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Energy Conservation Specialists

**Hillside  
Headcorn Road  
Grafty Green  
ME17 2AP**

## **Energy Assessment**

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**Reference:** Falcon/10198777

**Date:** May 2023

**Hillside, Grafty Green, Headcorn Road, ME17 2AP  
Energy Assessment**



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## Hillside, Headcorn Road.

# Energy Assessment

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Rev	Date	Purpose/Status	Document ref	QA
0	17 <sup>th</sup> May 2023	Planning	NV-10198777	NV OCDEA 06290 STR007444



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# Hillside, Headcorn Road

## Energy Assessment

### 1. Introduction

Falcon Energy has been instructed by Cyma Architects to undertake an energy report as part of a planning submission not only to condition 13 in the 22/503658/FULL consent but also to condition 9 in the Section 73 consent 23/500826/FULL for the site known as Hillside, the proposed works are for the demolition of the existing bungalow and outbuildings, erection of replacement single storey dwelling and carport/storage structure, and relocation of driveway entrance with new five-bar gate.

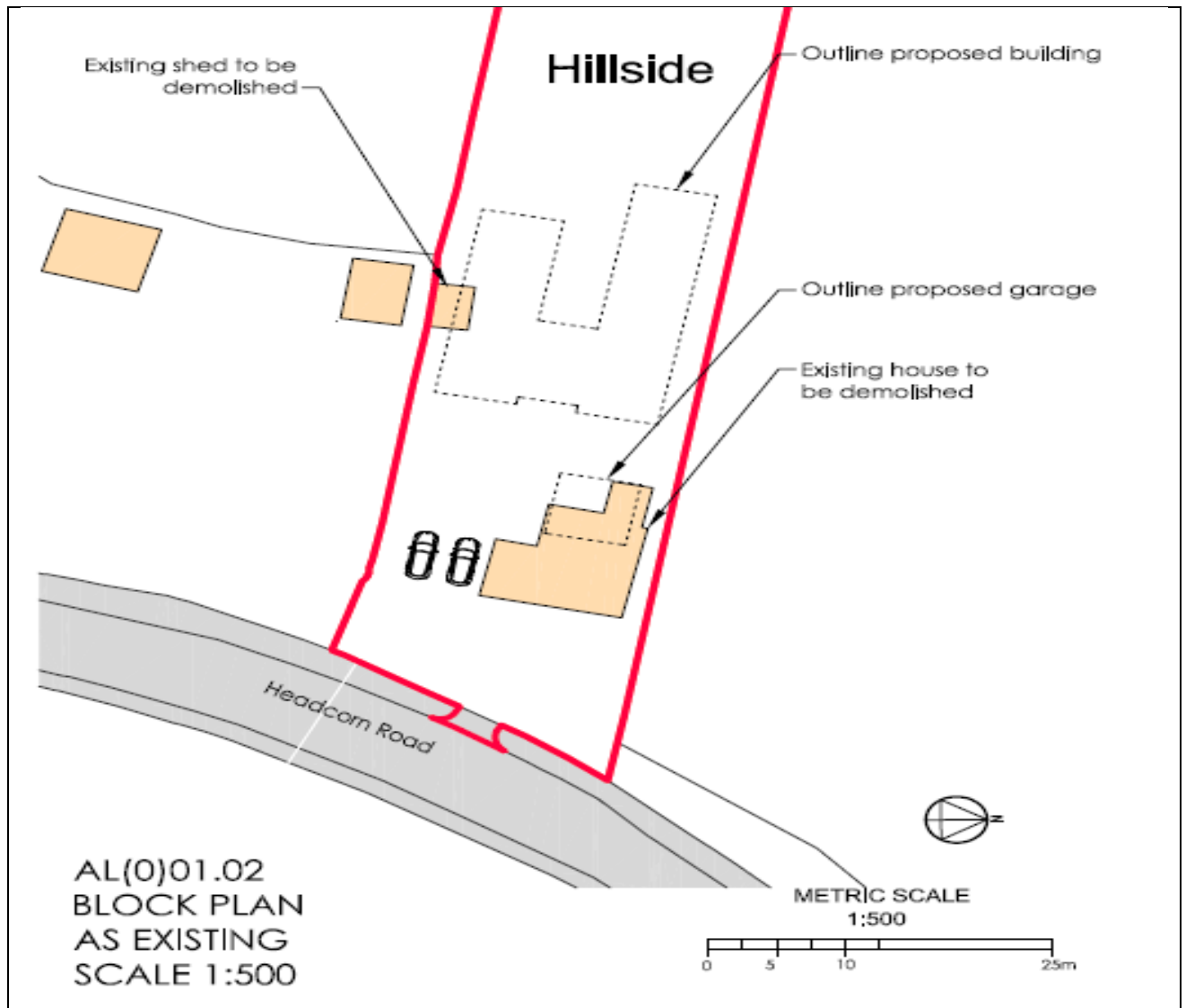


Figure 1, Site Layout



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## Energy Assessment

### 1.0 Energy Strategy.

**Condition 13 in 22/503658/FULL and Condition 9 in 23/500826/FULL** The development shall not commence above slab level until details of how decentralised and renewable or low-carbon sources of energy will be incorporated into the development hereby approved to provide at least 10% of total annual energy requirements of the development, have been submitted to and approved in writing by the local planning authority. The approved details shall be installed prior to first occupation and maintained thereafter;

*Reason: To ensure an energy efficient form of development*

### 1.1 Energy efficient design, insulation and ventilation.

The table below highlights the fabric first approach to the build.

Construction	10 % Reduction Specification (U Value)
External wall	0.11
Floor	0.12
Roof	0.10
Window	1.6
Door	1
Air Test	5
Boiler	n/a
ASHP	Air Hawk 208
Lighting	100% low energy
Renewables	Solar P.V

The house will be insulated with materials that will have a Global Warming Potential (GWP) of less than 5 and an Ozone Depletion Potential (ODP) of zero. This will include all insulation specified within the building elements, hot water stores and piping.



# Hillside, Headcorn Road

## Energy Assessment

### 1.2 Renewable Energies.

The following technologies were considered:

- Solar P.V/thermal
- Air source heat pump
- Ground source heat pump

#### Solar P.V/Thermal

This was felt viable due to the Roof layout and a South elevation.



#### Air source heat pump (Split System)

An air/water heat pump extracts thermal energy from the ambient air (low temperature) and transmits it together with electrical drive energy in the form of useful heat (higher temperature) to a heating and/or DHW circuit. The heat pump consists of separated circuits linked together via heat exchangers:

- ▶ Heat source circuit (extracting heat)
- ▶ Refrigerant circuit
- ▶ Heat sink circuit (supply of heat for room heating and/ or DHW)

Outdoor air is a heat source that is available everywhere in unlimited amounts and can be utilised without approval. It is especially suitable for retrofitting.



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### Energy Assessment

A split system consists of an indoor unit and a separately installed outdoor unit. The outdoor air is routed through the outdoor unit by means of a fan. The indoor and outdoor units are connected through refrigerant lines. Due to the defrosting mode integrated into OCHSNER air/ water heat pumps, the system also operates flawlessly at temperatures below  $-15^{\circ}\text{C}$ . For air/water heat pumps, the most efficient and therefore most common operating mode is bivalent parallel operation. Due to the integral defrosting mode, the monovalent operating mode is also possible. As the heating output of an air/water heat pump at an outdoor temperature of  $+15^{\circ}\text{C}$  is approx. triple the heating output at  $-15^{\circ}\text{C}$ , such systems are vastly oversized for operation in spring and autumn and therefore not recommended. Air Source Heat Pumps extracts heat from the outside air using an external condenser unit and transfers it, through refrigeration pipework to the indoor unit which then conveys that heat to the heating emitters and hot water cylinder. This system is capable of providing 100% of heating within a building. Providing air source heat pumps to the building for the space heating would reduce the carbon dioxide emissions by 19%.

The ASHP will be installed by an MCS accredited installer and designed to be the main heating source. Once full heat loss calculations have been carried out the final design will ensure the system is running to its optimum efficiency.



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## **Hillside, Headcorn Road**

# **Energy Assessment**

The ASHP is run by electricity this is the most efficient way to offset the carbon used to power the system.

The developer commits to monitor the performance of the heat pump system post-construction to ensure it is achieving the expected performance approved during planning.

The ASHP will supply Radiators through a 210-litre cylinder.



# Hillside, Headcorn Road Energy Assessment

## AIR HAWK 208 C11B

- INVERTER AIR/WATER HEAT PUMP
- INCL. HORIZONTAL SPLIT EVAPORATOR
- M2/M4 INDOOR UNIT
- HEATING OR HEATING/COOLING
- OTS CONTROLLER

### APPLIANCE DATA

Order no.		287301V
Suitable building heat load	kW	4 - 8
Max. flow temperature	°C	65
<b>Indoor unit</b>		
Dimensions (HxWxD)	mm	1280x600x580
Hydraulic assembly connection (dimension)	Inch	1
Hydraulic assembly connection (connection type)		Female thread
Liquid line connection (external diameter)	mm	10
Suction gas line connection (external diameter)	mm	18
Weight (excl. packaging)	kg	151
Standard colour		White/anthracite
Sound power level (EN12102)	dB(A)	43
Sound pressure level (at 1 m)	dB(A)	35
<b>Outdoor unit</b>		
Dimensions (HxWxD)	mm	1251x1292x965
Weight (excl. packaging)	kg	88
Standard colour		White aluminium (RAL 9006)
Casing type		Stainless steel, coated
Number of fans	pcs	1
Sound power level (EN12102)	dB(A)	45
Sound pressure level (at 3 m)	dB(A)	28
Evaporator type		Finned tube
Evaporator material (WGA)		Copper/aluminium

### HEAT SINK SYSTEM

Heat transfer medium		Water
Max. heat transfer medium op. pressure	bar	3
Min. flow rate, heating (WNA)	m <sup>3</sup> /h	0,50
Min. flow rate, cooling/defrost (WNA)	m <sup>3</sup> /h	0,85
Min. flow rate, DHW (WNA)	m <sup>3</sup> /h	0,50
Min. flow rate, auxiliary heater	m <sup>3</sup> /h	0,85
Flow meter	As standard	Internal
3-way switching module (DHW)	As standard	Internal
Circulation pump	Para 25-180/6-75	Internal
Diaphragm expansion vessel	l	24
Condenser type (WNA)		Plate heat exchanger
Condenser material (WNA)		Stainless steel 1.4301

