TPER	28.54	DPER	30.02
TPER			42.01
Assessor Details	Mr. Joe Solti	Assessor ID	5122-0001
Client	Mark Alford Design, .		

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> )
Main dwelling			
Ground floor	120.0000 (1b)	x 2.4100 (2b)	= 289.2000 (1b) - (3b)
First floor	104.0000 (1c)	x 2.6300 (2c)	= 273.5200 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	224.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 562.7200 (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	6 * 10 =	60.0000 (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) =	60.0000 / (5) =	0.1066 (8)										
Pressure test	Yes											
Pressure Test Method	Blower Door											
Measured/design AP50	5.0000	(17)										
Infiltration rate	0.3566	(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) =	0.3031 (21)										
Wind speed	Jan 5.1000	Feb 5.0000	Mar 4.9000	Apr 4.4000	May 4.3000	Jun 3.8000	Jul 3.8000	Aug 3.7000	Sep 4.0000	Oct 4.3000	Nov 4.5000	Dec 4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.3865	0.3789	0.3713	0.3334	0.3259	0.2880	0.2880	0.2804	0.3031	0.3259	0.3410	0.3562 (22b)
Effective ac	0.5747	0.5718	0.5689	0.5556	0.5531	0.5415	0.5415	0.5393	0.5459	0.5531	0.5581	0.5634 (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
Main dwelling							
Doors			2.1000	1.3000	2.7300		(26a)
Windows			42.5000	1.2357	52.5190		(27)
Rooflights			1.6000	1.2357	1.9772		(27a)
Ground Floor			120.0000	0.1200	14.4000	75.0000	9000.0000 (28a)
External Wall	228.5000	44.6000	183.9000	0.1800	33.1020	60.0000	11034.0000 (29a)
Roof (loft)	113.0000		113.0000	0.1100	12.4300	9.0000	1017.0000 (30)
Roof (skelling)	10.5000	1.6000	8.9000	0.1500	1.3350	9.0000	80.1000 (30)
Total net area of external elements A <sub>um</sub> (A, m <sup>2</sup> )			472.0000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	118.4932	(33)
Main dwelling							
Internal Wall			165.0000			75.0000	12375.0000 (32c)
Internal Wall			225.0000			9.0000	2025.0000 (32c)
Internal Floor			104.0000			18.0000	1872.0000 (32d)
Internal Ceiling			104.0000			9.0000	936.0000 (32e)
Heat capacity C <sub>m</sub> = Sum (A x k)							(28)...(30) + (32) + (32a)...(32e) = 38339.1000 (34)
Thermal mass parameter (TMP = C <sub>m</sub> / TFA) in kJ/m <sup>2</sup> K							171.1567 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value		Total

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E2 Other lintels (including other steel lintels)	39.5000	0.0500	1.9750
E3 Sill	25.8000	0.0200	0.5160
E4 Jamb	56.3000	0.0150	0.8445
E5 Ground floor (normal)	50.1000	0.0530	2.6553
E6 Intermediate floor within a dwelling	43.4000	0.0010	0.0434
E10 Eaves (insulation at ceiling level)	10.2000	0.0560	0.5712
E11 Eaves (insulation at rafter level)	9.6000	0.0170	0.1632
E12 Gable (insulation at ceiling level)	17.5000	0.0360	0.6300
E13 Gable (insulation at rafter level)	7.6000	0.0380	0.2888
E16 Corner (normal)	26.2000	0.0380	0.9956
R1 Head of roof window	1.8000	0.2400	0.4320
R2 Sill of roof window	1.8000	0.2400	0.4320
R3 Jamb of roof window	5.4000	0.2400	1.2960
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			10.8430 (36)
Point Thermal bridges			0.0000
Total fabric heat loss		(33) + (36) + (36a) =	129.3362 (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	106.7182	106.1796	105.6517	103.1722	102.7083	100.5487	100.5487	100.1488	101.3805	102.7083	103.6468	104.6279 (38)
Heat transfer coeff	236.0544	235.5158	234.9879	232.5084	232.0445	229.8849	229.8849	229.4850	230.7167	232.0445	232.9830	233.9641 (39)
Average = Sum(39)m / 12 =												232.5062
HLP	1.0538	1.0514	1.0491	1.0380	1.0359	1.0263	1.0263	1.0245	1.0300	1.0359	1.0401	1.0445 (40)
HLP (average)												1.0380
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

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

Assumed occupancy													3.0331 (42)
Hot water usage for mixer showers	93.8444	92.4341	90.3790	86.4470	83.5452	80.3092	78.4699	80.5094	82.7451	86.2196	90.2361	93.4848	93.4848 (42a)
Hot water usage for baths	32.4081	31.9268	31.2490	29.9993	29.0636	28.0260	27.4655	28.1385	28.8714	29.9816	31.2571	32.2986	32.2986 (42b)
Hot water usage for other uses	45.6923	44.0307	42.3692	40.7077	39.0461	37.3846	37.3846	39.0461	40.7077	42.3692	44.0307	45.6923	45.6923 (42c)
Average daily hot water use (litres/day)													158.1072 (43)
Daily hot water use	171.9448	168.3916	163.9972	157.1540	151.6549	145.7198	143.3200	147.6941	152.3241	158.5704	165.5239	171.4757	171.4757 (44)
Energy conte	272.3185	239.7874	252.0576	215.1359	204.1567	179.1795	173.3331	182.8761	187.8309	215.1786	235.8191	268.4894	268.4894 (45)
Energy content (annual)													Total = Sum(45)m = 2626.1629
Distribution loss (46)m = 0.15 x (45)m	40.8478	35.9681	37.8086	32.2704	30.6235	26.8769	26.0000	27.4314	28.1746	32.2768	35.3729	40.2734	40.2734 (46)
Water storage loss:													
Store volume													300.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):													2.0000 (48)
Temperature factor from Table 2b													0.5400 (49)
Enter (49) or (54) in (55)													1.0800 (55)
Total storage loss	33.4800	30.2400	33.4800	32.4000	33.4800	32.4000	33.4800	33.4800	32.4000	33.4800	32.4000	33.4800	33.4800 (56)
If cylinder contains dedicated solar storage	33.4800	30.2400	33.4800	32.4000	33.4800	32.4000	33.4800	33.4800	32.4000	33.4800	32.4000	33.4800	33.4800 (57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624 (59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)
Total heat required for water heating calculated for each month	329.0609	291.0386	308.8000	270.0479	260.8991	234.0915	230.0755	239.6185	242.7429	271.9210	290.7311	325.2318	325.2318 (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	329.0609	291.0386	308.8000	270.0479	260.8991	234.0915	230.0755	239.6185	242.7429	271.9210	290.7311	325.2318	325.2318 (64)
Total per year (kWh/year)													Total per year (kWh/year) = Sum(64)m = 3294.2589 (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	135.9398	120.7303	129.2031	115.4623	113.2760	103.5068	103.0272	106.2002	106.3834	116.9408	122.3395	134.6667	134.6667 (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	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	199.9605	221.3849	199.9605	206.6259	199.9605	206.6259	199.9605	199.9605	206.6259	199.9605	206.6259	199.9605 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	393.3198	397.4012	387.1161	365.2205	337.5811	311.6040	294.2496	290.1682	300.4533	322.3490	349.9884	375.9655 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656 (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)	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252 (71)
Water heating gains (Table 5)	182.7148	179.6582	173.6601	160.3643	152.2527	143.7594	138.4774	142.7422	147.7547	157.1785	169.9159	181.0036 (72)
Total internal gains	844.4921	866.9412	829.2337	800.7076	758.2912	730.4862	701.1845	701.3679	723.3308	747.9849	795.0271	825.4265 (73)

#### 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
Northeast	2.0000	11.2829	0.6300	0.0000	0.7700	10.9467 (75)
Southeast	15.1000	36.7938	0.6300	0.0000	0.7700	269.5152 (77)

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Southwest			3.1000		36.7938		0.6300		0.0000		0.7700		55.3309 (79)
Northwest			22.3000		11.2829		0.6300		0.0000		0.7700		122.0558 (81)
Southeast			0.6000		39.9751		0.6300		0.7000		1.0000		9.5197 (82)
Northwest			1.0000		16.3666		0.6300		0.7000		1.0000		6.4959 (82)

Solar gains	473.8642	854.9323	1296.2219	1817.3888	2228.0136	2296.3969	2178.8182	1859.6414	1474.7253	979.0205	576.2887	399.8885	(83)
Total gains	1318.3563	1721.8735	2125.4555	2618.0963	2986.3049	3026.8831	2880.0027	2561.0093	2198.0561	1727.0054	1371.3158	1225.3150	(84)

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	45.1157	45.2188	45.3204	45.8037	45.8953	46.3264	46.3264	46.4072	46.1594	45.8953	45.7104	45.5187	
alpha	4.0077	4.0146	4.0214	4.0536	4.0597	4.0884	4.0884	4.0938	4.0773	4.0597	4.0474	4.0346	
util living area	0.9917	0.9766	0.9378	0.8299	0.6562	0.4726	0.3480	0.4057	0.6577	0.9104	0.9820	0.9937	(86)
MIT	19.6332	19.8894	20.2301	20.6089	20.8263	20.9044	20.9199	20.9163	20.8522	20.5104	19.9944	19.5923	(87)
Th 2	20.0387	20.0407	20.0427	20.0518	20.0535	20.0615	20.0615	20.0630	20.0584	20.0535	20.0500	20.0464	(88)
util rest of house	0.9898	0.9714	0.9245	0.7982	0.6047	0.4081	0.2753	0.3259	0.5873	0.8852	0.9771	0.9923	(89)
MIT 2	18.4258	18.7521	19.1785	19.6368	19.8723	19.9517	19.9627	19.9624	19.9083	19.5364	18.8950	18.3794	(90)
Living area fraction	FLA = Living area / (4) =												0.1228 (91)
MIT	18.5740	18.8917	19.3076	19.7561	19.9894	20.0687	20.0802	20.0795	20.0242	19.6560	19.0300	18.5283	(92)
Temperature adjustment													0.0000
adjusted MIT	18.5740	18.8917	19.3076	19.7561	19.9894	20.0687	20.0802	20.0795	20.0242	19.6560	19.0300	18.5283	(93)

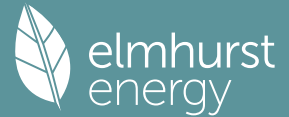
## 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.9857	0.9633	0.9121	0.7872	0.6010	0.4086	0.2767	0.3274	0.5846	0.8724	0.9701	0.9890	(94)
Useful gains	1299.5116	1658.7241	1938.7254	2060.9586	1794.8379	1236.6905	796.9658	838.3478	1284.9854	1506.6065	1330.3475	1211.8280	(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	3369.4418	3295.2642	3009.6432	2524.1414	1923.5085	1257.1611	800.0427	844.3966	1366.8152	2101.3855	2779.4766	3352.3063	(97)
Space heating kWh	1540.0280	1099.7550	796.7628	333.4916	95.7309	0.0000	0.0000	0.0000	0.0000	442.5156	1043.3729	1592.5159	(98a)
Space heating requirement - total per year (kWh/year)													6944.1727
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	1540.0280	1099.7550	796.7628	333.4916	95.7309	0.0000	0.0000	0.0000	0.0000	442.5156	1043.3729	1592.5159	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)													6944.1727
Space heating per m2													(98c) / (4) = 31.0008 (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 %)													219.3000 (206)
Efficiency of main space heating system 2 (in %)													0.0000 (207)
Efficiency of secondary/supplementary heating system, %													37.0000 (208)
Space heating requirement	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	1540.0280	1099.7550	796.7628	333.4916	95.7309	0.0000	0.0000	0.0000	0.0000	442.5156	1043.3729	1592.5159	(98)
Space heating efficiency (main heating system 1)	219.3000	219.3000	219.3000	219.3000	219.3000	0.0000	0.0000	0.0000	0.0000	219.3000	219.3000	219.3000	(210)
Space heating fuel (main heating system)	702.2472	501.4842	363.3209	152.0710	43.6530	0.0000	0.0000	0.0000	0.0000	201.7855	475.7742	726.1814	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	329.0609	291.0386	308.8000	270.0479	260.8991	234.0915	230.0755	239.6185	242.7429	271.9210	290.7311	325.2318	(64)
Efficiency of water heater (217)m	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	(216)
Fuel for water heating, kWh/month	172.8261	152.8564	162.1849	141.8319	137.0268	122.9472	120.8380	125.8501	127.4910	142.8156	152.6949	170.8150	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(231)
Lighting	42.5103	34.1033	30.7063	22.4967	17.3771	14.1973	15.8520	20.6050	26.7639	35.1157	39.6631	43.6918	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-21.3664	-37.0356	-68.2498	-95.3283	-116.0970	-111.9676	-108.6671	-92.6622	-68.4514	-46.4104	-25.2031	-17.6457	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-2.9871	-8.2366	-24.1977	-55.6900	-97.6647	-110.2719	-105.4620	-75.5563	-41.7954	-15.3325	-4.5269	-2.2041	(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													3166.5174 (211)
Space heating fuel - main system 2													0.0000 (213)
Space heating fuel - secondary													0.0000 (215)
Efficiency of water heater													190.4000