### ELECTRICAL DATA

Frequency	Hz	50
Power factor		0,97
Voltage fluctuations/flicker		≤15A: EN 61000-3-3
Harmonics		≤15A: EN 61000-3-2
Max. network impedance (Zmax)	Ohm	-
<b>Rated voltage ranges</b>		
Heat pump	V	-220-240 3x L1/N/PE
Compressor and fan	V	-220-240 L1/N/PE
Electric auxiliary heater, stage 1	V	-220-240 L1/N/PE
Electric auxiliary heater, stage 2	V	-220-240 L1/N/PE
Control circuit	V	-220-240 L1/N/PE
<b>Rated power consumptions</b>		
Compressor and fan	kW	3,3
Electric auxiliary heater, stage 1	kW	2,5
Electric auxiliary heater, stage 2	kW	3,0

### Fuse protection

Compressor and fan	1x B16A 1p
Electric auxiliary heater, stage 1	1x B16A 1p
Electric auxiliary heater, stage 2	1x B16A 1p
Control circuit	1x B13A 1p

### Rated currents

Compressor and fan	A	15
Electric auxiliary heater, stage 1	A	15,0
Electric auxiliary heater, stage 2	A	15,0
Control circuit	A	6,3
Max. starting current	A	10

### REFRIGERANT CIRCUIT

Refrigerant		R513A
Refrigerant charge	kg	2,7
Max. refrigerant operating pressure	bar	28,7
Compressor type		Rotary piston
Defrost technology		Refrigerant circuit reversal

### PERFORMANCE FIGURES

<b>A7/W27</b>			
Heating output range	kW	2,0 - 9,0	
Heating output (EN14825)	kW	2,13	
Power consumption (EN14825)	kW	0,34	
Coefficient of performance COP (EN14825)		6,38	
<b>A7/W38</b>			
Heating output range	kW	2,0 - 9,0	
Heating output (EN14511)	kW	2,55	
Power consumption (EN14511)	kW	0,51	
Coefficient of performance COP (EN14511)		5,04	
<b>A7/W88</b>			
Heating output range	kW	2,0 - 8,0	
Heating output (EN14511)	kW	3,98	
Power consumption (EN14511)	kW	1,28	
Coefficient of performance COP (EN14511)		3,10	
<b>A2/W30</b>			
Heating output range	kW	2,0 - 8,0	
Heating output (EN14825)	kW	3,22	
Power consumption (EN14825)	kW	0,71	
Coefficient of performance COP (EN14825)		4,53	
<b>A2/W38</b>			
Heating output range	kW	2,0 - 8,0	
Heating output (EN14511)	kW	2,49	
Power consumption (EN14511)	kW	0,59	
Coefficient of performance COP (EN14511)		4,22	
<b>A-7/W34</b>			
Heating output range	kW	2,0 - 6,3	
Heating output (EN14825)	kW	5,34	
Power consumption (EN14825)	kW	1,97	
Coefficient of performance COP (EN14825)		2,71	
<b>A-10/W38</b>			
Heating output range	kW	2,0 - 5,7	
Heating output (EN14825)	kW	4,90	
Power consumption (EN14825)	kW	1,88	
Coefficient of performance COP (EN14825)		2,60	
<b>A38/W18</b>			
Cooling capacity (EN14825)	kW	6,78	
Power consumption (EN14825)	kW	1,77	
Energy efficiency ratio EER (EN14825)		3,83	





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### Ground Source heat pump

Ground source needs a large area for the pipes to run which we do not have on site.

### 1.3 Summary of energy reductions

Plot Number	TER kgCO <sub>2</sub> /yr/m <sup>2</sup>	DER kgCO <sub>2</sub> /yr/m <sup>2</sup>	Percentage Reduction
House 1	7.2	2.53	64.86%
Total	7.2	2.53	64.86%

The site achieves a 64.86% improvement.

1a Target emission rate and dwelling emission rate	
Fuel for main heating system	Electricity
Target carbon dioxide emission rate	7.2 kgCO <sub>2</sub> /m <sup>2</sup>
Dwelling carbon dioxide emission rate	2.53 kgCO <sub>2</sub> /m <sup>2</sup> OK
1b Target primary energy rate and dwelling primary energy	
Target primary energy	41.11 kWh <sub>PE</sub> /m <sup>2</sup>
Dwelling primary energy	24.87 kWh <sub>PE</sub> /m <sup>2</sup> OK
1c Target fabric energy efficiency and dwelling fabric energy efficiency	
Target fabric energy efficiency	50.9 kWh/m <sup>2</sup>
Dwelling fabric energy efficiency	47.1 kWh/m <sup>2</sup> OK



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## Energy Assessment

### 1.4 10% Reduction SAPs

# Full SAP Calculation Printout



Property Reference	Hillside	Issued on Date	17/05/2023
Assessment Reference	00001	Prop Type Ref	
Property			
SAP Rating	88 B	DER	2.53
Environmental	97 A	TER	7.20
CO <sub>2</sub> Emissions (t/year)	0.42	% DER < TER	64.86
Compliance Check	See BREL	DPER	24.87
% DPER < TPER	39.51	TFEE	50.95
		% DPER < TPER	41.11
Assessor Details	Mr. Neil Vanson	Assessor ID	M057-0001
Client	CYMA Architects, Jesus Roman Garcia		

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

## 1. Overall dwelling characteristics

Ground floor		Area (m <sup>2</sup> )	205.0000 (1b)	Storey height (m)	2.8000 (2b)	Volume (m <sup>3</sup> )	574.0000 (1b) - (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	205.0000						
Dwelling volume							(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 574.0000 (5)

## 2. Ventilation rate

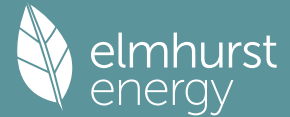
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	5 * 10 =	50.0000 (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) =	50.0000 / (5) =	0.0871 (8)
Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design AP50	5.0000	(17)
Infiltration rate	0.3371	(18)
Number of sides sheltered	0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3371 (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	0.4298	0.4214	0.4130	0.3708	0.3624	0.3203	0.3203	0.3118	0.3371	0.3624	0.3792	0.3961 (22b)
Effective ac	0.5924	0.5888	0.5853	0.5688	0.5657	0.5513	0.5513	0.5486	0.5568	0.5657	0.5719	0.5784 (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
Opening Type 1 (Uw = 1.60)			49.9200	1.5038	75.0677		(27)
Opening			1.4400	1.5038	2.1654		(27a)
Heatloss Floor 1			205.0000	0.1200	24.6000		(28a)
External Wall 1	263.2000	49.9200	213.2800	0.1100	23.4608		(29a)
External Roof 1	225.0000	1.4400	223.5600	0.1000	22.3560		(30)
Total net area of external elements Aum(A, m <sup>2</sup> )			693.2000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	147.6499	(33)

# Full SAP Calculation Printout



Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 100.0000 (35)

List of Thermal Bridges	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	28.4000	0.0060	0.1704
E3 Sill	28.4000	0.0190	0.5396
E4 Jamb	12.0000	0.0060	0.0720
E5 Ground floor (normal)	94.0000	0.0930	8.7420
E16 Corner (normal)	11.2000	0.0350	0.3920
R11 Upstands or kerbs of rooflights	8.4000	0.0380	0.3192
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			10.2352 (36)
Point Thermal bridges			0.0000 (36a) =
Total fabric heat loss			(33) + (36) + (36a) = 157.8851 (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	112.2066	111.5272	110.8613	107.7332	107.1480	104.4236	104.4236	103.9191	105.4730	107.1480	108.3319	109.5697 (38)
Average = Sum(39)m / 12 =	270.0917	269.4123	268.7463	265.6183	265.0331	262.3087	262.3087	261.8042	263.3581	265.0331	266.2170	267.4548 (39)

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.3175	1.3142	1.3110	1.2957	1.2928	1.2796	1.2796	1.2771	1.2847	1.2928	1.2986	1.3047 (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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hot water usage for mixer showers	111.9919	110.3089	107.8564	103.1640	99.7011	95.8393	93.6443	96.0782	98.7463	102.8926	107.6858	111.5628 (42a)
Hot water usage for baths	33.9263	33.4225	32.7129	31.4047	30.4251	29.3389	28.7521	29.4567	30.2239	31.3862	32.7213	33.8116 (42b)
Hot water usage for other uses	47.8308	46.0915	44.3522	42.6129	40.8736	39.1343	39.1343	40.8736	42.6129	44.3522	46.0915	47.8308 (42c)
Average daily hot water use (litres/day)	46.0277	40.5458	42.6326	36.3829	34.5298	30.3062	29.3036	30.9073	31.7369	36.3601	39.8552	45.3769 (43)
Daily hot water use	193.7490	189.8229	184.9215	177.1816	170.9998	164.3125	161.5308	166.4086	171.5831	178.6310	186.4987	193.2052 (44)
Energy content (annual)	306.8511	270.3052	284.2175	242.5527	230.1986	202.0414	195.3575	206.0486	211.5791	242.4006	265.7016	302.5127 (45)
Distribution loss (46)m = 0.15 x (45)m	46.0277	40.5458	42.6326	36.3829	34.5298	30.3062	29.3036	30.9073	31.7369	36.3601	39.8552	45.3769 (46)
Water storage loss:												210.0000 (47)
Store volume												210.0000 (47)
b) If manufacturer declared loss factor is not known:												
Hot water storage loss factor from Table 2 (kWh/litre/day)												0.0103 (51)
Volume factor from Table 2a												0.8298 (52)
Temperature factor from Table 2b												0.7800 (53)
Enter (49) or (54) in (55)												1.3985 (55)
Total storage loss	43.3524	39.1570	43.3524	41.9540	43.3524	41.9540	43.3524	43.3524	41.9540	43.3524	41.9540	43.3524 (56)
If cylinder contains dedicated solar storage	43.3524	39.1570	43.3524	41.9540	43.3524	41.9540	43.3524	43.3524	41.9540	43.3524	41.9540	43.3524 (57)
Primary loss	54.8576	49.5488	54.8576	53.0880	54.8576	22.5120	23.2624	23.2624	22.5120	54.8576	53.0880	54.8576 (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	405.0611	359.0110	382.4275	337.5947	328.4086	266.5074	261.9723	272.6634	276.0450	340.6106	360.7435	400.7227 (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	405.0611	359.0110	382.4275	337.5947	328.4086	266.5074	261.9723	272.6634	276.0450	340.6106	360.7435	400.7227 (64)
12Total per year (kWh/year)												3991.7679 (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	145.9141	129.5155	138.3884	123.1192	120.4271	85.1884	83.5663	87.1211	88.3596	124.4843	130.8162	144.4716 (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	150.4212	150.4212	150.4212	150.4212	150.4212	150.4212	150.4212	150.4212	150.4212	150.4212	150.4212	150.4212 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	189.5342	209.8415	189.5342	195.8520	189.5342	195.8520	189.5342	189.5342	195.8520	189.5342	195.8520	189.5342 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	375.7728	379.6721	369.8459	348.9270	322.5207	297.7025	281.1224	277.2231	287.0493	307.9682	334.3745	359.1927 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.0421	38.0421	38.0421	38.0421	38.0421	38.0421	38.0421	38.0421	38.0421	38.0421	38.0421	38.0421 (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)	-120.3370	-120.3370	-120.3370	-120.3370	-120.3370	-120.3370	-120.3370	-120.3370	-120.3370	-120.3370	-120.3370	-120.3370 (71)
Water heating gains (Table 5)	196.1211	192.7314	186.0059	170.9989	161.8644	118.3172	112.3203	117.0982	122.7217	167.3176	181.6891	194.1822 (72)

# Full SAP Calculation Printout



Total internal gains  
 829.5544 850.3714 813.5124 783.9043 742.0457 679.9981 651.1033 651.9819 673.7494 732.9463 780.0420 811.0355 (73)

## 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
North	1.9200	10.6334	0.7600	0.7000	0.7700	7.5269 (74)
East	6.0000	19.6403	0.7600	0.7000	0.7700	43.4454 (76)
South	10.5000	46.7521	0.7600	0.7000	0.7700	180.9818 (78)
West	31.5000	19.6403	0.7600	0.7000	0.7700	228.0882 (80)
North	1.4400	26.0000	0.7600	0.7000	1.0000	17.9263 (82)

Solar gains 477.9685 879.1946 1342.9680 1845.2144 2193.4902 2223.0218 2125.1011 1865.1688 1520.4837 1012.6112 585.1336 400.4346 (83)  
 Total gains 1307.5230 1729.5660 2156.4804 2629.1187 2935.5359 2903.0199 2776.2044 2517.1507 2194.2331 1745.5576 1365.1756 1211.4701 (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	21.0834	21.1365	21.1889	21.4384	21.4858	21.7089	21.7089	21.7508	21.6224	21.4858	21.3902	21.2912
alpha	2.4056	2.4091	2.4126	2.4292	2.4324	2.4473	2.4473	2.4501	2.4415	2.4324	2.4260	2.4194
util living area	0.9633	0.9314	0.8765	0.7756	0.6446	0.5031	0.3859	0.4340	0.6400	0.8475	0.9419	0.9690 (86)
Living	18.5807	18.9485	19.4553	20.0399	20.4673	20.7192	20.8161	20.7953	20.5806	19.9666	19.1609	18.5233
Non living	17.0024	17.4665	18.0985	18.8140	19.3066	19.5805	19.6658	19.6540	19.4513	18.7504	17.7495	16.9362
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0
24 / 9	20	0	0	0	0	0	0	0	0	0	0	0
16 / 9	11	28	28	0	0	0	0	0	0	0	0	31
MIT	20.5138	19.8381	20.0603	20.0399	20.4673	20.7192	20.8161	20.7953	20.5806	19.9666	19.1609	19.5973 (87)
Th 2	19.8271	19.8297	19.8323	19.8442	19.8464	19.8569	19.8569	19.8588	19.8529	19.8464	19.8419	19.8372 (88)
util rest of house	0.9575	0.9209	0.8579	0.7431	0.5941	0.4313	0.2956	0.3404	0.5704	0.8168	0.9313	0.9640 (89)
MIT 2	19.3847	18.7866	18.9733	18.8140	19.3066	19.5805	19.6658	19.6540	19.4513	18.7504	17.7495	18.5568 (90)
Living area fraction	19.8033	19.1764	19.3763	19.2684	19.7369	20.0026	20.0923	20.0771	19.8699	19.2013	18.2728	0.3707 (91)
MIT	19.8033	19.1764	19.3763	19.2684	19.7369	20.0026	20.0923	20.0771	19.8699	19.2013	18.2728	18.9425 (92)
Temperature adjustment												0.0000
adjusted MIT	19.8033	19.1764	19.3763	19.2684	19.7369	20.0026	20.0923	20.0771	19.8699	19.2013	18.2728	18.9425 (93)

## 8. Space heating requirement

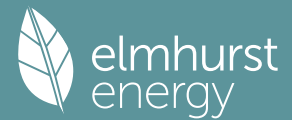
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9574	0.9141	0.8497	0.7246	0.5889	0.4410	0.3150	0.3592	0.5715	0.7960	0.9121	0.9594 (94)
Useful gains	1251.7756	1581.0379	1832.2955	1905.1735	1728.6946	1280.1685	874.4440	904.1398	1254.0599	1389.4760	1245.1876	1162.3042 (95)
Ext temp.	4.3000	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	4187.3163	3846.2471	3460.4501	2754.0488	2130.0446	1417.1601	916.0536	962.6864	1519.5618	2279.6211	2974.3799	3942.9549 (97)
Space heating kWh	2184.0423	1522.2206	1211.3470	611.1902	298.6044	0.0000	0.0000	0.0000	0.0000	662.2680	1245.0184	2068.8041 (98a)
Space heating requirement - total per year (kWh/year)												9803.4951
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	2184.0423	1522.2206	1211.3470	611.1902	298.6044	0.0000	0.0000	0.0000	0.0000	662.2680	1245.0184	2068.8041 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												9803.4951
Space heating per m2										(98c) / (4) =		47.8219 (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 %) 299.0088 (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	2184.0423	1522.2206	1211.3470	611.1902	298.6044	0.0000	0.0000	0.0000	0.0000	662.2680	1245.0184	2068.8041 (98)
Space heating efficiency (main heating system 1)	299.0088	299.0088	299.0088	299.0088	299.0088	0.0000	0.0000	0.0000	0.0000	299.0088	299.0088	299.0088 (210)
Space heating fuel (main heating system)	730.4274	509.0888	405.1208	204.4054	99.8648	0.0000	0.0000	0.0000	0.0000	221.4878	416.3818	691.8873 (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)												

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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	(213)
	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	405.0611	359.0110	382.4275	337.5947	328.4086	266.5074	261.9723	272.6634	276.0450	340.6106	360.7435	400.7227	400.7227	(64)
Efficiency of water heater														
(217)m	185.8383	185.8383	185.8383	185.8383	185.8383	185.8383	185.8383	185.8383	185.8383	185.8383	185.8383	185.8383	185.8383	(216)
Fuel for water heating, kWh/month	217.9643	193.1846	205.7851	181.6605	176.7174	143.4082	140.9679	146.7208	148.5404	183.2833	194.1169	215.6298	215.6298	(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	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	0.0000	(231)
Lighting	39.3815	31.5933	28.4462	20.8409	16.0981	13.1523	14.6853	19.0885	24.7940	32.5311	36.7438	40.4760	40.4760	(232)
Electricity generated by PVs (Appendix M) (negative quantity)														
(233a)m	-92.8526	-149.5315	-241.6233	-295.8618	-332.4388	-297.0723	-292.8004	-269.5973	-227.9638	-181.2534	-107.8340	-78.0317	-78.0317	(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	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	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	(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													3278.6641	(211)
Space heating fuel - main system 2													0.0000	(213)
Space heating fuel - secondary													0.0000	(215)
Efficiency of water heater													185.8383	
Water heating fuel used													2147.9793	(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)													317.8310	(232)
Energy saving/generation technologies (Appendices M ,N and Q)														
PV generation													-2566.8608	(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													3177.6136	(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	3278.6641	0.1558	510.6831 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2147.9793	0.1415	304.0239 (264)
Space and water heating			814.7070 (265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (267)
Energy for lighting	317.8310	0.1443	45.8728 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-2566.8608	0.1332	-342.0271
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-342.0271 (269)
Total CO2, kg/year			518.5528 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			2.5300 (273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	3278.6641	1.5766	5169.2195 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2147.9793	1.5234	3272.2423 (278)
Space and water heating			8441.4618 (279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (281)
Energy for lighting	317.8310	1.5338	487.4998 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-2566.8608	1.4924	-3830.7874
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-3830.7874 (283)
Total Primary energy kWh/year			5098.1742 (286)
Dwelling Primary energy Rate (DPER)			24.8700 (287)

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

## 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	205.0000 (1b)	x 2.8000 (2b)	= 574.0000 (1b) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	205.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 574.0000 (5)

## 2. Ventilation rate

		Air changes 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) =	0.0697 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.3197 (18)
Number of sides sheltered		0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3197 (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	0.4076	0.3996	0.3916	0.3517	0.3437	0.3037	0.3037	0.2957	0.3197	0.3437	0.3596	0.3756 (22b)
Effective ac	0.5831	0.5798	0.5767	0.5618	0.5591	0.5461	0.5461	0.5437	0.5511	0.5591	0.5647	0.5705 (25)