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Water heating fuel used	1730.1780 (219)
Space cooling fuel	0.0000 (221)
Electricity for pumps and fans:	
Total electricity for the above, kWh/year	0.0000 (231)
Electricity for lighting (calculated in Appendix L)	343.0824 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-1353.0097 (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	3886.7681 (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	3166.5174	0.1565	495.4525 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1730.1780	0.1410	243.9500 (264)
Space and water heating			739.4025 (265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (267)
Energy for lighting	343.0824	0.1443	49.5174 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-809.0847	0.1310	-106.0285
PV Unit electricity exported	-543.9250	0.1174	-63.8350
Total			-169.8635 (269)
Total CO2, kg/year			619.0563 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			2.7600 (273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	3166.5174	1.5792	5000.6688 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1730.1780	1.5214	2632.2251 (278)
Space and water heating			7632.8938 (279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (281)
Energy for lighting	343.0824	1.5338	526.2312 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-809.0847	1.4841	-1200.7860
PV Unit electricity exported	-543.9250	0.4303	-234.0247
Total			-1434.8108 (283)
Total Primary energy kWh/year			6724.3143 (286)
Dwelling Primary energy Rate (DPER)			30.0200 (287)

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 SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)  
 CALCULATION OF TARGET EMISSIONS  
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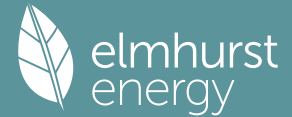
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**1. Overall dwelling characteristics**  
 -----

	Area (m2)	Storey height (m)	Volume (m3)
Main dwelling			
Ground floor	120.0000 (1b)	x 2.4100 (2b)	= 289.2000 (1b) - (3b)
First floor	104.0000 (1c)	x 2.6300 (2c)	= 273.5200 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	224.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	562.7200 (5)

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

	m3 per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	4 * 10 = 40.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) = 0.0711 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.3211 (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) = 0.2729 (21)

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	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	0.3480	0.3412	0.3343	0.3002	0.2934	0.2593	0.2593	0.2525	0.2729	0.2934	0.3070	0.3207	(22b)
	0.5605	0.5582	0.5559	0.5451	0.5430	0.5336	0.5336	0.5319	0.5372	0.5430	0.5471	0.5514	(25)

### 3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Main dwelling								
TER Semi-glazed door			2.1000	1.0000	2.1000			(26a)
TER Opening Type			42.5000	1.1450	48.6641			(27)
TER Roof Window			1.6000	1.1450	2.2642			(27a)
Ground Floor			120.0000	0.1300	15.6000			(28a)
External Wall	228.5000	44.6000	183.9000	0.1800	33.1020			(29a)
Roof (loft)	113.0000		113.0000	0.1100	12.4300			(30)
Roof (skelling)	10.5000	1.6000	8.9000	0.1100	0.9790			(30)
Total net area of external elements Aum(A, m2)			472.0000					(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	115.1393		(33)

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

171.1567 (35)

#### List of Thermal Bridges

K1 Element	Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)	39.5000	0.0500	1.9750	
E3 Sill	25.8000	0.0500	1.2900	
E4 Jamb	56.3000	0.0500	2.8150	
E5 Ground floor (normal)	50.1000	0.1600	8.0160	
E6 Intermediate floor within a dwelling	43.4000	0.0000	0.0000	
E10 Eaves (insulation at ceiling level)	10.2000	0.0600	0.6120	
E11 Eaves (insulation at rafter level)	9.6000	0.0400	0.3840	
E12 Gable (insulation at ceiling level)	17.5000	0.0600	1.0500	
E13 Gable (insulation at rafter level)	7.6000	0.0800	0.6080	
E16 Corner (normal)	26.2000	0.0900	2.3580	
R1 Head of roof window	1.8000	0.0800	0.1440	
R2 Sill of roof window	1.8000	0.0600	0.1080	
R3 Jamb of roof window	5.4000	0.0800	0.4320	

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

19.7920 (36)

#### Point Thermal bridges

(36a) = 0.0000

#### Total fabric heat loss

(33) + (36) + (36a) = 134.9313 (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	104.0915	103.6549	103.2270	101.2171	100.8410	99.0904	99.0904	98.7662	99.7647	100.8410	101.6018	102.3971	(38)
Heat transfer coeff	239.0228	238.5862	238.1583	236.1483	235.7723	234.0217	234.0217	233.6975	234.6960	235.7723	236.5330	237.3284	(39)
Average = Sum(39)m / 12 =													236.1465

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0671	1.0651	1.0632	1.0542	1.0526	1.0447	1.0447	1.0433	1.0477	1.0526	1.0560	1.0595	(40)
HLP (average)													1.0542
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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

Assumed occupancy														
Hot water usage for mixer showers	75.0755	73.9472	72.3032	69.1576	66.8362	64.2474	62.7759	64.4075	66.1961	68.9757	72.1889	74.7878	(42a)	3.0331 (42)
Hot water usage for baths	32.4081	31.9268	31.2490	29.9993	29.0636	28.0260	27.4655	28.1385	28.8714	29.9816	31.2571	32.2986	(42b)	
Hot water usage for other uses	45.6923	44.0307	42.3692	40.7077	39.0461	37.3846	37.3846	39.0461	40.7077	42.3692	44.0307	45.6923	(42c)	
Average daily hot water use (litres/day)													(43)	140.8030

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	153.1759	149.9048	145.9214	139.8646	134.9459	129.6579	127.6260	131.5922	135.7751	141.3265	147.4767	152.7787	(44)
Energy conte	242.5932	213.4625	224.2758	191.4676	181.6631	159.4296	154.3526	162.9386	167.4243	191.7787	210.1076	239.2145	(45)
Energy content (annual)										Total = Sum(45)m =			2338.7080
Distribution loss (46)m = 0.15 x (45)m	36.3890	32.0194	33.6414	28.7201	27.2495	23.9144	23.1529	24.4408	25.1136	28.7668	31.5161	35.8822	(46)

#### Water storage loss:

Store volume														
a) If manufacturer declared loss factor is known (kWh/day):														300.0000 (47)
Temperature factor from Table 2b														2.1127 (48)
Enter (49) or (54) in (55)														0.5400 (49)
Total storage loss														1.1409 (55)

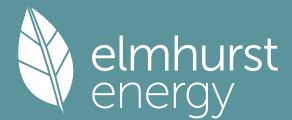
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
35.3664	31.9439	35.3664	34.2256	35.3664	34.2256	35.3664	35.3664	35.3664	34.2256	35.3664	34.2256	35.3664	(56)
35.3664	31.9439	35.3664	34.2256	35.3664	34.2256	35.3664	35.3664	35.3664	34.2256	35.3664	34.2256	35.3664	(57)
Primary loss	23.2624	21.0112	23.2624	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	301.2220	266.4175	282.9046	248.2052	240.2919	216.1671	212.9814	221.5674	224.1619	250.4076	266.8451	297.8433	(62)
WWHRS	-34.3214	-30.3541	-31.7851	-26.3193	-24.5286	-20.9893	-19.6742	-20.9215	-21.7164	-25.6012	-29.0031	-33.6858	(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	266.9006	236.0634	251.1196	221.8859	215.7633	195.1778	193.3072	200.6460	202.4455	224.8063	237.8421	264.1575	(64)
12Total per year (kWh/year)										Total per year (kWh/year) = Sum(64)m =			2710.1151 (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)	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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
127.5653	113.3403	121.4748	109.0530	107.3060	98.4004	98.2253	101.0801	101.0586	110.6695	115.2508	126.4419		(65)

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

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Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	199.9605	221.3849	199.9605	206.6259	199.9605	206.6259	199.9605	199.9605	206.6259	199.9605	206.6259	199.9605 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	393.3198	397.4012	387.1161	365.2205	337.5811	311.6040	294.2496	290.1682	300.4533	322.3490	349.9884	375.9655 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656 (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)	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252 (71)
Water heating gains (Table 5)	171.4587	168.6612	163.2725	151.4625	144.2285	136.6672	132.0232	135.8604	140.3592	148.7493	160.0706	169.9488 (72)
Total internal gains	836.2360	858.9442	821.8461	794.8058	753.2671	723.3940	694.7303	694.4861	715.9353	742.5557	788.1817	817.3717 (73)

## 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	g Specific data or Table 6c	FF Specific data or Table 6c	Access factor Table 6d	Gains W					
Northeast	2.0000	11.2829	0.6300	0.7000	0.7700	6.8964 (75)						
Southeast	15.1000	36.7938	0.6300	0.7000	0.7700	169.7946 (77)						
Southwest	3.1000	36.7938	0.6300	0.7000	0.7700	34.8585 (79)						
Northwest	22.3000	11.2829	0.6300	0.7000	0.7700	76.8952 (81)						
Southeast	0.6000	39.9751	0.6300	0.7000	1.0000	9.5197 (82)						
Northwest	1.0000	16.3666	0.6300	0.7000	1.0000	6.4959 (82)						
Solar gains	304.4602	550.0288	835.6219	1173.9086	1440.8370	1485.6945	1409.3738	1201.8680	951.4976	630.3306	370.4051	256.8402 (83)
Total gains	1140.6962	1408.9730	1657.4680	1968.7144	2194.1040	2209.0884	2104.1042	1896.3541	1667.4329	1372.8863	1158.5868	1074.2119 (84)

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation factor for gains for living area, nil,m (see Table 9a)												
tau	44.5554	44.6369	44.7171	45.0977	45.1696	45.5075	45.5075	45.5707	45.3768	45.1696	45.0244	44.8735
alpha	3.9704	3.9758	3.9811	4.0065	4.0113	4.0338	4.0338	4.0380	4.0251	4.0113	4.0016	3.9916
util living area	0.9950	0.9882	0.9713	0.9173	0.8002	0.6250	0.4750	0.5406	0.7891	0.9545	0.9900	0.9961 (86)
MIT	19.1415	19.4060	19.7995	20.3137	20.7147	20.9234	20.9802	20.9673	20.8015	20.2546	19.6034	19.0986 (87)
Th 2	20.0278	20.0294	20.0310	20.0384	20.0398	20.0462	20.0462	20.0474	20.0437	20.0398	20.0370	20.0340 (88)
util rest of house	0.9939	0.9854	0.9643	0.8971	0.7544	0.5486	0.3783	0.4395	0.7240	0.9395	0.9872	0.9952 (89)
MIT 2	17.8359	18.1741	18.6737	19.3146	19.7791	19.9937	20.0374	20.0315	19.8862	19.2557	18.4328	17.7851 (90)
Living area fraction												
MIT	17.9962	18.3254	18.8119	19.4373	19.8939	20.1078	20.1532	20.1464	19.9986	19.3783	18.5765	17.9464 (92)
Temperature adjustment												0.0000
adjusted MIT	17.9962	18.3254	18.8119	19.4373	19.8939	20.1078	20.1532	20.1464	19.9986	19.3783	18.5765	17.9464 (93)

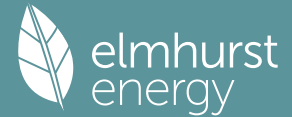
## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9900	0.9782	0.9524	0.8817	0.7466	0.5538	0.3895	0.4505	0.7205	0.9256	0.9807	0.9920 (94)
Useful gains	1129.3323	1378.3180	1578.4991	1735.7768	1638.0467	1223.5034	819.5189	854.3012	1201.3863	1270.7583	1136.2649	1065.6293 (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	3273.7006	3203.1089	2932.1913	2488.3590	1931.9028	1288.9510	831.5178	875.5274	1384.3781	2069.6801	2714.5653	3262.4051 (97)
Space heating kWh	1595.4100	1226.2595	1007.1470	541.8592	218.6290	0.0000	0.0000	0.0000	0.0000	594.3978	1136.3763	1634.4012 (98a)
Space heating requirement - total per year (kWh/year)												7954.4800
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	1595.4100	1226.2595	1007.1470	541.8592	218.6290	0.0000	0.0000	0.0000	0.0000	594.3978	1136.3763	1634.4012 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												7954.4800
Space heating per m2										(98c) / (4) =		35.5111 (99)