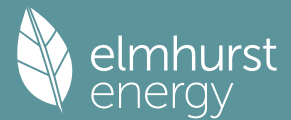
## 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
TER Opening Type (Uw = 1.20)			49.8200	1.1450	57.0458		(27)
Opening			1.4400	2.0221	2.9118		(27a)
Heatloss Floor 1			205.0000	0.1300	26.6500		(28a)
External Wall 1	263.2000	49.8200	213.3800	0.1800	38.4084		(29a)
External Roof 1	225.0000	1.4400	223.5600	0.1100	24.5916		(30)
Total net area of external elements Aum(A, m <sup>2</sup> )			693.2000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	149.6076	(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K	
List of Thermal Bridges	
K1 Element	Length Psi-value Total
E1 Steel lintel with perforated steel base plate	28.4000 0.0500 1.4200
E3 Sill	28.4000 0.0500 1.4200
E4 Jamb	12.0000 0.0500 0.6000
E5 Ground floor (normal)	94.0000 0.1600 15.0400
E16 Corner (normal)	11.2000 0.0900 1.0080
R11 Upstands or kerbs of rooflights	8.4000 0.0800 0.6720
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	20.1600 (36)
Point Thermal bridges	0.0000 (36a) =
Total fabric heat loss	(33) + (36) + (36a) = 169.7676 (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	110.4449	109.8339	109.2350	106.4220	105.8956	103.4456	103.4456	102.9919	104.3893	105.8956	106.9604	108.0735 (38)
Heat transfer coeff	280.2125	279.6015	279.0026	276.1895	275.6632	273.2131	273.2131	272.7594	274.1569	275.6632	276.7279	277.8411 (39)
Average = Sum(39)m / 12 =												276.1870

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.3669	1.3639	1.3610	1.3473	1.3447	1.3327	1.3327	1.3305	1.3374	1.3447	1.3499	1.3553 (40)
HLP (average)												1.3473
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

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

Assumed occupancy												3.0084 (42)
Hot water usage for mixer showers	74.6613	73.5392	71.9042	68.7760	66.4674	63.8929	62.4295	64.0522	65.8309	68.5951	71.7906	74.3752 (42a)
Hot water usage for baths	32.2300	31.7513	31.0773	29.8345	28.9038	27.8719	27.3145	27.9839	28.7127	29.8168	31.0853	32.1210 (42b)
Hot water usage for other uses	45.4393	43.7869	42.1346	40.4823	38.8299	37.1776	37.1776	38.8299	40.4823	42.1346	43.7869	45.4393 (42c)
Average daily hot water use (litres/day)												140.0259 (43)
Daily hot water use	152.3305	149.0775	145.1161	139.0927	134.2012	128.9424	126.9217	130.8660	135.0258	140.5465	146.6628	151.9355 (44)
Energy content (annual)	241.2543	212.2844	223.0381	190.4110	180.6606	158.5497	153.5008	162.0394	166.5003	190.7203	208.9480	237.8943 (45)
Energy content (annual)										Total = Sum(45)m =		2325.8013
Distribution loss (46)m = 0.15 x (45)m	36.1882	31.8427	33.4557	28.5616	27.0991	23.7825	23.0251	24.3059	24.9750	28.6081	31.3422	35.6841 (46)
Water storage loss:												210.0000 (47)
Store volume												1.7016 (48)
a) If manufacturer declared loss factor is known (kWh/day):												0.5400 (49)
Temperature factor from Table 2b												0.9188 (55)
Enter (49) or (54) in (55)												
Total storage loss	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842 (56)
If cylinder contains dedicated solar storage	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842 (57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)
Total heat required for water heating calculated for each month	293.0009	259.0233	274.7847	240.4883	232.4072	208.6271	205.2474	213.7860	216.5776	242.4669	259.0254	289.6409 (62)
WWHRS	-34.1320	-30.1866	-31.6097	-26.1741	-24.3933	-20.8735	-19.5656	-20.8061	-21.5966	-25.4600	-28.8430	-33.4999 (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	258.8689	228.8366	243.1750	214.3142	208.0139	187.7536	185.6818	192.9799	194.9811	217.0070	230.1823	256.1410 (64)
12Total per year (kWh/year)								Total per year (kWh/year) = Sum(64)m =				2617.9353 (64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												0.0000 (64a)
Heat gains from water heating, kWh/month	121.6143	107.9757	115.5574	103.3735	101.4669	92.7797	92.4363	95.2754	95.4232	104.8118	109.5371	120.4971 (65)

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

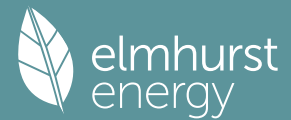
Metabolic gains (Table 5), Watts												
(66)m	150.4212	150.4212	150.4212	150.4212	150.4212	150.4212	150.4212	150.4212	150.4212	150.4212	150.4212	150.4212 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	189.5342	209.8415	189.5342	195.8520	189.5342	195.8520	189.5342	189.5342	195.8520	189.5342	195.8520	189.5342 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	375.7728	379.6721	369.8459	348.9270	322.5207	297.7025	281.1224	277.2231	287.0493	307.9682	334.3745	359.1927 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.0421	38.0421	38.0421	38.0421	38.0421	38.0421	38.0421	38.0421	38.0421	38.0421	38.0421	38.0421 (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)	-120.3370	-120.3370	-120.3370	-120.3370	-120.3370	-120.3370	-120.3370	-120.3370	-120.3370	-120.3370	-120.3370	-120.3370 (71)
Water heating gains (Table 5)	163.4601	160.6781	155.3191	143.5743	136.3803	128.8606	124.2423	128.0583	132.5323	140.8761	152.1348	161.9585 (72)
Total internal gains	799.8935	821.3180	785.8256	759.4798	719.5616	690.5415	663.0253	662.9420	683.5600	709.5048	753.4877	781.8118 (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						
North	1.9200	10.6334	0.6300	0.7000	0.7700	6.2394 (74)						
East	5.9900	19.6403	0.6300	0.7000	0.7700	35.9539 (76)						
South	10.4800	46.7521	0.6300	0.7000	0.7700	149.7386 (78)						
West	31.4300	19.6403	0.6300	0.7000	0.7700	188.6529 (80)						
North	1.4400	26.0000	0.6300	0.7000	1.0000	14.8599 (82)						
Solar gains	395.4448	727.3987	1111.1067	1526.6557	1814.8208	1839.2619	1758.2421	1543.1709	1257.9790	837.7820	484.1075	331.2974 (83)



# Full SAP Calculation Printout



Total gains 1195.3383 1548.7167 1896.9323 2286.1355 2534.3824 2529.8035 2421.2674 2206.1128 1941.5389 1547.2868 1237.5952 1113.1092 (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	20.3219	20.3663	20.4100	20.6179	20.6573	20.8425	20.8425	20.8772	20.7708	20.6573	20.5778	20.4953	
alpha	2.3548	2.3578	2.3607	2.3745	2.3772	2.3895	2.3895	2.3918	2.3847	2.3772	2.3719	2.3664	
util living area	0.9698	0.9455	0.9036	0.8225	0.7079	0.5675	0.4448	0.4941	0.6953	0.8786	0.9529	0.9742	(86)
MIT	17.7429	18.1871	18.8387	19.6391	20.2829	20.7073	20.8828	20.8459	20.4940	19.5953	18.5187	17.6722	(87)
Th 2	19.7888	19.7911	19.7934	19.8040	19.8060	19.8153	19.8153	19.8170	19.8117	19.8060	19.8020	19.7978	(88)
util rest of house	0.9648	0.9367	0.8879	0.7932	0.6584	0.4904	0.3416	0.3896	0.6258	0.8517	0.9439	0.9699	(89)
MIT 2	16.0052	16.5672	17.3851	18.3725	19.1294	19.5942	19.7537	19.7300	19.3911	18.3473	17.0004	15.9200	(90)
Living area fraction									fLA = Living area / (4) =				0.3707 (91)
MIT	16.6494	17.1678	17.9240	18.8420	19.5571	20.0068	20.1723	20.1437	19.8000	18.8099	17.5632	16.5696	(92)
Temperature adjustment												0.0000	
adjusted MIT	16.6494	17.1678	17.9240	18.8420	19.5571	20.0068	20.1723	20.1437	19.8000	18.8099	17.5632	16.5696	(93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9449	0.9096	0.8559	0.7650	0.6469	0.5038	0.3743	0.4204	0.6250	0.8229	0.9191	0.9520	(94)
Useful gains	1129.4471	1408.7259	1623.5541	1748.9585	1639.4587	1274.5427	906.3501	927.3569	1213.4929	1273.1934	1137.5219	1059.6732	(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	3460.4626	3430.0920	3187.3275	2745.8818	2165.9031	1477.2205	975.9991	1021.1269	1562.6896	2263.1812	2895.4736	3436.7784	(97)
Space heating kWh	1734.2755	1358.3580	1163.4474	717.7848	391.6747	0.0000	0.0000	0.0000	0.0000	736.5509	1265.7252	1768.5663	(98a)
Space heating requirement - total per year (kWh/year)												9136.3828	
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	1734.2755	1358.3580	1163.4474	717.7848	391.6747	0.0000	0.0000	0.0000	0.0000	736.5509	1265.7252	1768.5663	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												9136.3828	
Space heating per m2												(98c) / (4) =	44.5677 (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	1734.2755	1358.3580	1163.4474	717.7848	391.6747	0.0000	0.0000	0.0000	0.0000	736.5509	1265.7252	1768.5663	(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)	1878.9551	1471.6772	1260.5064	777.6650	424.3496	0.0000	0.0000	0.0000	0.0000	797.9966	1371.3166	1916.1065	(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	258.8689	228.8366	243.1750	214.3142	208.0139	187.7536	185.6818	192.9799	194.9811	217.0070	230.1823	256.1410	(64)
Efficiency of water heater (217)m	87.5180	87.3792	87.1017	86.5555	85.4569	79.8000	79.8000	79.8000	79.8000	86.5779	87.2852	87.5508	(216)
Fuel for water heating, kWh/month	295.7893	261.8892	279.1851	247.6033	243.4138	235.2802	232.6839	241.8295	244.3372	250.6495	263.7128	292.5625	(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	39.3815	31.5933	28.4462	20.8409	16.0981	13.1523	14.6853	19.0885	24.7940	32.5311	36.7438	40.4760	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-134.1089	-165.9322	-209.5419	-205.9373	-199.6786	-178.6003	-175.9070	-175.9330	-174.5577	-173.1377	-138.6432	-118.8143	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-166.0514	-332.4320	-632.2682	-911.7288	-1171.6370	-1165.6528	-1152.2650	-990.8820	-747.2422	-462.0909	-216.8999	-132.6961	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													

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(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												9898.5729	(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												3088.9363	(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)												317.8310	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-10132.6386	(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												3258.7016	(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	9898.5729	0.2100	2078.7003 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	3088.9363	0.2100	648.6766 (264)
Space and water heating			2727.3769 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	317.8310	0.1443	45.8728 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-2050.7922	0.1375	-282.0823
PV Unit electricity exported	-8081.8464	0.1271	-1027.4728
Total			-1309.5551 (269)
Total CO2, kg/year			1475.6240 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			7.2000 (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	9898.5729	1.1300	11185.3874 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	3088.9363	1.1300	3490.4981 (278)
Space and water heating			14675.8854 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	317.8310	1.5338	487.4998 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-2050.7922	1.5085	-3093.6431
PV Unit electricity exported	-8081.8464	0.4667	-3771.9505
Total			-6865.5937 (283)
Total Primary energy kWh/year			8427.8924 (286)
Target Primary Energy Rate (TPER)			41.1100 (287)

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

## 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	205.0000 (1b)	x 2.8000 (2b)	= 574.0000 (1b) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	205.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 574.0000 (5)

## 2. Ventilation rate

												m3 per hour
Number of open chimneys												0 * 80 = 0.0000 (6a)
Number of open flues												0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire												0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler												0 * 20 = 0.0000 (6d)
Number of flues attached to other heater												0 * 35 = 0.0000 (6e)
Number of blocked chimneys												0 * 20 = 0.0000 (6f)
Number of intermittent extract fans												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) = 0.0697 (8)
Pressure test												Yes
Pressure Test Method												Blower Door
Measured/design AP50												5.0000 (17)
Infiltration rate												0.3197 (18)
Number of sides sheltered												0 (19)
Shelter factor												(20) = 1 - [0.075 x (19)] = 1.0000 (20)
Infiltration rate adjusted to include shelter factor												(21) = (18) x (20) = 0.3197 (21)
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.4076	0.3996	0.3916	0.3517	0.3437	0.3037	0.3037	0.2957	0.3197	0.3437	0.3596	0.3756 (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	0.5831	0.5798	0.5767	0.5618	0.5591	0.5461	0.5461	0.5437	0.5511	0.5591	0.5647	0.5705 (25)

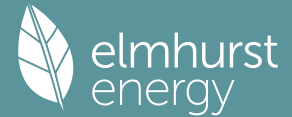
## 3. Heat losses and heat loss parameter

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					
Opening Type 1 (Uw = 1.60)			49.9200	1.5038	75.0677		(27)					
Opening			1.4400	1.5038	2.1654		(27a)					
Heatloss Floor 1			205.0000	0.1200	24.6000		(28a)					
External Wall 1	263.2000	49.9200	213.2800	0.1100	23.4608		(29a)					
External Roof 1	225.0000	1.4400	223.5600	0.1000	22.3560		(30)					
Total net area of external elements Aum(A, m2)			693.2000				(31)					
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 147.6499		(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K								100.0000 (35)				
List of Thermal Bridges												
K1 Element				Length	Psi-value	Total						
E1 Steel lintel with perforated steel base plate				28.4000	0.0060	0.1704						
E3 Sill				28.4000	0.0190	0.5396						
E4 Jamb				12.0000	0.0060	0.0720						
E5 Ground floor (normal)				94.0000	0.0930	8.7420						
E16 Corner (normal)				11.2000	0.0350	0.3920						
R11 Upstands or kerbs of rooflights				8.4000	0.0380	0.3192						
Thermal bridges (Sum(L x Psi) calculated using Appendix K)								10.2352 (36)				
Point Thermal bridges								0.0000 (36a)				
Total fabric heat loss								(33) + (36) + (36a) = 157.8851 (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	110.4449	109.8339	109.2350	106.4220	105.8956	103.4456	103.4456	102.9919	104.3893	105.8956	106.9604	108.0735 (38)
Average = Sum(39)m / 12 =	268.3300	267.7190	267.1201	264.3070	263.7807	261.3307	261.3307	260.8769	262.2744	263.7807	264.8455	265.9586 (39)
												264.3045
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.3089	1.3059	1.3030	1.2893	1.2867	1.2748	1.2748	1.2726	1.2794	1.2867	1.2919	1.2974 (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												3.0084 (42)
Hot water usage for mixer showers												0.0000 (42a)
Hot water usage for baths	32.2300	31.7513	31.0773	29.8345	28.9038	27.8719	27.3145	27.9839	28.7127	29.8168	31.0853	32.1210 (42b)
Hot water usage for other uses	45.4393	43.7869	42.1346	40.4823	38.8299	37.1776	37.1776	38.8299	40.4823	42.1346	43.7869	45.4393 (42c)
Average daily hot water use (litres/day)												71.1907 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	77.6693	75.5383	73.2119	70.3167	67.7338	65.0495	64.4921	66.8138	69.1949	71.9514	74.8722	77.5603 (44)

# Full SAP Calculation Printout



Energy conte	123.0092	107.5655	112.5240	96.2601	91.1827	79.9860	77.9976	82.7294	85.3243	97.6374	106.6692	121.4407 (45)
Energy content (annual)												Total = Sum(45)m = 1182.3260
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	104.5578	91.4307	95.6454	81.8211	77.5053	67.9881	66.2980	70.3200	72.5256	82.9918	90.6688	103.2246 (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	104.5578	91.4307	95.6454	81.8211	77.5053	67.9881	66.2980	70.3200	72.5256	82.9918	90.6688	103.2246 (64)
												Total per year (kWh/year) = Sum(64)m = 1004.9771 (64)
												1005 (64)
12Total per year (kWh/year)												
Electric shower(s)	59.7912	53.2745	58.1737	55.5144	56.5561	53.9491	55.7474	56.5561	55.5144	58.1737	57.0798	59.7912 (64a)
												Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 680.1217 (64a)
Heat gains from water heating, kWh/month	41.0873	36.1763	38.4548	34.3339	33.5154	30.4843	30.5113	31.7190	32.0100	35.2914	36.9372	40.7540 (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	150.4212	150.4212	150.4212	150.4212	150.4212	150.4212	150.4212	150.4212	150.4212	150.4212	150.4212	150.4212 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	189.5342	209.8415	189.5342	195.8520	189.5342	195.8520	189.5342	189.5342	195.8520	189.5342	195.8520	189.5342 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	375.7728	379.6721	369.8459	348.9270	322.5207	297.7025	281.1224	277.2231	287.0493	307.9682	334.3745	359.1927 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.0421	38.0421	38.0421	38.0421	38.0421	38.0421	38.0421	38.0421	38.0421	38.0421	38.0421	38.0421 (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)	-120.3370	-120.3370	-120.3370	-120.3370	-120.3370	-120.3370	-120.3370	-120.3370	-120.3370	-120.3370	-120.3370	-120.3370 (71)
Water heating gains (Table 5)	55.2248	53.8338	51.6865	47.6859	45.0475	42.3393	41.0099	42.6331	44.4584	47.4346	51.3016	54.7768 (72)
Total internal gains	688.6582	711.4737	679.1930	660.5914	625.2288	604.0202	579.7929	577.5168	595.4860	613.0634	649.6545	671.6301 (73)

## 6. Solar gains

[Jan]	Area	Solar flux	g	FF	Access	Gains
	m2	Table 6a	Specific data	Specific data	factor	W
		W/m2	or Table 6b	or Table 6c	Table 6d	
North	1.9200	10.6334	0.7600	0.7000	0.7700	7.5269 (74)
East	6.0000	19.6403	0.7600	0.7000	0.7700	43.4454 (76)
South	10.5000	46.7521	0.7600	0.7000	0.7700	180.9818 (78)
West	31.5000	19.6403	0.7600	0.7000	0.7700	228.0882 (80)
North	1.4400	26.0000	0.7600	0.7000	1.0000	17.9263 (82)

Solar gains	477.9685	879.1946	1342.9680	1845.2144	2193.4902	2223.0218	2125.1011	1865.1688	1520.4837	1012.6112	585.1336	400.4346 (83)
Total gains	1166.6267	1590.6683	2022.1610	2505.8058	2818.7190	2827.0420	2704.8940	2442.6856	2115.9697	1625.6746	1234.7881	1072.0648 (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	21.2218	21.2702	21.3179	21.5448	21.5878	21.7902	21.7902	21.8281	21.7118	21.5878	21.5010	21.4110	
alpha	2.4148	2.4180	2.4212	2.4363	2.4392	2.4527	2.4527	2.4552	2.4475	2.4392	2.4334	2.4274	
util living area	0.9710	0.9414	0.8889	0.7895	0.6585	0.5119	0.3935	0.4435	0.6526	0.8638	0.9523	0.9760 (86)	
MIT	17.8431	18.3454	19.0391	19.8425	20.4331	20.7852	20.9184	20.8887	20.5918	19.7282	18.6245	17.7616 (87)	
Th 2	19.8338	19.8362	19.8385	19.8492	19.8512	19.8606	19.8606	19.8624	19.8570	19.8512	19.8472	19.8429 (88)	
util rest of house	0.9663	0.9323	0.8718	0.7581	0.6085	0.4398	0.3021	0.3488	0.5834	0.8353	0.9433	0.9721 (89)	
MIT 2	16.9668	17.4619	18.1381	18.9056	19.4382	19.7353	19.8273	19.8136	19.5948	18.8233	17.7507	16.8918 (90)	
Living area fraction												fLA = Living area / (4) = 0.3707 (91)	
MIT	17.2917	17.7895	18.4721	19.2530	19.8070	20.1245	20.2318	20.2122	19.9644	19.1588	18.0746	17.2143 (92)	
Temperature adjustment													0.0000
adjusted MIT	17.2917	17.7895	18.4721	19.2530	19.8070	20.1245	20.2318	20.2122	19.9644	19.1588	18.0746	17.2143 (93)	