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

Fraction of space heat from secondary/supplementary system (Table 11)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Fraction of space heat from main system(s)												0.0000 (201)
Efficiency of main space heating system 1 (in %)												1.0000 (202)
Efficiency of main space heating system 2 (in %)												92.3000 (206)
Efficiency of secondary/supplementary heating system, %												0.0000 (207)
												0.0000 (208)
Space heating requirement	1595.4100	1226.2595	1007.1470	541.8592	218.6290	0.0000	0.0000	0.0000	0.0000	594.3978	1136.3763	1634.4012 (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)	1728.5048	1328.5585	1091.1669	587.0631	236.8678	0.0000	0.0000	0.0000	0.0000	643.9846	1231.1769	1770.7488 (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	266.9006	236.0634	251.1196	221.8859	215.7633	195.1778	193.3072	200.6460	202.4455	224.8063	237.8421	264.1575 (64)

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Efficiency of water heater (217)m	87.3875	87.2122	86.8452	85.9827	84.0894	79.8000	79.8000	79.8000	79.8000	86.1342	87.0998	79.8000 (216)
Fuel for water heating, kWh/month (233a)m	305.4219	270.6771	289.1575	258.0587	256.5880	244.5837	242.2397	251.4360	253.6911	260.9955	273.0683	302.1427 (219)
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa (235a)m	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041 (231)
Lighting (234a)m	41.5478	33.3312	30.0111	21.9874	16.9837	13.8758	15.4931	20.1385	26.1579	34.3206	38.7651	42.7026 (232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-96.5084	-128.7539	-175.1600	-185.9074	-191.4172	-175.2403	-172.7229	-167.1229	-156.4510	-141.3876	-103.3049	-84.2881 (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	-79.1952	-162.9715	-317.6069	-468.3362	-611.3042	-611.6396	-604.7437	-515.8908	-383.1391	-230.4536	-104.8178	-62.9375 (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												8618.0715 (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												3208.0603 (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)												335.3149 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-5931.3007 (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												6316.1460 (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	8618.0715	0.2100	1809.7950 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	3208.0603	0.2100	673.6927 (264)
Space and water heating			2483.4877 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	335.3149	0.1443	48.3963 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1778.2646	0.1358	-241.5554
PV Unit electricity exported	-4153.0360	0.1264	-525.0906
Total			-766.6460 (269)
Total CO2, kg/year			1777.1673 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			7.9300 (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	8618.0715	1.1300	9738.4208 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	3208.0603	1.1300	3625.1081 (278)
Space and water heating			13363.5289 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	335.3149	1.5338	514.3172 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1778.2646	1.5021	-2671.1348
PV Unit electricity exported	-4153.0360	0.4641	-1927.5393
Total			-4598.6742 (283)
Total Primary energy kWh/year			9409.2727 (286)
Target Primary Energy Rate (TPER)			42.0100 (287)

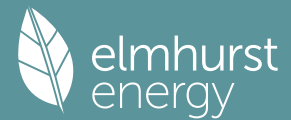
## SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022) CALCULATION OF FABRIC ENERGY EFFICIENCY

### 1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Main dwelling			
Ground floor	120.0000 (1b)	x 2.4100 (2b)	= 289.2000 (1b) - (3b)
First floor	104.0000 (1c)	x 2.6300 (2c)	= 273.5200 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	224.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	562.7200 (5)



# Full SAP Calculation Printout



Energy conte	78.1004	75.9576	73.6183	70.7070	68.1097	65.4106	64.8501	67.1847	69.5790	72.3508	75.2878	77.9909 (44)
Energy content (annual)	123.6920	108.1626	113.1485	96.7944	91.6888	80.4299	78.4306	83.1887	85.7979	98.1794	107.2613	122.1148 (45)
Distribution loss (46)m = 0.15 x (45)m												1188.8887
Water 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 (46)
Total storage loss:	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Combi loss	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	105.1382	91.9382	96.1762	82.2752	77.9354	68.3654	66.6660	70.7104	72.9282	83.4525	91.1721	103.7976 (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	105.1382	91.9382	96.1762	82.2752	77.9354	68.3654	66.6660	70.7104	72.9282	83.4525	91.1721	103.7976 (64)
12Total per year (kWh/year)												1010.5554 (64)
Electric shower(s)	60.1230	53.5700	58.4964	55.8224	56.8699	54.2484	56.0567	56.8699	55.8224	58.4964	57.3965	60.1230 (64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												683.8951 (64a)
Heat gains from water heating, kWh/month	41.3153	36.3771	38.6682	34.5244	33.7013	30.6535	30.6807	31.8951	32.1877	35.4872	37.1421	40.9801 (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	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	199.9605	221.3849	199.9605	206.6259	199.9605	206.6259	199.9605	199.9605	206.6259	199.9605	206.6259	199.9605 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	393.3198	397.4012	387.1161	365.2205	337.5811	311.6040	294.2496	290.1682	300.4533	322.3490	349.9884	375.9655 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656 (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)	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252 (71)
Water heating gains (Table 5)	55.5313	54.1325	51.9733	47.9506	45.2975	42.5742	41.2374	42.8697	44.7051	47.6979	51.5863	55.0808 (72)
Total internal gains	717.3085	741.4155	707.5469	688.2938	651.3360	629.3010	603.9446	601.4954	620.2812	638.5043	676.6975	699.5038 (73)

## 6. Solar gains

[Jan]	Area	Solar flux	g	FF	Access	Gains						
	m2	Table 6a	Specific data	Specific data	factor	W						
		W/m2	or Table 6b	or Table 6c	Table 6d							
Northeast	2.0000	11.2829	0.6300	0.0000	0.7700	10.9467 (75)						
Southeast	15.1000	36.7938	0.6300	0.0000	0.7700	269.5152 (77)						
Southwest	3.1000	36.7938	0.6300	0.0000	0.7700	55.3309 (79)						
Northwest	22.3000	11.2829	0.6300	0.0000	0.7700	122.0558 (81)						
Southeast	0.6000	39.9751	0.6300	0.7000	1.0000	9.5197 (82)						
Northwest	1.0000	16.3666	0.6300	0.7000	1.0000	6.4959 (82)						
Solar gains	473.8642	854.9323	1296.2219	1817.3888	2228.0136	2296.3969	2178.8182	1859.6414	1474.7253	979.0205	576.2887	399.8885 (83)
Total gains	1191.1728	1596.3479	2003.7688	2505.6826	2879.3497	2925.6979	2782.7627	2461.1368	2095.0065	1617.5248	1252.9862	1099.3923 (84)

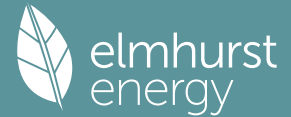
## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	45.6233	45.7088	45.7929	46.1921	46.2676	46.6222	46.6222	46.6885	46.4850	46.2676	46.1152	45.9569
alpha	4.0416	4.0473	4.0529	4.0795	4.0845	4.1081	4.1081	4.1126	4.0990	4.0845	4.0743	4.0638
util living area	0.9942	0.9817	0.9470	0.8437	0.6705	0.4848	0.3576	0.4189	0.6779	0.9243	0.9867	0.9958 (86)
MIT	19.2234	19.5695	20.0337	20.5563	20.8619	20.9713	20.9935	20.9879	20.8944	20.4095	19.7043	19.1646 (87)
Th 2	20.0484	20.0500	20.0516	20.0590	20.0604	20.0669	20.0669	20.0681	20.0644	20.0604	20.0576	20.0547 (88)
util rest of house	0.9929	0.9775	0.9353	0.8136	0.6193	0.4193	0.2834	0.3373	0.6079	0.9020	0.9830	0.9948 (89)
MIT 2	18.4161	18.7602	19.2146	19.7082	19.9676	20.0524	20.0648	20.0638	20.0033	19.5884	18.9018	18.3623 (90)
Living area fraction									FLA = Living area / (4) =			0.1228 (91)
MIT	18.5152	18.8595	19.3151	19.8123	20.0774	20.1653	20.1788	20.1772	20.1127	19.6892	19.0003	18.4608 (92)
Temperature adjustment												0.0000
adjusted MIT	18.5152	18.8595	19.3151	19.8123	20.0774	20.1653	20.1788	20.1772	20.1127	19.6892	19.0003	18.4608 (93)

## 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.9897	0.9706	0.9242	0.8048	0.6202	0.4264	0.2924	0.3470	0.6117	0.8913	0.9774	0.9924 (94)
Useful gains	1178.9513	1549.4455	1851.9769	2016.4640	1785.8968	1247.5002	813.7153	854.0884	1281.6060	1441.7033	1224.6750	1090.9834 (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	3318.2248	3252.4493	2980.3255	2515.8768	1928.2825	1271.2525	817.4888	861.5971	1377.5059	2092.1174	2748.2394	3304.6933 (97)
Space heating kWh	1591.6194	1144.4186	839.4914	359.5773	105.9350	0.0000	0.0000	0.0000	0.0000	483.9081	1096.9664	1647.0001 (98a)
Space heating requirement - total per year (kWh/year)												7268.9163
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

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Space heating kWh	1591.6194	1144.4186	839.4914	359.5773	105.9350	0.0000	0.0000	0.0000	0.0000	483.9081	1096.9664	1647.0001 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												7268.9163
Space heating per m2												(98c) / (4) = 32.4505 (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												
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	2147.2101	1690.3569	1733.5784	0.0000	0.0000	0.0000	0.0000 (100)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.9332	0.9624	0.9406	0.0000	0.0000	0.0000	0.0000 (101)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2003.8416	1626.7511	1630.5202	0.0000	0.0000	0.0000	0.0000 (102)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	3308.3658	3146.1313	2777.2080	0.0000	0.0000	0.0000	0.0000 (103)
Cooled fraction	0.0000	0.0000	0.0000	0.0000	0.0000	939.2575	1130.4189	853.1357	0.0000	0.0000	0.0000	0.0000 (104)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500 (105)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	234.8144	282.6047	213.2839	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement												730.7030 (107)
Energy for space heating												32.4505 (99)
Energy for space cooling												3.2621 (108)
Total												35.7126 (109)
Fabric Energy Efficiency (DFEE)												35.7 (109)

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

### 1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Main dwelling			
Ground floor	120.0000 (1b)	x 2.4100 (2b)	= 289.2000 (1b) - (3b)
First floor	104.0000 (1c)	x 2.6300 (2c)	= 273.5200 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	224.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	562.7200 (5)

### 2. Ventilation rate

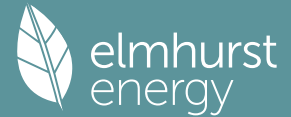
		m3 per hour
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	4 * 10 =	40.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) = 0.0711 (8)
Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design AP50	5.0000	(17)
Infiltration rate	0.3211	(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) =	0.2729 (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	0.3480	0.3412	0.3343	0.3002	0.2934	0.2593	0.2593	0.2525	0.2729	0.2934	0.3070	0.3207 (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	0.5605	0.5582	0.5559	0.5451	0.5430	0.5336	0.5336	0.5319	0.5372	0.5430	0.5471	0.5514 (25)

### 3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
Main dwelling							
TER Semi-glazed door			2.1000	1.0000	2.1000		(26a)
TER Opening Type			42.5000	1.1450	48.6641		(27)
TER Roof Window			1.6000	1.1450	2.2642		(27a)
Ground Floor			120.0000	0.1300	15.6000		(28a)
External Wall	228.5000	44.6000	183.9000	0.1800	33.1020		(29a)
Roof (loft)	113.0000		113.0000	0.1100	12.4300		(30)
Roof (skelling)	10.5000	1.6000	8.9000	0.1100	0.9790		(30)
Total net area of external elements Aum(A, m2)			472.0000				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		115.1393		(33)