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9515	0.9108	0.8469	0.7395	0.6064	0.4574	0.3329	0.3793	0.5906	0.8143	0.9244	0.9591	(94)
Useful gains	1110.0754	1448.8099	1712.5405	1853.0137	1709.4022	1293.0083	900.5820	926.5386	1249.5960	1323.8561	1141.4017	1028.2570	(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													
	3486.0647	3450.7579	3197.9929	2736.3586	2138.4828	1443.7341	949.0997	994.5084	1538.0917	2257.6402	2906.5859	3461.2551	(97)
Space heating kWh													
	1767.7361	1345.3091	1105.1765	636.0083	319.2360	0.0000	0.0000	0.0000	0.0000	694.7354	1270.9326	1810.1506	(98a)
Space heating requirement - total per year (kWh/year)													8949.2846
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													
	1767.7361	1345.3091	1105.1765	636.0083	319.2360	0.0000	0.0000	0.0000	0.0000	694.7354	1270.9326	1810.1506	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)													8949.2846
Space heating per m2													(98c) / (4) = 43.6550 (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	2456.5082	1933.8469	1982.6647	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7966	0.8495	0.8162	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1956.8067	1642.8248	1618.2814	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	3194.5387	3056.6261	2757.7102	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	891.1671	1051.8682	847.7350	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	222.7918	262.9670	211.9337	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement													697.6925 (107)
Energy for space heating													43.6550 (99)
Energy for space cooling													3.4034 (108)
Total													47.0584 (109)
Fabric Energy Efficiency (DFEE)													47.1 (109)

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

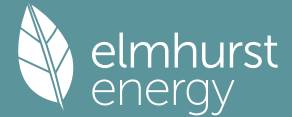
## 1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	205.0000 (1b)	2.8000 (2b)	574.0000 (1b) - (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	205.0000		
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 574.0000 (5)

## 2. Ventilation rate

	m3 per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	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) = 0.0697 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.3197 (18)
Number of sides sheltered	0 (19)

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Shelter factor														(20) = 1 - [0.075 x (19)] = 1.0000 (20)
Infiltration rate adjusted to include shelter factor														(21) = (18) x (20) = 0.3197 (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	0.4076	0.3996	0.3916	0.3517	0.3437	0.3037	0.3037	0.2957	0.3197	0.3437	0.3596	0.3756	(22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)													(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =													(23c)
Effective ac	0.5831	0.5798	0.5767	0.5618	0.5591	0.5461	0.5461	0.5437	0.5511	0.5591	0.5647	0.5705	(25)

### 3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opening Type (Uw = 1.20)			49.8200	1.1450	57.0458			(27)
Opening			1.4400	2.0221	2.9118			(27a)
Heatloss Floor 1			205.0000	0.1300	26.6500			(28a)
External Wall 1	263.2000	49.8200	213.3800	0.1800	38.4084			(29a)
External Roof 1	225.0000	1.4400	223.5600	0.1100	24.5916			(30)
Total net area of external elements Aum(A, m2)			693.2000					(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 149.6076			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 100.0000 (35)

#### List of Thermal Bridges

K1 Element	Length	Psi-value	Total	
E1 Steel lintel with perforated steel base plate	28.4000	0.0500	1.4200	
E3 Sill	28.4000	0.0500	1.4200	
E4 Jamb	12.0000	0.0500	0.6000	
E5 Ground floor (normal)	94.0000	0.1600	15.0400	
E16 Corner (normal)	11.2000	0.0900	1.0080	
R11 Upstands or kerbs of rooflights	8.4000	0.0800	0.6720	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			20.1600	(36)
Point Thermal bridges			0.0000	(36a) =
Total fabric heat loss			(33) + (36) + (36a) = 169.7676	(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	110.4449	109.8339	109.2350	106.4220	105.8956	103.4456	103.4456	102.9919	104.3893	105.8956	106.9604	108.0735	(38)
Average = Sum(39)m / 12 =	280.2125	279.6015	279.0026	276.1895	275.6632	273.2131	273.2131	272.7594	274.1569	275.6632	276.7279	277.8411	(39)
												276.1870	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3669	1.3639	1.3610	1.3473	1.3447	1.3327	1.3327	1.3305	1.3374	1.3447	1.3499	1.3553	(40)
HLP (average)												1.3473	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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

Assumed occupancy													3.0084 (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	32.2300	31.7513	31.0773	29.8345	28.9038	27.8719	27.3145	27.9839	28.7127	29.8168	31.0853	32.1210	(42b)
Hot water usage for other uses	45.4393	43.7869	42.1346	40.4823	38.8299	37.1776	37.1776	38.8299	40.4823	42.1346	43.7869	45.4393	(42c)
Average daily hot water use (litres/day)													(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	77.6693	75.5383	73.2119	70.3167	67.7338	65.0495	64.4921	66.8138	69.1949	71.9514	74.8722	77.5603	(44)
Energy conte	123.0092	107.5655	112.5240	96.2601	91.1827	79.9860	77.9976	82.7294	85.3243	97.6374	106.6692	121.4407	(45)
Energy content (annual)										Total = Sum(45)m =		1182.3260	
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)

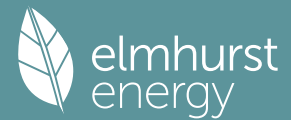
Water storage loss:  
Total storage loss (56)

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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Total heat required for water heating calculated for each month	104.5578	91.4307	95.6454	81.8211	77.5053	67.9881	66.2980	70.3200	72.5256	82.9918	90.6688	103.2246	(62)
WVHRS	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	104.5578	91.4307	95.6454	81.8211	77.5053	67.9881	66.2980	70.3200	72.5256	82.9918	90.6688	103.2246	(64)
Total per year (kWh/year) = Sum(64)m =												1004.9771	(64)
												1005	(64)

12Total per year (kWh/year)													
Electric shower(s)	59.7912	53.2745	58.1737	55.5144	56.5561	53.9491	55.7474	56.5561	55.5144	58.1737	57.0798	59.7912	(64a)

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Heat gains from water heating, kWh/month  
 41.0873 36.1763 38.4548 34.3339 33.5154 30.4843 30.5113 31.7190 32.0100 35.2914 36.9372 40.7540 (65)

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 680.1217 (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	150.4212	150.4212	150.4212	150.4212	150.4212	150.4212	150.4212	150.4212	150.4212	150.4212	150.4212	150.4212	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	189.5342	209.8415	189.5342	195.8520	189.5342	195.8520	189.5342	189.5342	195.8520	189.5342	195.8520	189.5342	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	375.7728	379.6721	369.8459	348.9270	322.5207	297.7025	281.1224	277.2231	287.0493	307.9682	334.3745	359.1927	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.0421	38.0421	38.0421	38.0421	38.0421	38.0421	38.0421	38.0421	38.0421	38.0421	38.0421	38.0421	(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)	-120.3370	-120.3370	-120.3370	-120.3370	-120.3370	-120.3370	-120.3370	-120.3370	-120.3370	-120.3370	-120.3370	-120.3370	(71)
Water heating gains (Table 5)	55.2248	53.8338	51.6865	47.6859	45.0475	42.3393	41.0099	42.6331	44.4584	47.4346	51.3016	54.7768	(72)
Total internal gains	688.6582	711.4737	679.1930	660.5914	625.2288	604.0202	579.7929	577.5168	595.4860	613.0634	649.6545	671.6301	(73)

## 6. Solar gains

[Jan]	Area m <sup>2</sup>	Solar flux Table 6a W/m <sup>2</sup>	Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
North	1.9200	10.6334	0.6300	0.7000	0.7700	6.2394 (74)
East	5.9900	19.6403	0.6300	0.7000	0.7700	35.9539 (76)
South	10.4800	46.7521	0.6300	0.7000	0.7700	149.7386 (78)
West	31.4300	19.6403	0.6300	0.7000	0.7700	188.6529 (80)
North	1.4400	26.0000	0.6300	0.7000	1.0000	14.8599 (82)

Solar gains 395.4448 727.3987 1111.1067 1526.6557 1814.8208 1839.2619 1758.2421 1543.1709 1257.9790 837.7820 484.1075 331.2974 (83)  
 Total gains 1084.1030 1438.8724 1790.2997 2187.2471 2440.0496 2443.2821 2338.0349 2120.6877 1853.4650 1450.8454 1133.7620 1002.9276 (84)

## 7. Mean internal temperature (heating season)

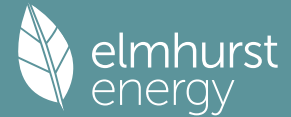
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, n <sub>l1</sub> ,m (see Table 9a)													
tau	20.3219	20.3663	20.4100	20.6179	20.6573	20.8425	20.8425	20.8772	20.7708	20.6573	20.5778	20.4953	
alpha	2.3548	2.3578	2.3607	2.3745	2.3772	2.3895	2.3895	2.3918	2.3847	2.3772	2.3719	2.3664	
util living area	0.9753	0.9528	0.9130	0.8340	0.7211	0.5808	0.4572	0.5088	0.7117	0.8913	0.9605	0.9792	(86)
MIT	17.6486	18.1007	18.7651	19.5869	20.2506	20.6917	20.8755	20.8356	20.4652	19.5334	18.4346	17.5773	(87)
Th 2	19.7888	19.7911	19.7934	19.8040	19.8060	19.8153	19.8153	19.8170	19.8117	19.8060	19.8020	19.7978	(88)
util rest of house	0.9711	0.9450	0.8985	0.8060	0.6723	0.5033	0.3523	0.4028	0.6432	0.8664	0.9527	0.9757	(89)
MIT 2	16.7473	17.1945	17.8465	18.6413	19.2525	19.6328	19.7639	19.7441	19.4626	18.6125	17.5368	16.6820	(90)
Living area fraction									fLA = Living area / (4) =				0.3707 (91)
MIT	17.0815	17.5304	18.1871	18.9919	19.6225	20.0253	20.1760	20.1487	19.8343	18.9539	17.8696	17.0139	(92)
Temperature adjustment													0.0000
adjusted MIT	17.0815	17.5304	18.1871	18.9919	19.6225	20.0253	20.1760	20.1487	19.8343	18.9539	17.8696	17.0139	(93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9574	0.9250	0.8736	0.7833	0.6640	0.5181	0.3860	0.4345	0.6447	0.8438	0.9349	0.9637	(94)
Useful gains	1037.9374	1330.9210	1564.0903	1713.3232	1620.1248	1265.8765	902.4429	921.5008	1194.8845	1224.2507	1059.9552	966.4745	(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	3581.5225	3531.4859	3260.7194	2787.2706	2183.9460	1482.2734	977.0160	1022.4991	1572.0899	2302.8659	2980.2561	3560.2215	(97)
Space heating kWh	1892.4274	1478.7796	1262.2920	773.2421	419.4830	0.0000	0.0000	0.0000	0.0000	802.4897	1382.6167	1929.7478	(98a)
Space heating requirement - total per year (kWh/year)													9941.0782
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	1892.4274	1478.7796	1262.2920	773.2421	419.4830	0.0000	0.0000	0.0000	0.0000	802.4897	1382.6167	1929.7478	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)													9941.0782
Space heating per m <sup>2</sup>										(98c) / (4) =			48.4931 (99)



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## 8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000		
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	2568.2035	2021.7772	2072.9716	0.0000	0.0000	0.0000	0.0000	(100)	
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7287	0.7911	0.7527	0.0000	0.0000	0.0000	0.0000	(101)	
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1871.3776	1599.3801	1560.4249	0.0000	0.0000	0.0000	0.0000	(102)	
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2749.9704	2631.5930	2384.4750	0.0000	0.0000	0.0000	0.0000	(103)	
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	632.5868	767.9664	613.0933	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	158.1467	191.9916	153.2733	0.0000	0.0000	0.0000	0.0000	(107)	
Space cooling requirement													503.4116	(107)
Energy for space heating													48.4931	(99)
Energy for space cooling													2.4557	(108)
Total													50.9487	(109)
Fabric Energy Efficiency (TFEE)													50.9	(109)

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

### 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	205.0000 (1b)	2.8000 (2b)	574.0000 (1b) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	205.0000		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 574.0000 (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	5 * 10 = 50.0000 (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) =	50.0000 / (5) = 0.0871 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.3371 (18)
Number of sides sheltered	0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.3371 (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	0.4298	0.4214	0.4130	0.3708	0.3624	0.3203	0.3203	0.3118	0.3371	0.3624	0.3792	0.3961	(22b)
Effective ac	0.5924	0.5888	0.5853	0.5688	0.5657	0.5513	0.5513	0.5486	0.5568	0.5657	0.5719	0.5784	(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
Opening Type 1 (Uw = 1.60)			49.9200	1.5038	75.0677		(27)
Opening			1.4400	1.5038	2.1654		(27a)
Heatloss Floor 1			205.0000	0.1200	24.6000		(28a)
External Wall 1	263.2000	49.9200	213.2800	0.1100	23.4608		(29a)



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External Roof 1 225.0000 1.4400 223.5600 0.1000 22.3560 (30)  
 Total net area of external elements Aum(A, m2) 693.2000 (31)  
 Fabric heat loss, W/K = Sum (A x U) (26)...(30) + (32) = 147.6499 (33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 100.0000 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	28.4000	0.0060	0.1704
E3 Sill	28.4000	0.0190	0.5396
E4 Jamb	12.0000	0.0060	0.0720
E5 Ground floor (normal)	94.0000	0.0930	8.7420
E16 Corner (normal)	11.2000	0.0350	0.3920
R11 Upstands or kerbs of rooflights	8.4000	0.0380	0.3192
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			10.2352 (36)
Point Thermal bridges			0.0000 (36a) =
Total fabric heat loss			157.8851 (37) (33) + (36) + (36a) =

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	112.2066	111.5272	110.8613	107.7332	107.1480	104.4236	104.4236	103.9191	105.4730	107.1480	108.3319	109.5697 (38)
Heat transfer coeff	270.0917	269.4123	268.7463	265.6183	265.0331	262.3087	262.3087	261.8042	263.3581	265.0331	266.2170	267.4548 (39)
Average = Sum(39)m / 12 =												265.6155

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.3175	1.3142	1.3110	1.2957	1.2928	1.2796	1.2796	1.2771	1.2847	1.2928	1.2986	1.3047 (40)
HLP (average)												1.2957
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

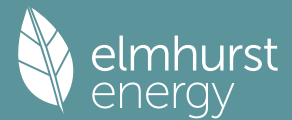
4. Water heating energy requirements (kWh/year)

Assumed occupancy													3.0084 (42)
Hot water usage for mixer showers	111.9919	110.3089	107.8564	103.1640	99.7011	95.8393	93.6443	96.0782	98.7463	102.8926	107.6858	111.5628 (42a)	
Hot water usage for baths	33.9263	33.4225	32.7129	31.4047	30.4251	29.3389	28.7521	29.4567	30.2239	31.3862	32.7213	33.8116 (42b)	
Hot water usage for other uses	47.8308	46.0915	44.3522	42.6129	40.8736	39.1343	39.1343	40.8736	42.6129	44.3522	46.0915	47.8308 (42c)	
Average daily hot water use (litres/day)													178.1904 (43)
Daily hot water use	193.7490	189.8229	184.9215	177.1816	170.9998	164.3125	161.5308	166.4086	171.5831	178.6310	186.4987	193.2052 (44)	
Energy conte	306.8511	270.3052	284.2175	242.5527	230.1986	202.0414	195.3575	206.0486	211.5791	242.4006	265.7016	302.5127 (45)	
Energy content (annual)													Total = Sum(45)m = 2959.7666
Distribution loss (46)m = 0.15 x (45)m	46.0277	40.5458	42.6326	36.3829	34.5298	30.3062	29.3036	30.9073	31.7369	36.3601	39.8552	45.3769 (46)	
Water storage loss:													210.0000 (47)
Store volume													
b) If manufacturer declared loss factor is not known :													
Hot water storage loss factor from Table 2 (kWh/litre/day)													0.0103 (51)
Volume factor from Table 2a													0.8298 (52)
Temperature factor from Table 2b													0.7800 (53)
Enter (49) or (54) in (55)													1.3985 (55)
Total storage loss	43.3524	39.1570	43.3524	41.9540	43.3524	41.9540	43.3524	43.3524	41.9540	43.3524	41.9540	43.3524 (56)	
If cylinder contains dedicated solar storage	43.3524	39.1570	43.3524	41.9540	43.3524	41.9540	43.3524	43.3524	41.9540	43.3524	41.9540	43.3524 (57)	
Primary loss	54.8576	49.5488	54.8576	53.0880	54.8576	22.5120	23.2624	23.2624	22.5120	54.8576	53.0880	54.8576 (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	405.0611	359.0110	382.4275	337.5947	328.4086	266.5074	261.9723	272.6634	276.0450	340.6106	360.7435	400.7227 (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	405.0611	359.0110	382.4275	337.5947	328.4086	266.5074	261.9723	272.6634	276.0450	340.6106	360.7435	400.7227 (64)	
													Total per year (kWh/year) = Sum(64)m = 3991.7679 (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	145.9141	129.5155	138.3884	123.1192	120.4271	85.1884	83.5663	87.1211	88.3596	124.4843	130.8162	144.4716 (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	180.5055	180.5055	180.5055	180.5055	180.5055	180.5055	180.5055	180.5055	180.5055	180.5055	180.5055	180.5055 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	44.9923	39.9617	32.4991	24.6039	18.3917	15.5270	16.7775	21.8080	29.2707	37.1659	43.3781	46.2427 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	560.8549	566.6748	552.0088	520.7866	481.3742	444.3321	419.5857	413.7658	428.4318	459.6540	499.0664	536.1085 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	56.0590	56.0590	56.0590	56.0590	56.0590	56.0590	56.0590	56.0590	56.0590	56.0590	56.0590	56.0590 (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)												

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	-120.3370	-120.3370	-120.3370	-120.3370	-120.3370	-120.3370	-120.3370	-120.3370	-120.3370	-120.3370	-120.3370	-120.3370	(71)
Water heating gains (Table 5)	196.1211	192.7314	186.0059	170.9989	161.8644	118.3172	112.3203	117.0982	122.7217	167.3176	181.6891	194.1822	(72)
Total internal gains	918.1957	915.5955	886.7413	832.6168	777.8578	694.4038	664.9109	668.8995	696.6517	780.3649	840.3611	892.7609	(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	Access factor Table 6d	Gains W					
North	1.9200	10.6334	0.7600	0.7600	0.7000	0.7700	7.5269 (74)						
East	6.0000	19.6403	0.7600	0.7600	0.7000	0.7700	43.4454 (76)						
South	10.5000	46.7521	0.7600	0.7600	0.7000	0.7700	180.9818 (78)						
West	31.5000	19.6403	0.7600	0.7600	0.7000	0.7700	228.0882 (80)						
North	1.4400	26.0000	0.7600	0.7600	0.7000	1.0000	17.9263 (82)						
Solar gains	477.9685	879.1946	1342.9680	1845.2144	2193.4902	2223.0218	2125.1011	1865.1688	1520.4837	1012.6112	585.1336	400.4346	(83)
Total gains	1396.1643	1794.7901	2229.7093	2677.8313	2971.3480	2917.4256	2790.0121	2534.0683	2217.1354	1792.9762	1425.4947	1293.1956	(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	21.0834	21.1365	21.1889	21.4384	21.4858	21.7089	21.7089	21.7508	21.6224	21.4858	21.3902	21.2912
alpha	2.4056	2.4091	2.4126	2.4292	2.4324	2.4473	2.4473	2.4501	2.4415	2.4324	2.4260	2.4194
util living area	0.9581	0.9264	0.8693	0.7698	0.6400	0.5012	0.3843	0.4316	0.6361	0.8408	0.9368	0.9645 (86)
Living	18.6358	18.9851	19.4894	20.0557	20.4740	20.7205	20.8166	20.7962	20.5848	19.9867	19.1961	18.5753
Non living	17.0717	17.5118	18.1394	18.8319	19.3134	19.5815	19.6662	19.6546	19.4551	18.7734	17.7930	17.0018
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0
24 / 9	20	0	0	0	0	0	0	0	0	0	0	0
16 / 9	11	28	28	0	0	0	0	0	0	0	0	31
MIT	20.5249	19.8588	20.0811	20.0557	20.4740	20.7205	20.8166	20.7962	20.5848	19.9867	19.1961	19.6267 (87)
Th 2	19.8271	19.8297	19.8323	19.8442	19.8464	19.8569	19.8569	19.8588	19.8529	19.8464	19.8419	19.8372 (88)
util rest of house	0.9515	0.9153	0.8500	0.7369	0.5894	0.4296	0.2943	0.3383	0.5664	0.8092	0.9254	0.9589 (89)
MIT 2	19.3956	18.8066	18.9936	18.8319	19.3134	19.5815	19.6662	19.6546	19.4551	18.7734	17.7930	18.5857 (90)
Living area fraction	19.8142	19.1967	19.3967	19.2856	19.7437	20.0038	20.0927	20.0779	19.8739	19.2232	18.3132	18.9716 (91)
MIT	19.8142	19.1967	19.3967	19.2856	19.7437	20.0038	20.0927	20.0779	19.8739	19.2232	18.3132	18.9716 (92)
Temperature adjustment												0.0000
adjusted MIT	19.8142	19.1967	19.3967	19.2856	19.7437	20.0038	20.0927	20.0779	19.8739	19.2232	18.3132	18.9716 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9514	0.9084	0.8418	0.7188	0.5846	0.4393	0.3136	0.3572	0.5678	0.7887	0.9055	0.9539 (94)
Useful gains	1328.3747	1630.3429	1877.0745	1924.9268	1736.9059	1281.6112	874.9532	905.0626	1258.8823	1414.2010	1290.8328	1233.5393 (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	4190.2677	3851.7070	3465.9506	2758.5980	2131.8394	1417.4597	916.1597	962.8788	1520.6126	2285.4299	2985.1389	3950.7413 (97)
Space heating kWh	2129.2484	1492.7566	1182.1238	600.2433	293.8306	0.0000	0.0000	0.0000	0.0000	648.1943	1219.9004	2021.5983 (98a)
Space heating requirement - total per year (kWh/year)												9587.8957
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	2129.2484	1492.7566	1182.1238	600.2433	293.8306	0.0000	0.0000	0.0000	0.0000	648.1943	1219.9004	2021.5983 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												9587.8957
Space heating per m2										(98c) / (4) =		46.7702 (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 %)												299.0088 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement	2129.2484	1492.7566	1182.1238	600.2433	293.8306	0.0000	0.0000	0.0000	0.0000	648.1943	1219.9004	2021.5983 (98)
Space heating efficiency (main heating system 1)	299.0088	299.0088	299.0088	299.0088	299.0088	0.0000	0.0000	0.0000	0.0000	299.0088	299.0088	299.0088 (210)
Space heating fuel (main heating system)	712.1022	499.2350	395.3475	200.7443	98.2682	0.0000	0.0000	0.0000	0.0000	216.7810	407.9814	676.0999 (211)