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

171.1567 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	39.5000	0.0500	1.9750
E3 Sill	25.8000	0.0500	1.2900
E4 Jamb	56.3000	0.0500	2.8150
E5 Ground floor (normal)	50.1000	0.1600	8.0160
E6 Intermediate floor within a dwelling	43.4000	0.0000	0.0000
E10 Eaves (insulation at ceiling level)	10.2000	0.0600	0.6120
E11 Eaves (insulation at rafter level)	9.6000	0.0400	0.3840
E12 Gable (insulation at ceiling level)	17.5000	0.0600	1.0500
E13 Gable (insulation at rafter level)	7.6000	0.0800	0.6080
E16 Corner (normal)	26.2000	0.0900	2.3580
R1 Head of roof window	1.8000	0.0800	0.1440
R2 Sill of roof window	1.8000	0.0600	0.1080
R3 Jamb of roof window	5.4000	0.0800	0.4320

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

19.7920 (36)

Point Thermal bridges

(36a) = 0.0000

Total fabric heat loss

(33) + (36) + (36a) = 134.9313 (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	104.0915	103.6549	103.2270	101.2171	100.8410	99.0904	99.0904	98.7662	99.7647	100.8410	101.6018	102.3971
Heat transfer coeff	239.0228	238.5862	238.1583	236.1483	235.7723	234.0217	234.0217	233.6975	234.6960	235.7723	236.5330	237.3284
Average = Sum(39)m / 12 =												236.1465

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.0671	1.0651	1.0632	1.0542	1.0526	1.0447	1.0447	1.0433	1.0477	1.0526	1.0560	1.0595
HLP (average)												1.0542
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Assumed occupancy												3.0331 (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
Hot water usage for baths	32.4081	31.9268	31.2490	29.9993	29.0636	28.0260	27.4655	28.1385	28.8714	29.9816	31.2571	32.2986
Hot water usage for other uses	45.6923	44.0307	42.3692	40.7077	39.0461	37.3846	37.3846	39.0461	40.7077	42.3692	44.0307	45.6923
Average daily hot water use (litres/day)												71.5859 (43)
Daily hot water use	78.1004	75.9576	73.6183	70.7070	68.1097	65.4106	64.8501	67.1847	69.5790	72.3508	75.2878	77.9909
Energy conte	123.6920	108.1626	113.1485	96.7944	91.6888	80.4299	78.4306	83.1887	85.7979	98.1794	107.2613	122.1148
Energy content (annual)												1188.8887
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
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
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
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
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
Total heat required for water heating calculated for each month	105.1382	91.9382	96.1762	82.2752	77.9354	68.3654	66.6660	70.7104	72.9282	83.4525	91.1721	103.7976
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
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
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
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
Output from w/h	105.1382	91.9382	96.1762	82.2752	77.9354	68.3654	66.6660	70.7104	72.9282	83.4525	91.1721	103.7976
12Total per year (kWh/year)												1011 (64)
Electric shower(s)	60.1230	53.5700	58.4964	55.8224	56.8699	54.2484	56.0567	56.8699	55.8224	58.4964	57.3965	60.1230
Total Energy used by instantaneous electric shower (s) (kWh/year) = Sum(64a)m =												683.8951 (64a)
Heat gains from water heating, kWh/month	41.3153	36.3771	38.6682	34.5244	33.7013	30.6535	30.6807	31.8951	32.1877	35.4872	37.1421	40.9801

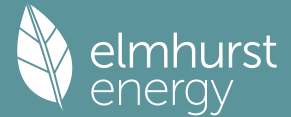
5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565	151.6565
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	199.9605	221.3849	199.9605	206.6259	199.9605	206.6259	199.9605	199.9605	206.6259	199.9605	206.6259	199.9605
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	393.3198	397.4012	387.1161	365.2205	337.5811	311.6040	294.2496	290.1682	300.4533	322.3490	349.9884	375.9655
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656	38.1656
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)	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252
Water heating gains (Table 5)	55.5313	54.1325	51.9733	47.9506	45.2975	42.5742	41.2374	42.8697	44.7051	47.6979	51.5863	55.0808
Total internal gains	717.3085	741.4155	707.5469	688.2938	651.3360	629.3010	603.9446	601.4954	620.2812	638.5043	676.6975	699.5038

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
Northeast	2.0000	11.2829	0.6300	0.7000	0.7700	6.8964 (75)
Southeast	15.1000	36.7938	0.6300	0.7000	0.7700	169.7946 (77)
Southwest	3.1000	36.7938	0.6300	0.7000	0.7700	34.8585 (79)

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Northwest		22.3000		11.2829		0.6300		0.7000		0.7700		76.8952 (81)
Southeast		0.6000		39.9751		0.6300		0.7000		1.0000		9.5197 (82)
Northwest		1.0000		16.3666		0.6300		0.7000		1.0000		6.4959 (82)

Solar gains	304.4602	550.0288	835.6219	1173.9086	1440.8370	1485.6945	1409.3738	1201.8680	951.4976	630.3306	370.4051	256.8402 (83)
Total gains	1021.7688	1291.4443	1543.1689	1862.2024	2092.1730	2114.9955	2013.3184	1803.3634	1571.7788	1268.8349	1047.1025	956.3439 (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	44.5554	44.6369	44.7171	45.0977	45.1696	45.5075	45.5075	45.5707	45.3768	45.1696	45.0244	44.8735
alpha	3.9704	3.9758	3.9811	4.0065	4.0113	4.0338	4.0338	4.0380	4.0251	4.0113	4.0016	3.9916
util living area	0.9967	0.9913	0.9772	0.9290	0.8188	0.6458	0.4941	0.5639	0.8128	0.9643	0.9930	0.9975 (86)
MIT	19.0656	19.3330	19.7332	20.2642	20.6868	20.9137	20.9772	20.9620	20.7765	20.1979	19.5334	19.0229 (87)
Th 2	20.0278	20.0294	20.0310	20.0384	20.0398	20.0462	20.0462	20.0474	20.0437	20.0398	20.0370	20.0340 (88)
util rest of house	0.9959	0.9891	0.9715	0.9110	0.7749	0.5689	0.3945	0.4603	0.7506	0.9520	0.9910	0.9968 (89)
MIT 2	18.2441	18.5114	18.9087	19.4289	19.8144	19.9996	20.0382	20.0328	19.9030	19.3753	18.7176	18.2060 (90)
Living area fraction									fLA = Living area / (4) =			0.1228 (91)
MIT	18.3449	18.6122	19.0099	19.5315	19.9215	20.1118	20.1535	20.1469	20.0103	19.4763	18.8178	18.3063 (92)
Temperature adjustment												0.0000
adjusted MIT	18.3449	18.6122	19.0099	19.5315	19.9215	20.1118	20.1535	20.1469	20.0103	19.4763	18.8178	18.3063 (93)

## 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	1015.4330	1271.8401	1486.8353	1674.9509	1608.4479	1215.2331	817.6483	850.6199	1175.8183	1195.7629	1033.7489	951.7377 (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	3357.0561	3271.5493	2979.3475	2510.6005	1938.4093	1289.8919	831.6001	875.6375	1387.1169	2092.7787	2771.6355	3347.8265 (97)
Space heating kWh	1742.1676	1343.8046	1110.4291	601.6677	245.4913	0.0000	0.0000	0.0000	0.0000	667.3798	1251.2783	1782.6901 (98a)
Space heating requirement - total per year (kWh/year)												8744.9084
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	1742.1676	1343.8046	1110.4291	601.6677	245.4913	0.0000	0.0000	0.0000	0.0000	667.3798	1251.2783	1782.6901 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												8744.9084
Space heating per m2												39.0398 (99)

## 8c. Space cooling requirement

Calculated for June, July and August. See Table 10b												
Ext. temp.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat loss rate W	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8286	0.8902	0.8475	0.0000	0.0000	0.0000	0.0000 (100)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1822.7322	1541.6060	1505.2129	0.0000	0.0000	0.0000	0.0000 (101)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2360.7916	2246.7808	2008.3819	0.0000	0.0000	0.0000	0.0000 (102)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	387.4028	524.6500	374.3577	0.0000	0.0000	0.0000	0.0000 (103)
Cooled fraction									fc = cooled area / (4) =			1.0000 (104)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500 (105)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	96.8507	131.1625	93.5894	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling requirement												321.6026 (107)
Energy for space heating												39.0398 (99)
Energy for space cooling												1.4357 (108)
Total												40.4755 (109)
Fabric Energy Efficiency (TFEE)												40.5 (109)

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

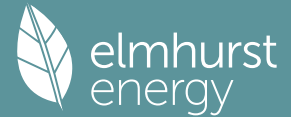
## 1. Overall dwelling characteristics

Main dwelling		Area (m2)	Storey height (m)	Volume (m3)
Ground floor		120.0000 (1b)	x 2.4100 (2b)	= 289.2000 (1b) - (3b)
First floor		104.0000 (1c)	x 2.6300 (2c)	= 273.5200 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)		224.0000		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	562.7200 (5)

## 2. Ventilation rate

m3 per hour

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Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	6 * 10 =	60.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)

Air changes per hour

Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	60.0000 / (5) =	0.1066 (8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50			5.0000 (17)
Infiltration rate			0.3566 (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) =		0.3031 (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	0.3865	0.3789	0.3713	0.3334	0.3259	0.2880	0.2880	0.2804	0.3031	0.3259	0.3410	0.3562 (22b)
	0.5747	0.5718	0.5689	0.5556	0.5531	0.5415	0.5415	0.5393	0.5459	0.5531	0.5581	0.5634 (25)

### 3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
Main dwelling							
Doors			2.1000	1.3000	2.7300		(26a)
Windows			42.5000	1.2357	52.5190		(27)
Rooflights			1.6000	1.2357	1.9772		(27a)
Ground Floor			120.0000	0.1200	14.4000	75.0000	9000.0000 (28a)
External Wall	228.5000	44.6000	183.9000	0.1800	33.1020	60.0000	11034.0000 (29a)
Roof (loft)	113.0000		113.0000	0.1100	12.4300	9.0000	1017.0000 (30)
Roof (skelting)	10.5000	1.6000	8.9000	0.1500	1.3350	9.0000	80.1000 (30)
Total net area of external elements Aum(A, m2)			472.0000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	118.4932	(33)
Main dwelling							
Internal Wall			165.0000			75.0000	12375.0000 (32c)
Internal Wall			225.0000			9.0000	2025.0000 (32c)
Internal Floor			104.0000			18.0000	1872.0000 (32d)
Internal Ceiling			104.0000			9.0000	936.0000 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 38339.1000 (34)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 171.1567 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	39.5000	0.0500	1.9750
E3 Sill	25.8000	0.0200	0.5160
E4 Jamb	56.3000	0.0150	0.8445
E5 Ground floor (normal)	50.1000	0.0530	2.6553
E6 Intermediate floor within a dwelling	43.4000	0.0010	0.0434
E10 Eaves (insulation at ceiling level)	10.2000	0.0560	0.5712
E11 Eaves (insulation at rafter level)	9.6000	0.0170	0.1632
E12 Gable (insulation at ceiling level)	17.5000	0.0360	0.6300
E13 Gable (insulation at rafter level)	7.6000	0.0380	0.2888
E16 Corner (normal)	26.2000	0.0380	0.9956
R1 Head of roof window	1.8000	0.2400	0.4320
R2 Sill of roof window	1.8000	0.2400	0.4320
R3 Jamb of roof window	5.4000	0.2400	1.2960

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 10.8430 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 129.3362 (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	106.7182	106.1796	105.6517	103.1722	102.7083	100.5487	100.5487	100.1488	101.3805	102.7083	103.6468	104.6279 (38)
Heat transfer coeff	236.0544	235.5158	234.9879	232.5084	232.0445	229.8849	229.8849	229.4850	230.7167	232.0445	232.9830	233.9641 (39)
Average = Sum(39)m / 12 =												232.5062

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.0538	1.0514	1.0491	1.0380	1.0359	1.0263	1.0263	1.0245	1.0300	1.0359	1.0401	1.0445 (40)
HLP (average)												1.0380
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

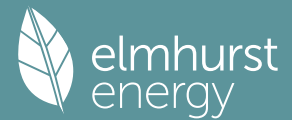
### 4. Water heating energy requirements (kWh/year)

Assumed occupancy 3.0331 (42)

Hot water usage for mixer showers	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hot water usage for mixer showers	93.8444	92.4341	90.3790	86.4470	83.5452	80.3092	78.4699	80.5094	82.7451	86.2196	90.2361	93.4848 (42a)
Hot water usage for baths	32.4081	31.9268	31.2490	29.9993	29.0636	28.0260	27.4655	28.1385	28.8714	29.9816	31.2571	32.2986 (42b)
Hot water usage for other uses	45.6923	44.0307	42.3692	40.7077	39.0461	37.3846	37.3846	39.0461	40.7077	42.3692	44.0307	45.6923 (42c)
Average daily hot water use (litres/day)												158.1072 (43)

Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	171.9448	168.3916	163.9972	157.1540	151.6549	145.7198	143.3200	147.6941	152.3241	158.5704	165.5239	171.4757 (44)
Energy conte	272.3185	239.7874	252.0576	215.1359	204.1567	179.1795	173.3331	182.8761	187.8309	215.1786	235.8191	268.4894 (45)
Energy content (annual)										Total = Sum(45)m =		2626.1629
Distribution loss (46)m = 0.15 x (45)m												
Distribution loss	40.8478	35.9681	37.8086	32.2704	30.6235	26.8769	26.0000	27.4314	28.1746	32.2768	35.3729	40.2734 (46)
Water storage loss:												
Store volume												300.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												2.0000 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												1.0800 (55)

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Total storage loss	33.4800	30.2400	33.4800	32.4000	33.4800	32.4000	33.4800	33.4800	32.4000	33.4800	32.4000	33.4800 (56)
If cylinder contains dedicated solar storage	33.4800	30.2400	33.4800	32.4000	33.4800	32.4000	33.4800	33.4800	32.4000	33.4800	32.4000	33.4800 (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	329.0609	291.0386	308.8000	270.0479	260.8991	234.0915	230.0755	239.6185	242.7429	271.9210	290.7311	325.2318 (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)
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	329.0609	291.0386	308.8000	270.0479	260.8991	234.0915	230.0755	239.6185	242.7429	271.9210	290.7311	325.2318 (64)
												Total per year (kWh/year) = Sum(64)m = 3294.2589 (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	135.9398	120.7303	129.2031	115.4623	113.2760	103.5068	103.0272	106.2002	106.3834	116.9408	122.3395	134.6667 (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	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	48.5669	43.1367	35.0811	26.5586	19.8529	16.7607	18.1105	23.5407	31.5962	40.1187	46.8244	49.9167 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	587.0445	593.1361	577.7853	545.1052	503.8523	465.0805	439.1786	433.0869	448.4377	481.1179	522.3707	561.1425 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319 (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)	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252 (71)
Water heating gains (Table 5)	182.7148	179.6582	173.6601	160.3643	152.2527	143.7594	138.4774	142.7422	147.7547	157.1785	169.9159	181.0036 (72)
Total internal gains	935.2206	932.8255	903.4209	848.9226	792.8524	742.4951	712.6609	716.2643	744.6832	795.3096	856.0055	908.9573 (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						
Northeast	2.0000	11.2829	0.6300	0.0000	0.7700	10.9467 (75)						
Southeast	15.1000	36.7938	0.6300	0.0000	0.7700	269.5152 (77)						
Southwest	3.1000	36.7938	0.6300	0.0000	0.7700	55.3309 (79)						
Northwest	22.3000	11.2829	0.6300	0.0000	0.7700	122.0558 (81)						
Southeast	0.6000	39.9751	0.6300	0.7000	1.0000	9.5197 (82)						
Northwest	1.0000	16.3666	0.6300	0.7000	1.0000	6.4959 (82)						
Solar gains	473.8642	854.9323	1296.2219	1817.3888	2228.0136	2296.3969	2178.8182	1859.6414	1474.7253	979.0205	576.2887	399.8885 (83)
Total gains	1409.0848	1787.7578	2199.6428	2666.3114	3020.8661	3038.8920	2891.4791	2575.9057	2219.4085	1774.3300	1432.2943	1308.8458 (84)

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	45.1157	45.2188	45.3204	45.8037	45.8953	46.3264	46.3264	46.4072	46.1594	45.8953	45.7104	45.5187
alpha	4.0077	4.0146	4.0214	4.0536	4.0597	4.0884	4.0884	4.0938	4.0773	4.0597	4.0474	4.0346
util living area	0.9895	0.9736	0.9314	0.8230	0.6507	0.4709	0.3467	0.4035	0.6531	0.9037	0.9791	0.9921 (86)
MIT	19.6757	19.9183	20.2573	20.6197	20.8293	20.9047	20.9200	20.9165	20.8541	20.5258	20.0218	19.6319 (87)
Th 2	20.0387	20.0407	20.0427	20.0518	20.0535	20.0615	20.0615	20.0630	20.0584	20.0535	20.0500	20.0464 (88)
util rest of house	0.9872	0.9678	0.9171	0.7908	0.5992	0.4065	0.2742	0.3241	0.5827	0.8772	0.9736	0.9903 (89)
MIT 2	18.4798	18.7882	19.2114	19.6485	19.8750	19.9519	19.9627	19.9625	19.9098	19.5539	18.9294	18.4299 (90)
Living area fraction	18.6267	18.9269	19.3398	19.7677	19.9921	20.0688	20.0802	20.0796	20.0257	19.6732	19.0635	18.5775 (92)
Temperature adjustment												0.0000
adjusted MIT	18.6267	18.9269	19.3398	19.7677	19.9921	20.0688	20.0802	20.0796	20.0257	19.6732	19.0635	18.5775 (93)

## 8. Space heating requirement

Utilisation	0.9823	0.9591	0.9044	0.7800	0.5957	0.4071	0.2756	0.3255	0.5801	0.8644	0.9660	0.9863 (94)
Useful gains	1384.1676	1714.6719	1989.4017	2079.7388	1799.4958	1237.0067	797.0182	838.4931	1287.5493	1533.8091	1383.5593	1290.9530 (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	3381.8717	3303.5651	3017.1961	2526.8409	1924.1439	1257.2035	800.0501	844.4169	1367.1665	2105.3881	2787.2885	3363.8137 (97)
Space heating kWh	1486.2918	1067.7362	764.6790	321.9135	92.7382	0.0000	0.0000	0.0000	0.0000	425.2548	1010.6850	1542.2083 (98a)
Space heating requirement - total per year (kWh/year)												6711.5068
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	1486.2918	1067.7362	764.6790	321.9135	92.7382	0.0000	0.0000	0.0000	0.0000	425.2548	1010.6850	1542.2083 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												6711.5068
Space heating per m <sup>2</sup>												(98c) / (4) = 29.9621 (99)

# Full SAP Calculation Printout



## 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 %)													219.3000 (206)
Efficiency of main space heating system 2 (in %)													0.0000 (207)
Efficiency of secondary/supplementary heating system, %													37.0000 (208)
Space heating requirement	1486.2918	1067.7362	764.6790	321.9135	92.7382	0.0000	0.0000	0.0000	0.0000	425.2548	1010.6850	1542.2083	(98)
Space heating efficiency (main heating system 1)	219.3000	219.3000	219.3000	219.3000	219.3000	0.0000	0.0000	0.0000	0.0000	219.3000	219.3000	219.3000	(210)
Space heating fuel (main heating system)	677.7436	486.8838	348.6908	146.7914	42.2883	0.0000	0.0000	0.0000	0.0000	193.9146	460.8687	703.2414	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	329.0609	291.0386	308.8000	270.0479	260.8991	234.0915	230.0755	239.6185	242.7429	271.9210	290.7311	325.2318	(64)
Efficiency of water heater (217)m	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	(216)
Fuel for water heating, kWh/month	172.8261	152.8564	162.1849	141.8319	137.0268	122.9472	120.8380	125.8501	127.4910	142.8156	152.6949	170.8150	(219)
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(232)
Lighting	42.5103	34.1033	30.7063	22.4967	17.3771	14.1973	15.8520	20.6050	26.7639	35.1157	39.6631	43.6918	(231)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-21.3406	-36.9848	-68.0942	-95.1649	-116.0134	-111.9676	-108.6671	-92.6622	-68.4514	-46.3395	-25.1729	-17.6278	(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	-3.0129	-8.2873	-24.3533	-55.8535	-97.7483	-110.2719	-105.4620	-75.5563	-41.7954	-15.4034	-4.5571	-2.2220	(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													3060.4226 (211)
Space heating fuel - main system 2													0.0000 (213)
Space heating fuel - secondary													0.0000 (215)
Efficiency of water heater													190.4000
Water heating fuel used													1730.1780 (219)
Space cooling fuel													0.0000 (221)
Electricity for pumps and fans:													0.0000 (231)
Total electricity for the above, kWh/year													343.0824 (232)
Electricity for lighting (calculated in Appendix L)													
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation													-1353.0097 (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													3780.6733 (238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3060.4226	16.4900	504.6637	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1730.1780	16.4900	285.3063	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(249)
Energy for lighting	343.0824	16.4900	56.5743	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-808.4864	16.4900	-133.3194	
PV Unit electricity exported	-544.5233	5.5900	-30.4389	
Total			-163.7583	(252)
Total energy cost			682.7861	(255)

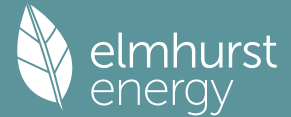
## 11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600 (256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	0.9138 (257)
SAP value		85.1879
SAP rating (Section 12)		85 (258)
SAP band		B

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year

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Space heating - main system 1	3060.4226	0.1565	478.8884 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1730.1780	0.1410	243.9500 (264)
Space and water heating			722.8384 (265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (267)
Energy for lighting	343.0824	0.1443	49.5174 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-808.4864	0.1310	-105.9409
PV Unit electricity exported	-544.5233	0.1174	-63.9312
Total			-169.8720 (269)
Total CO2, kg/year			602.4838 (272)
CO2 emissions per m2			2.6900 (273)
EI value			96.9988
EI rating			97 (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

Main dwelling	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	120.0000 (1b)	x 2.4100 (2b)	= 289.2000 (1b) - (3b)
First floor	104.0000 (1c)	x 2.6300 (2c)	= 273.5200 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	224.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 562.7200 (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	6 * 10 = 60.0000 (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) =	60.0000 / (5) = 0.1066 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.3566 (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) = 0.3031 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	3.9000	3.5000	3.5000	3.4000	3.4000	3.1000	3.2000	3.0000	2.9000	3.1000	3.0000	3.3000 (22)
Wind factor	0.9750	0.8750	0.8750	0.8500	0.8500	0.7750	0.8000	0.7500	0.7250	0.7750	0.7500	0.8250 (22a)
Adj infilt rate												
Effective ac	0.2956	0.2652	0.2652	0.2577	0.2577	0.2349	0.2425	0.2273	0.2198	0.2349	0.2273	0.2501 (22b)
	0.5437	0.5352	0.5352	0.5332	0.5332	0.5276	0.5294	0.5258	0.5241	0.5276	0.5258	0.5313 (25)

3. Heat losses and heat loss parameter

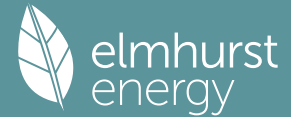
Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
Main dwelling							
Doors			2.1000	1.3000	2.7300		(26a)
Windows			42.5000	1.2357	52.5190		(27)
Rooflights			1.6000	1.2357	1.9772		(27a)
Ground Floor			120.0000	0.1200	14.4000	75.0000	9000.0000 (28a)
External Wall	228.5000	44.6000	183.9000	0.1800	33.1020	60.0000	11034.0000 (29a)
Roof (loft)	113.0000		113.0000	0.1100	12.4300	9.0000	1017.0000 (30)
Roof (skelling)	10.5000	1.6000	8.9000	0.1500	1.3350	9.0000	80.1000 (30)
Total net area of external elements Aum(A, m2)			472.0000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	118.4932	(33)
Main dwelling							
Internal Wall			165.0000			75.0000	12375.0000 (32c)
Internal Wall			225.0000			9.0000	2025.0000 (32c)
Internal Floor			104.0000			18.0000	1872.0000 (32d)
Internal Ceiling			104.0000			9.0000	936.0000 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	38339.1000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							171.1567 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	39.5000	0.0500	1.9750
E3 Sill	25.8000	0.0200	0.5160
E4 Jamb	56.3000	0.0150	0.8445
E5 Ground floor (normal)	50.1000	0.0530	2.6553
E6 Intermediate floor within a dwelling	43.4000	0.0010	0.0434
E10 Eaves (insulation at ceiling level)	10.2000	0.0560	0.5712
E11 Eaves (insulation at rafter level)	9.6000	0.0170	0.1632



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## 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	46.2439	46.5630	46.5630	46.6380	46.6380	46.8513	46.7822	46.9185	46.9836	46.8513	46.9185	46.7111
alpha	4.0829	4.1042	4.1042	4.1092	4.1092	4.1234	4.1188	4.1279	4.1322	4.1234	4.1279	4.1141
util living area	0.9835	0.9667	0.9084	0.7640	0.5693	0.3684	0.2614	0.2925	0.5504	0.8484	0.9650	0.9877 (86)
MIT	19.8595	20.0434	20.3948	20.7201	20.8744	20.9183	20.9238	20.9233	20.8930	20.6643	20.2085	19.8165 (87)
Th 2	20.0600	20.0658	20.0658	20.0672	20.0672	20.0710	20.0698	20.0722	20.0734	20.0710	20.0722	20.0685 (88)
util rest of house	0.9796	0.9595	0.8899	0.7256	0.5148	0.3089	0.1961	0.2198	0.4774	0.8099	0.9558	0.9848 (89)
MIT 2	18.7297	18.9652	19.3977	19.7732	19.9307	19.9712	19.9732	19.9756	19.9565	19.7273	19.1811	18.6819 (90)
Living area fraction	FLA = Living area / (4) =											0.1228 (91)
MIT	18.8685	19.0975	19.5201	19.8895	20.0466	20.0874	20.0899	20.0920	20.0715	19.8424	19.3072	18.8212 (92)
Temperature adjustment	0.0000											
adjusted MIT	18.8685	19.0975	19.5201	19.8895	20.0466	20.0874	20.0899	20.0920	20.0715	19.8424	19.3072	18.8212 (93)

## 8. Space heating requirement

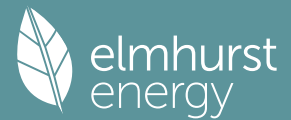
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9732	0.9500	0.8772	0.7177	0.5136	0.3099	0.1975	0.2213	0.4772	0.7990	0.9460	0.9795 (94)
Useful gains	1484.7974	1751.3778	2011.1241	2055.7062	1638.0431	1059.4911	634.4591	632.7487	1161.9085	1537.0060	1471.9112	1369.6569 (95)
Ext temp.	5.1000	5.4000	7.2000	9.6000	12.6000	15.4000	17.3000	17.3000	14.8000	11.5000	8.0000	5.1000 (96)
Heat loss rate W	3170.8120	3132.8606	2817.8255	2349.5898	1700.4237	1065.5001	635.1012	633.7315	1194.8861	1896.2951	2566.5633	3128.3156 (97)
Space heating kWh	1254.3949	928.3565	600.1858	211.5961	46.4112	0.0000	0.0000	0.0000	0.0000	267.3111	788.1495	1308.4421 (98a)
Space heating requirement - total per year (kWh/year)												5404.8471
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	1254.3949	928.3565	600.1858	211.5961	46.4112	0.0000	0.0000	0.0000	0.0000	267.3111	788.1495	1308.4421 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												5404.8471
Space heating per m2												(98c) / (4) = 24.1288 (99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												
Fraction of space heat from main system(s)												
Efficiency of main space heating system 1 (in %)												
Efficiency of main space heating system 2 (in %)												
Efficiency of secondary/supplementary heating system, %												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	1254.3949	928.3565	600.1858	211.5961	46.4112	0.0000	0.0000	0.0000	0.0000	267.3111	788.1495	1308.4421 (98)
Space heating efficiency (main heating system 1)	219.3000	219.3000	219.3000	219.3000	219.3000	0.0000	0.0000	0.0000	0.0000	219.3000	219.3000	219.3000 (210)
Space heating fuel (main heating system)	571.9995	423.3272	273.6825	96.4871	21.1633	0.0000	0.0000	0.0000	0.0000	121.8929	359.3933	596.6448 (211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)
Water heating requirement	329.0609	291.0386	308.8000	270.0479	260.8991	234.0915	230.0755	239.6185	242.7429	271.9210	290.7311	325.2318 (64)
Efficiency of water heater	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000 (216)
Fuel for water heating, kWh/month	172.8261	152.8564	162.1849	141.8319	137.0268	122.9472	120.8380	125.8501	127.4910	142.8156	152.6949	170.8150 (219)
Space cooling fuel requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (231)
Lighting	42.5103	34.1033	30.7063	22.4967	17.3771	14.1973	15.8520	20.6050	26.7639	35.1157	39.6631	43.6918 (232)
Electricity generated by PVs (Appendix M) (negative quantity)	-27.0270	-40.5134	-73.9429	-103.7385	-122.5932	-125.0622	-120.4343	-104.2504	-78.1607	-53.4533	-30.9373	-21.9641 (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)	-4.6064	-9.9937	-29.6741	-69.7760	-113.3993	-139.5646	-131.0913	-95.7240	-53.5695	-21.1057	-6.7710	-3.3016 (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												2464.5906 (211)
Space heating fuel - main system 1												0.0000 (213)
Space heating fuel - main system 2												0.0000 (215)
Space heating fuel - secondary												190.4000
Efficiency of water heater												1730.1780 (219)
Water heating fuel used												0.0000 (221)
Space cooling fuel												0.0000 (231)
Electricity for pumps and fans:												0.0000 (232)
Total electricity for the above, kWh/year												343.0824 (232)
Electricity for lighting (calculated in Appendix L)												

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

# Full SAP Calculation Printout



PV generation	-1580.6547	(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	2957.1963	(238)

## 10a. Fuel costs - using BEDF prices (572)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	2464.5906	26.0600	642.2723 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1730.1780	26.0600	450.8844 (247)
Energy for instantaneous electric shower(s)	0.0000	26.0600	0.0000 (247a)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (249)
Energy for lighting	343.0824	26.0600	89.4073 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-902.0774	26.0600	-235.0814
PV Unit electricity exported	-678.5773	5.8100	-39.4253
Total			-274.5067 (252)
Total energy cost			908.0572 (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	2464.5906	0.1572	387.5318 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1730.1780	0.1410	243.9500 (264)
Space and water heating			631.4818 (265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (267)
Energy for lighting	343.0824	0.1443	49.5174 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-902.0774	0.1312	-118.3264
PV Unit electricity exported	-678.5773	0.1174	-79.6554
Total			-197.9818 (269)
Total CO2, kg/year			483.0174 (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	2464.5906	1.5821	3899.2126 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1730.1780	1.5214	2632.2251 (278)
Space and water heating			6531.4376 (279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (281)
Energy for lighting	343.0824	1.5338	526.2312 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-902.0774	1.4846	-1339.2058
PV Unit electricity exported	-678.5773	0.4303	-291.9927
Total			-1631.1985 (283)
Total Primary energy kWh/year			5426.4704 (286)

## SAP 10 EPC IMPROVEMENTS

CJ5701C

Current energy efficiency rating: B 85  
 Current environmental impact rating: A 97

N Solar water heating	Recommended
U Solar photovoltaic panels	Already installed
V2 Wind turbine	Not applicable

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.0	-£ 88	-44 kg (9.2%)

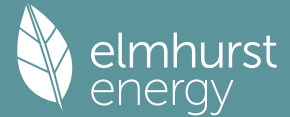
Recommended measures	Typical annual savings	Energy efficiency impact	Environmental impact
Solar water heating	£88	0.20 kg/m <sup>2</sup>	B 86 A 97
<b>Total Savings</b>	<b>£88</b>	<b>0.20 kg/m<sup>2</sup></b>	

Potential energy efficiency rating: B 86  
 Potential environmental impact rating: A 97

Fuel prices for cost data on this page from database revision number 572 TEST (30 May 2025)  
 Recommendation texts revision number 6.1 (11 Jun 2019)

Typical heating and lighting costs of this home (per year, South East England):	Saving		
	Current	Potential	
Electricity	£1183	£1089	£94
Space heating	£642	£663	-£21
Water heating	£451	£336	£115
Lighting	£89	£89	£0

# Full SAP Calculation Printout



Generated (PV)	-£275	-£269	-£5
Total cost of fuels	£908	£820	£89
Total cost of uses	£907	£819	£89
Delivered energy	13 kWh/m <sup>2</sup>	12 kWh/m <sup>2</sup>	2 kWh/m <sup>2</sup>
Carbon dioxide emissions	0.5 tonnes	0.4 tonnes	0.0 tonnes
CO2 emissions per m <sup>2</sup>	2 kg/m <sup>2</sup>	2 kg/m <sup>2</sup>	0 kg/m <sup>2</sup>
Primary energy	24 kWh/m <sup>2</sup>	22 kWh/m <sup>2</sup>	2 kWh/m <sup>2</sup>

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

## 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Main dwelling			
Ground floor	120.0000 (1b)	x 2.4100 (2b)	= 289.2000 (1b) - (3b)
First floor	104.0000 (1c)	x 2.6300 (2c)	= 273.5200 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	224.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 562.7200 (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	6 * 10 = 60.0000 (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) =	60.0000 / (5) = 0.1066 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.3566 (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) = 0.3031 (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	0.3865	0.3789	0.3713	0.3334	0.3259	0.2880	0.2880	0.2804	0.3031	0.3259	0.3410	0.3562 (22b)
Effective ac	0.5747	0.5718	0.5689	0.5556	0.5531	0.5415	0.5415	0.5393	0.5459	0.5531	0.5581	0.5634 (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
Main dwelling							
Doors			2.1000	1.3000	2.7300		(26a)
Windows			42.5000	1.2357	52.5190		(27)
Rooflights			1.6000	1.2357	1.9772		(27a)
Ground Floor			120.0000	0.1200	14.4000	75.0000	9000.0000 (28a)
External Wall	228.5000	44.6000	183.9000	0.1800	33.1020	60.0000	11034.0000 (29a)
Roof (loft)	113.0000		113.0000	0.1100	12.4300	9.0000	1017.0000 (30)
Roof (skelling)	10.5000	1.6000	8.9000	0.1500	1.3350	9.0000	80.1000 (30)
Total net area of external elements Aum (A, m <sup>2</sup> )			472.0000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 118.4932		(33)
Main dwelling							
Internal Wall			165.0000			75.0000	12375.0000 (32c)
Internal Wall			225.0000			9.0000	2025.0000 (32c)
Internal Floor			104.0000			18.0000	1872.0000 (32d)
Internal Ceiling			104.0000			9.0000	936.0000 (32e)
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 38339.1000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							171.1567 (35)

### List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	39.5000	0.0500	1.9750
E3 Sill	25.8000	0.0200	0.5160
E4 Jamb	56.3000	0.0150	0.8445
E5 Ground floor (normal)	50.1000	0.0530	2.6553
E6 Intermediate floor within a dwelling	43.4000	0.0010	0.0434
E10 Eaves (insulation at ceiling level)	10.2000	0.0560	0.5712
E11 Eaves (insulation at rafter level)	9.6000	0.0170	0.1632
E12 Gable (insulation at ceiling level)	17.5000	0.0360	0.6300
E13 Gable (insulation at rafter level)	7.6000	0.0380	0.2888
E16 Corner (normal)	26.2000	0.0380	0.9956
R1 Head of roof window	1.8000	0.2400	0.4320
R2 Sill of roof window	1.8000	0.2400	0.4320
R3 Jamb of roof window	5.4000	0.2400	1.2960
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			10.8430 (36)



# Full SAP Calculation Printout



Southeast		15.1000	36.7938	0.6300	0.0000	0.7700	269.5152 (77)
Southwest		3.1000	36.7938	0.6300	0.7700	0.7700	55.3309 (79)
Northwest		22.3000	11.2829	0.6300	0.0000	0.7700	122.0558 (81)
Southeast		0.6000	39.9751	0.6300	0.7000	1.0000	9.5197 (82)
Northwest		1.0000	16.3666	0.6300	0.7000	1.0000	6.4959 (82)

Solar gains	473.8642	854.9323	1296.2219	1817.3888	2228.0136	2296.3969	2178.8182	1859.6414	1474.7253	979.0205	576.2887	399.8885 (83)
Total gains	1409.0848	1787.7578	2198.1420	2658.8074	3007.1087	3024.8845	2877.4717	2562.8988	2213.4053	1772.8292	1432.2943	1308.8458 (84)

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	45.1157	45.2188	45.3204	45.8037	45.8953	46.3264	46.3264	46.4072	46.1594	45.8953	45.7104	45.5187
alpha	4.0077	4.0146	4.0214	4.0536	4.0597	4.0884	4.0884	4.0938	4.0773	4.0597	4.0474	4.0346
util living area	0.9895	0.9736	0.9315	0.8241	0.6529	0.4729	0.3483	0.4054	0.6544	0.9039	0.9791	0.9921 (86)
MIT	19.6757	19.9183	20.2568	20.6180	20.8281	20.9044	20.9199	20.9164	20.8536	20.5253	20.0218	19.6319 (87)
Th 2	20.0387	20.0407	20.0427	20.0518	20.0535	20.0615	20.0615	20.0630	20.0584	20.0535	20.0500	20.0464 (88)
util rest of house	0.9872	0.9678	0.9172	0.7919	0.6014	0.4083	0.2755	0.3257	0.5840	0.8775	0.9736	0.9903 (89)
MIT 2	18.4798	18.7882	19.2107	19.6467	19.8739	19.9517	19.9627	19.9624	19.9094	19.5534	18.9294	18.4299 (90)
Living area fraction												FLA = Living area / (4) =
MIT	18.6267	18.9269	19.3392	19.7660	19.9911	20.0686	20.0802	20.0795	20.0253	19.6727	19.0635	18.5775 (92)
Temperature adjustment												0.0000
adjusted MIT	18.6267	18.9269	19.3392	19.7660	19.9911	20.0686	20.0802	20.0795	20.0253	19.6727	19.0635	18.5775 (93)

## 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9823	0.9591	0.9046	0.7811	0.5978	0.4088	0.2770	0.3271	0.5814	0.8647	0.9660	0.9863 (94)
Ext temp.	1384.1676	1714.6719	1988.3927	2076.8590	1797.6618	1236.6374	796.9541	838.3664	1286.8365	1532.9608	1383.5593	1290.9530 (95)
Heat loss rate W	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)
Space heating kWh	3381.8717	3303.5651	3017.0457	2526.4273	1923.8938	1257.1540	800.0410	844.3992	1367.0689	2105.2633	2787.2885	3363.8137 (97)
Solar heating kWh	1486.2918	1067.7362	765.3178	323.6892	93.9166	0.0000	0.0000	0.0000	0.0000	425.7931	1010.6850	1542.2083 (98a)
Space heating requirement - total per year (kWh/year)												6715.6381
Solar heating contribution - total per year (kWh/year)												-0.0000 (98b)
Space heating kWh	1486.2918	1067.7362	765.3178	323.6892	93.9166	0.0000	0.0000	0.0000	0.0000	425.7931	1010.6850	1542.2083 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												6715.6381
Space heating per m2												(98c) / (4) = 29.9805 (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 %)												219.3000 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												37.0000 (208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	1486.2918	1067.7362	765.3178	323.6892	93.9166	0.0000	0.0000	0.0000	0.0000	425.7931	1010.6850	1542.2083 (98)
Space heating efficiency (main heating system 1)	219.3000	219.3000	219.3000	219.3000	219.3000	0.0000	0.0000	0.0000	0.0000	219.3000	219.3000	219.3000 (210)
Space heating fuel (main heating system)	677.7436	486.8838	348.9821	147.6011	42.8256	0.0000	0.0000	0.0000	0.0000	194.1601	460.8687	703.2414 (211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)
Water heating												
Water heating requirement	329.0609	274.8670	247.7745	180.2161	138.0236	119.7551	115.9337	139.9673	177.8832	241.6623	290.7311	325.2318 (64)
Efficiency of water heater (217)m	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000 (216)
Fuel for water heating, kWh/month	172.8261	144.3629	130.1336	94.6513	72.4914	62.8966	60.8895	73.5122	93.4260	126.9235	152.6949	170.8150 (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	6.7945	6.1370	6.7945	6.5753	6.7945	6.5753	6.7945	6.7945	6.5753	6.7945	6.5753	6.7945 (231)
Lighting	42.5103	34.1033	30.7063	22.4967	17.3771	14.1973	15.8520	20.6050	26.7639	35.1157	39.6631	43.6918 (232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	-21.3478	-36.9766	-67.8213	-93.8816	-112.2851	-107.3976	-104.2291	-89.8661	-67.4926	-46.2585	-25.1863	-17.6332 (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	-3.0056	-8.2956	-24.6261	-57.1367	-101.4766	-114.8419	-109.9000	-78.3524	-42.7542	-15.4844	-4.5437	-2.2167 (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												3062.3065 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)

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Efficiency of water heater		190.4000	
Water heating fuel used		1355.6232	(219)
Space cooling fuel		0.0000	(221)
Electricity for pumps and fans:			
pump for solar water heating		80.0000	(230g)
Total electricity for the above, kWh/year		80.0000	(231)
Electricity for lighting (calculated in Appendix L)		343.0824	(232)
Energy saving/generation technologies (Appendices M ,N and Q)			
PV generation		-1353.0097	(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		3488.0023	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	3062.3065	16.4900	504.9743 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1355.6232	16.4900	223.5423 (247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000 (247a)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (249)
Pump for solar water heating	80.0000	16.4900	13.1920 (249)
Energy for lighting	343.0824	16.4900	56.5743 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-790.3758	16.4900	-130.3330
PV Unit electricity exported	-562.6339	5.5900	-31.4512
Total			-161.7842 (252)
Total energy cost			636.4987 (255)

-----  
 11a. SAP rating - Individual heating systems  
 -----

Energy cost deflator (Table 12):		0.3600	(256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	0.8518	(257)
SAP value		86.1920	
SAP rating (Section 12)		86	(258)
SAP band		B	

-----  
 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	3062.3065	0.1565	479.1531 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1355.6232	0.1449	196.3822 (264)
Space and water heating			675.5353 (265)
Pumps, fans and electric keep-hot	80.0000	0.1387	11.0970 (267)
Energy for lighting	343.0824	0.1443	49.5174 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-790.3758	0.1313	-103.7440
PV Unit electricity exported	-562.6339	0.1172	-65.9224
Total			-169.6665 (269)
Total CO2, kg/year			566.4832 (272)
CO2 emissions per m2			2.5300 (273)
EI value			97.1781
EI rating			97 (274)
EI band			A

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 SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)  
 CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING  
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-----  
 1. Overall dwelling characteristics  
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	Area (m2)	Storey height (m)	Volume (m3)
Main dwelling			
Ground floor	120.0000 (1b)	x 2.4100 (2b)	= 289.2000 (1b) - (3b)
First floor	104.0000 (1c)	x 2.6300 (2c)	= 273.5200 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	224.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	562.7200 (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)

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Number of flues attached to solid fuel boiler 0 \* 20 = 0.0000 (6d)  
 Number of flues attached to other heater 0 \* 35 = 0.0000 (6e)  
 Number of blocked chimneys 0 \* 20 = 0.0000 (6f)  
 Number of intermittent extract fans 6 \* 10 = 60.0000 (7a)  
 Number of passive vents 0 \* 10 = 0.0000 (7b)  
 Number of flueless gas fires 0 \* 40 = 0.0000 (7c)

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = 60.0000 / (5) = 0.1066 (8)  
 Pressure test Yes  
 Pressure Test Method Blower Door  
 Measured/design AP50 5.0000 (17)  
 Infiltration rate 0.3566 (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) = 0.3031 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	3.9000	3.5000	3.5000	3.4000	3.4000	3.1000	3.2000	3.0000	2.9000	3.1000	3.0000	3.3000
Wind factor	0.9750	0.8750	0.8750	0.8500	0.8500	0.7750	0.8000	0.7500	0.7250	0.7750	0.7500	0.8250
Adj infilt rate												
Effective ac	0.2956	0.2652	0.2652	0.2577	0.2577	0.2349	0.2425	0.2273	0.2198	0.2349	0.2273	0.2501
	0.5437	0.5352	0.5352	0.5332	0.5332	0.5276	0.5294	0.5258	0.5241	0.5276	0.5258	0.5313

### 3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
Main dwelling							
Doors			2.1000	1.3000	2.7300		(26a)
Windows			42.5000	1.2357	52.5190		(27)
Rooflights			1.6000	1.2357	1.9772		(27a)
Ground Floor			120.0000	0.1200	14.4000	75.0000	9000.0000 (28a)
External Wall	228.5000	44.6000	183.9000	0.1800	33.1020	60.0000	11034.0000 (29a)
Roof (loft)	113.0000		113.0000	0.1100	12.4300	9.0000	1017.0000 (30)
Roof (skelling)	10.5000	1.6000	8.9000	0.1500	1.3350	9.0000	80.1000 (30)
Total net area of external elements Aum(A, m2)			472.0000				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	118.4932		(33)
Main dwelling							
Internal Wall			165.0000			75.0000	12375.0000 (32c)
Internal Wall			225.0000			9.0000	2025.0000 (32c)
Internal Floor			104.0000			18.0000	1872.0000 (32d)
Internal Ceiling			104.0000			9.0000	936.0000 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 38339.1000 (34)  
 Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 171.1567 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	39.5000	0.0500	1.9750
E3 Sill	25.8000	0.0200	0.5160
E4 Jamb	56.3000	0.0150	0.8445
E5 Ground floor (normal)	50.1000	0.0530	2.6553
E6 Intermediate floor within a dwelling	43.4000	0.0010	0.0434
E10 Eaves (insulation at ceiling level)	10.2000	0.0560	0.5712
E11 Eaves (insulation at rafter level)	9.6000	0.0170	0.1632
E12 Gable (insulation at ceiling level)	17.5000	0.0360	0.6300
E13 Gable (insulation at rafter level)	7.6000	0.0380	0.2888
E16 Corner (normal)	26.2000	0.0380	0.9956
R1 Head of roof window	1.8000	0.2400	0.4320
R2 Sill of roof window	1.8000	0.2400	0.4320
R3 Jamb of roof window	5.4000	0.2400	1.2960

Thermal bridges (Sum(L x Psi) calculated using Appendix K)  
 Point Thermal bridges (36a) = 10.8430 (36)  
 Total fabric heat loss (33) + (36) + (36a) = 129.3362 (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	100.9593	99.3809	99.3809	99.0130	99.0130	97.9732	98.3091	97.6479	97.3333	97.9732	97.6479	98.6557
Heat transfer coeff	230.2955	228.7171	228.7171	228.3492	228.3492	227.3094	227.6453	226.9841	226.6695	227.3094	226.9841	227.9919
Average = Sum(39)m / 12 =												227.9435

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.0281	1.0211	1.0211	1.0194	1.0194	1.0148	1.0163	1.0133	1.0119	1.0148	1.0133	1.0178
HLP (average)												1.0176
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

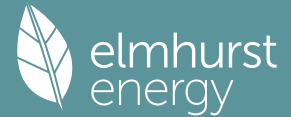
### 4. Water heating energy requirements (kWh/year)

Assumed occupancy 3.0331 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hot water usage for mixer showers	93.8444	92.4341	90.3790	86.4470	83.5452	80.3092	78.4699	80.5094	82.7451	86.2196	90.2361	93.4848
Hot water usage for baths	32.4081	31.9268	31.2490	29.9993	29.0636	28.0260	27.4655	28.1385	28.8714	29.9816	31.2571	32.2986
Hot water usage for other uses	45.6923	44.0307	42.3692	40.7077	39.0461	37.3846	37.3846	39.0461	40.7077	42.3692	44.0307	45.6923
Average daily hot water use (litres/day)												158.1072

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	171.9448	168.3916	163.9972	157.1540	151.6549	145.7198	143.3200	147.6941	152.3241	158.5704	165.5239	171.4757
Energy conte	272.3185	239.7874	252.0576	215.1359	204.1567	179.1795	173.3331	182.8761	187.8309	215.1786	235.8191	268.4894
Energy content (annual)												2626.1629
Distribution loss (46)m = 0.15 x (45)m	40.8478	35.9681	37.8086	32.2704	30.6235	26.8769	26.0000	27.4314	28.1746	32.2768	35.3729	40.2734
Water storage loss:												
Store volume												300.0000
a) If manufacturer declared loss factor is known (kWh/day):												2.0000
Temperature factor from Table 2b												0.5400
Enter (49) or (54) in (55)												1.0800
Total storage loss	33.4800	30.2400	33.4800	32.4000	33.4800	32.4000	33.4800	33.4800	32.4000	33.4800	32.4000	33.4800
If cylinder contains dedicated solar storage												

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Primary loss	33.4800	30.2400	33.4800	32.4000	33.4800	32.4000	33.4800	33.4800	32.4000	33.4800	32.4000	33.4800 (57)
Combi loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624 (59)
Total heat required for water heating calculated for each month	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)
WWHRS	329.0609	291.0386	307.4043	263.2943	248.1048	221.4848	217.0485	227.5221	237.3400	270.5252	290.7311	325.2318 (62)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63a)
Aperture area of solar collector	-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)
Zero-loss collector efficiency												3.0000 (H1)
Collector linear heat loss coefficient												0.8000 (H2)
Collector 2nd order heat loss coefficient												1.8000 (H3)
Collector loop efficiency												0.0000 (H4)
Incidence angle modifier												0.9000 (H5)
Overshading factor												1.0000 (H6)
Overall heat loss coefficient of system												0.8000 (H8)
Heat loss coefficient of collector loop												6.5000 (H10)
Dedicated solar storage volume												3.9667 (H11)
Effective solar volume												75.0000 (H12)
Reference volume												75.0000 (H14)
Storage tank correction coefficient												225.0000 (H15)
Heat delivered to hot water												1.3161 (H16)
Heat delivered to space heating												773.0287 (H24)
Solar input												0.0000 (H29)
Solar input	-3.0056	-20.7991	-67.5165	-95.4999	-119.8214	-120.8181	-118.0714	-104.6856	-73.8426	-41.7067	-7.2618	-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	326.0552	270.2395	239.8878	167.7945	128.2833	100.6667	98.9772	122.8365	163.4974	228.8185	283.4693	325.2318 (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	135.9398	120.7303	128.0865	110.0594	103.0406	93.4214	92.6056	96.5231	102.0611	115.8242	122.3395	134.6667 (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	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878	181.9878 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	48.5669	43.1367	35.0811	26.5586	19.8529	16.7607	18.1105	23.5407	31.5962	40.1187	46.8244	49.9167 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	587.0445	593.1361	577.7853	545.1052	503.8523	465.0805	439.1786	433.0869	448.4377	481.1179	522.3707	561.1425 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319	56.2319 (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)	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252	-121.3252 (71)
Water heating gains (Table 5)	182.7148	179.6582	172.1593	152.8603	138.4954	129.7519	124.4699	129.7353	141.7515	155.6777	169.9159	181.0036 (72)
Total internal gains	935.2206	932.8255	901.9201	841.4186	779.0951	728.4876	698.6535	703.2574	738.6800	793.8088	856.0055	908.9573 (73)

## 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W						
Northeast	2.0000	14.6130	0.6300	0.0000	0.7700	14.1776 (75)						
Southeast	15.1000	45.0642	0.6300	0.0000	0.7700	330.0956 (77)						
Southwest	3.1000	45.0642	0.6300	0.0000	0.7700	67.7680 (79)						
Northwest	22.3000	14.6130	0.6300	0.0000	0.7700	158.0799 (81)						
Southeast	0.6000	50.1759	0.6300	0.7000	1.0000	11.9489 (82)						
Northwest	1.0000	21.2590	0.6300	0.7000	1.0000	8.4377 (82)						
Solar gains	590.5076	910.8155	1389.1928	2015.4983	2396.7268	2676.0702	2499.9805	2142.4936	1690.1303	1128.3062	700.0020	489.3220 (83)
Total gains	1525.7282	1843.6410	2291.1129	2856.9169	3175.8219	3404.5579	3198.6340	2845.7510	2428.8102	1922.1150	1556.0076	1398.2793 (84)

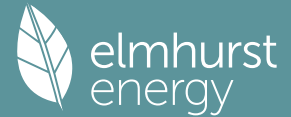
## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	46.2439	46.5630	46.5630	46.6380	46.6380	46.8513	46.7822	46.9185	46.9836	46.8513	46.9185	46.7111
alpha	4.0829	4.1042	4.1042	4.1092	4.1092	4.1234	4.1188	4.1279	4.1322	4.1234	4.1279	4.1141
util living area	0.9835	0.9667	0.9086	0.7652	0.5714	0.3698	0.2625	0.2938	0.5516	0.8486	0.9650	0.9877 (86)
MIT	19.8595	20.0434	20.3943	20.7189	20.8737	20.9182	20.9237	20.9233	20.8927	20.6639	20.2085	19.8165 (87)
Th 2	20.0600	20.0658	20.0658	20.0672	20.0672	20.0710	20.0698	20.0722	20.0734	20.0710	20.0722	20.0685 (88)
util rest of house	0.9796	0.9595	0.8901	0.7268	0.5168	0.3101	0.1969	0.2208	0.4784	0.8102	0.9558	0.9848 (89)
MIT 2	18.7297	18.9652	19.3971	19.7720	19.9302	19.9711	19.9732	19.9756	19.9564	19.7269	19.1811	18.6819 (90)
Living area fraction	18.8685	19.0975	19.5196	19.8882	20.0460	20.0874	20.0899	20.0920	20.0713	19.8420	19.3072	18.8212 (92)
MIT	18.8685	19.0975	19.5196	19.8882	20.0460	20.0874	20.0899	20.0920	20.0713	19.8420	19.3072	18.8212 (92)
Temperature adjustment												0.0000
adjusted MIT	18.8685	19.0975	19.5196	19.8882	20.0460	20.0874	20.0899	20.0920	20.0713	19.8420	19.3072	18.8212 (93)

## 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9732	0.9500	0.8774	0.7188	0.5155	0.3112	0.1983	0.2223	0.4783	0.7993	0.9460	0.9795 (94)
Ext temp.	5.1000	5.4000	7.2000	9.6000	12.6000	15.4000	17.3000	17.3000	14.8000	11.5000	8.0000	5.1000 (95)
Heat loss rate W	3170.8120	3132.8606	2817.6957	2349.3033	1700.2945	1065.4860	635.0993	633.7285	1194.8451	1896.2063	2566.5633	3128.3156 (97)

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Space heating kWh	1254.3949	928.3565	600.7536	212.8758	47.0383	0.0000	0.0000	0.0000	0.0000	267.7090	788.1495	1308.4421 (98a)
Space heating requirement - total per year (kWh/year)												5407.7196
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	1254.3949	928.3565	600.7536	212.8758	47.0383	0.0000	0.0000	0.0000	0.0000	267.7090	788.1495	1308.4421 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												5407.7196
Space heating per m2												(98c) / (4) = 24.1416 (99)

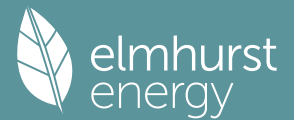
## 9a. Energy requirements - Individual heating systems, including micro-CHP

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 %)												219.3000 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												37.0000 (208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	1254.3949	928.3565	600.7536	212.8758	47.0383	0.0000	0.0000	0.0000	0.0000	267.7090	788.1495	1308.4421 (98)
Space heating efficiency (main heating system 1)	219.3000	219.3000	219.3000	219.3000	219.3000	0.0000	0.0000	0.0000	0.0000	219.3000	219.3000	219.3000 (210)
Space heating fuel (main heating system)	571.9995	423.3272	273.9414	97.0706	21.4493	0.0000	0.0000	0.0000	0.0000	122.0743	359.3933	596.6448 (211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)
Water heating requirement	326.0552	270.2395	239.8878	167.7945	128.2833	100.6667	98.9772	122.8365	163.4974	228.8185	283.4693	325.2318 (64)
Efficiency of water heater	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000 (216)
Fuel for water heating, kWh/month	171.2475	141.9325	125.9915	88.1273	67.3757	52.8711	51.9838	64.5150	85.8705	120.1778	148.8810	170.8150 (219)
Space cooling fuel requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	6.7945	6.1370	6.7945	6.7945	6.7945	6.7945	6.7945	6.7945	6.7945	6.7945	6.7945	6.7945 (231)
Lighting	42.5103	34.1033	30.7063	22.4967	17.3771	14.1973	15.8520	20.6050	26.6739	35.1157	39.6631	43.6918 (232)
Electricity generated by PVs (Appendix M) (negative quantity)	-27.0361	-40.4920	-73.5282	-101.7627	-117.7694	-118.3639	-114.1384	-100.0921	-76.6177	-53.2396	-30.9465	-21.9726 (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)	-4.5973	-10.0150	-30.0888	-71.7518	-118.2231	-146.2630	-137.3873	-99.8823	-55.1125	-21.3194	-6.7619	-3.2931 (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												2465.9004 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												190.4000
Water heating fuel used												1289.7887 (219)
Space cooling fuel												0.0000 (221)
Electricity for pumps and fans:												
pump for solar water heating												80.0000 (230g)
Total electricity for the above, kWh/year												80.0000 (231)
Electricity for lighting (calculated in Appendix L)												343.0824 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-1580.6547 (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												2598.1169 (238)

## 10a. Fuel costs - using BEDF prices (572)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	2465.9004	26.0600	642.6136 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1289.7887	26.0600	336.1189 (247)
Energy for instantaneous electric shower(s)	0.0000	26.0600	0.0000 (247a)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (249)
Pump for solar water heating	80.0000	26.0600	20.8480 (249)
Energy for lighting	343.0824	26.0600	89.4073 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-875.9591	26.0600	-228.2749
PV Unit electricity exported	-704.6956	5.8100	-40.9428
Total			-269.2178 (252)
Total energy cost			819.7701 (255)

# Full SAP Calculation Printout



## 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	2465.9004	0.1572	387.7173 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1289.7887	0.1457	187.8797 (264)
Space and water heating			575.5970 (265)
Pumps, fans and electric keep-hot	80.0000	0.1387	11.0970 (267)
Energy for lighting	343.0824	0.1443	49.5174 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-875.9591	0.1315	-115.1588
PV Unit electricity exported	-704.6956	0.1171	-82.5268
Total			-197.6856 (269)
Total CO2, kg/year			438.5258 (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	2465.9004	1.5821	3901.2095 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1289.7887	1.5388	1984.7759 (278)
Space and water heating			5885.9853 (279)
Pumps, fans and electric keep-hot	80.0000	1.5128	121.0240 (281)
Energy for lighting	343.0824	1.5338	526.2312 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-875.9591	1.4857	-1301.4055
PV Unit electricity exported	-704.6956	0.4293	-302.4978
Total			-1603.9033 (283)
Total Primary energy kWh/year			4929.3372 (286)

# Part G Compliance Report

## PROJECT DETAILS

Project Reference: CJ5701G  
Client: Pippin Deveopments Ltd  
Property: 4 Bedroom House (2 no)  
Crosswinds, Hampers Lane  
Storrington RH20 3HZ

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Local Authority: Horsham District Council  
Agent: Mark Alford Design

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Assessor: Joe Solti  
Address: Therm Energy Ltd  
Contact: 01903 884357  
Software: G-Calc 2015 version 3.0.2  
Prepared on: 20-Jun-25

## RESULT SUMMARY

By following the Government's national calculation methodology for assessing water efficiency in new dwellings this 4 bed dwelling, as designed, achieves a water consumption of 110 litres per person per day.

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

<b>Table 1: The Water Calculator for New Dwellings</b>					
Installation Type	Unit of measure	Value	Use factor	Fixed use	litres/person/day
WC(single flush)	Flush volume (litres)		4.42	0.00	0
WC(dual flush)	Full flush vol.	6	1.46	0.00	8.76
	Part flush vol.	3	2.96	0.00	8.88
WC(multiple fittings)	Average effective Flush vol. (litres)		4.42	0.00	0
Taps(excl. Kitchen)	Flow rate (litres/min)	6	1.58	1.58	11.06
Bath (shower also present)	Capacity to overflow (litres)	180	0.11	0.00	19.8
Shower (bath also present)	Flow rate (litres/min)	8	4.37	0.00	34.96
Bath only	Capacity to overflow (litres)	0	0.50	0.00	0
Shower only	Flow rate (litres/minute)	0	5.6	0.00	0
Kitchen sink taps	Flow rate (litres/minute)	6	0.44	10.36	13
Washing Machine	litres/kg dry load	7.1	2.1	0.0	14.91
Dishwasher	litres/place setting	1.1	3.6	0.0	3.96
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)					115.33
Contribution from greywater (litres/person/day)					-
Contribution from rainwater (litres/person/day)					- 0
Normalisation factor					0.91
Total Water Consumption. Code for Sustainable Homes (litres/person/day)					<b>105</b>
External water use					5.0
Total Water Consumption. (36(1)) (litres/person/day)					<b>110</b>

<b>Summary of fitting types "As Designed"</b>			
Type	Description	Flow rates, volumes etc.	Qty
Taps	Taps	6 litres/min	1
Baths	Baths	180 litres to overflow	1
Dishwashers	Dishwasher	1.1 litres/place	1
Washing Machines	Washing Machine	7.1 litres/kg	1
Showers	Showers	8 litres/min	1
WC's	Toilets	6 / 3 litres flush vols.	1
		litres flush vols.	1
Kitchen/Utility taps	Taps	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 (Mark Alford Design).  
The completed table should be returned to the assessor: Joe Solti (Contact: 01903 884357).

<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: CJ5701G - 4 Bedroom House (2 no)

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

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

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