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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	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	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	0.0000	(215)
Water heating														
Water heating requirement	405.0611	359.0110	382.4275	337.5947	328.4086	266.5074	261.9723	272.6634	276.0450	340.6106	360.7435	400.7227	400.7227	(64)
Efficiency of water heater	185.8383	185.8383	185.8383	185.8383	185.8383	185.8383	185.8383	185.8383	185.8383	185.8383	185.8383	185.8383	185.8383	(216)
Fuel for water heating, kWh/month	217.9643	193.1846	205.7851	181.6605	176.7174	143.4082	140.9679	146.7208	148.5404	183.2833	194.1169	215.6298	215.6298	(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	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	0.0000	(231)
Lighting	39.3815	31.5933	28.4462	20.8409	16.0981	13.1523	14.6853	19.0885	24.7940	32.5311	36.7438	40.4760	40.4760	(232)
Electricity generated by PVs (Appendix M) (negative quantity)	-92.8126	-149.4440	-241.3642	-295.5878	-332.2076	-297.0723	-292.8004	-269.5973	-227.9638	-181.1278	-107.7868	-78.0051	-78.0051	(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	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	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	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	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	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	0.0000	(235d)
Annual totals kWh/year														
Space heating fuel - main system 1													3206.5594	(211)
Space heating fuel - main system 2													0.0000	(213)
Space heating fuel - secondary													0.0000	(215)
Efficiency of water heater													185.8383	
Water heating fuel used													2147.9793	(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)													317.8310	(232)
Energy saving/generation technologies (Appendices M ,N and Q)														
PV generation													-2565.7697	(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													3106.6000	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	3206.5594	16.4900	528.7616 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2147.9793	16.4900	354.2018 (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	317.8310	16.4900	52.4103 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-2565.7697	16.4900	-423.0954
PV Unit electricity exported	0.0000	5.5900	0.0000
Total			-423.0954 (252)
Total energy cost			512.2783 (255)

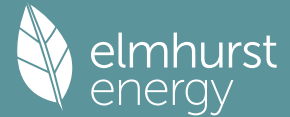
## 11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600 (256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.7377 (257)
SAP value		88.0422
SAP rating (Section 12)		88 (258)
SAP band		B

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

Energy	Emission factor	Emissions
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	kWh/year	kg CO2/kWh	kg CO2/year
Space heating - main system 1	3206.5594	0.1557	499.4079 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2147.9793	0.1415	304.0239 (264)
Space and water heating			803.4319 (265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (267)
Energy for lighting	317.8310	0.1443	45.8728 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-2565.7697	0.1332	-341.8687
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-341.8687 (269)
Total CO2, kg/year			507.4360 (272)
CO2 emissions per m2			2.4800 (273)
EI value			97.2801
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

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	205.0000 (1b)	2.8000 (2b)	574.0000 (1b) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	205.0000		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 574.0000 (5)

### 2. Ventilation rate

	Value	Unit	Reference
Number of open chimneys	0 * 80 =	m3 per hour	0.0000 (6a)
Number of open flues	0 * 20 =	m3 per hour	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	m3 per hour	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	m3 per hour	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	m3 per hour	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	m3 per hour	0.0000 (6f)
Number of intermittent extract fans	5 * 10 =	m3 per hour	50.0000 (7a)
Number of passive vents	0 * 10 =	m3 per hour	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	m3 per hour	0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	50.0000 / (5) =	Air changes per hour	0.0871 (8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50			5.0000 (17)
Infiltration rate			0.3371 (18)
Number of sides sheltered			0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3371 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.8000	4.5000	4.4000	3.9000	3.9000	3.6000	3.7000	3.5000	3.7000	4.0000	4.1000	4.4000 (22)
Wind factor	1.2000	1.1250	1.1000	0.9750	0.9750	0.9000	0.9250	0.8750	0.9250	1.0000	1.0250	1.1000 (22a)
Adj infilt rate	0.4045	0.3792	0.3708	0.3287	0.3287	0.3034	0.3118	0.2950	0.3118	0.3371	0.3455	0.3708 (22b)
Effective ac	0.5818	0.5719	0.5688	0.5540	0.5540	0.5460	0.5486	0.5435	0.5486	0.5568	0.5597	0.5688 (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
Opening Type 1 (Uw = 1.60)			49.9200	1.5038	75.0677		(27)
Opening			1.4400	1.5038	2.1654		(27a)
Heatloss Floor 1			205.0000	0.1200	24.6000		(28a)
External Wall 1	263.2000	49.9200	213.2800	0.1100	23.4608		(29a)
External Roof 1	225.0000	1.4400	223.5600	0.1000	22.3560		(30)
Total net area of external elements Aum(A, m2)			693.2000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 147.6499		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							100.0000 (35)

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## List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	28.4000	0.0060	0.1704
E3 Sill	28.4000	0.0190	0.5396
E4 Jamb	12.0000	0.0060	0.0720
E5 Ground floor (normal)	94.0000	0.0930	8.7420
E16 Corner (normal)	11.2000	0.0350	0.3920
R11 Upstands or kerbs of rooflights	8.4000	0.0380	0.3192
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			10.2352 (36)
Point Thermal bridges			0.0000
Total fabric heat loss		(33) + (36) + (36a) =	157.8851 (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	110.2087	108.3319	107.7332	104.9416	104.9416	103.4280	103.9191	102.9504	103.9191	105.4730	106.0179	107.7332 (38)
Average = Sum(39)m / 12 =	268.0938	266.2170	265.6183	262.8267	262.8267	261.3131	261.8042	260.8355	261.8042	263.3581	263.9030	265.6183 (39)
HLP	1.3078	1.2986	1.2957	1.2821	1.2821	1.2747	1.2771	1.2724	1.2771	1.2847	1.2873	1.2957 (40)
HLP (average)												1.2863
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

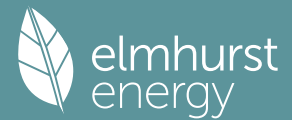
## 4. Water heating energy requirements (kWh/year)

Assumed occupancy													3.0084 (42)
Hot water usage for mixer showers													111.5628 (42a)
Hot water usage for baths													33.8116 (42b)
Hot water usage for other uses													47.8308 (42c)
Average daily hot water use (litres/day)													178.1904 (43)
Daily hot water use	193.7490	189.8229	184.9215	177.1816	170.9998	164.3125	161.5308	166.4086	171.5831	178.6310	186.4987	193.2052 (44)	
Energy content (annual)	306.8511	270.3052	284.2175	242.5527	230.1986	202.0414	195.3575	206.0486	211.5791	242.4006	265.7016	302.5127 (45)	
Distribution loss (46)m = 0.15 x (45)m	46.0277	40.5458	42.6326	36.3829	34.5298	30.3062	29.3036	30.9073	31.7369	36.3601	39.8552	45.3769 (46)	
Water storage loss:													210.0000 (47)
Store volume													0.0103 (51)
b) If manufacturer declared loss factor is not known :													0.8298 (52)
Hot water storage loss factor from Table 2 (kWh/litre/day)													0.7800 (53)
Volume factor from Table 2a													1.3985 (55)
Temperature factor from Table 2b													
Enter (49) or (54) in (55)													
Total storage loss	43.3524	39.1570	43.3524	41.9540	43.3524	41.9540	43.3524	43.3524	41.9540	43.3524	41.9540	43.3524 (56)	
If cylinder contains dedicated solar storage													
Primary loss	54.8576	49.5488	54.8576	53.0880	54.8576	22.5120	23.2624	23.2624	22.5120	54.8576	53.0880	54.8576 (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 (61)	
Total heat required for water heating calculated for each month	405.0611	359.0110	382.4275	337.5947	328.4086	266.5074	261.9723	272.6634	276.0450	340.6106	360.7435	400.7227 (62)	
MWHR	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)	
FGHR	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	405.0611	359.0110	382.4275	337.5947	328.4086	266.5074	261.9723	272.6634	276.0450	340.6106	360.7435	400.7227 (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	145.9141	129.5155	138.3884	123.1192	120.4271	85.1884	83.5663	87.1211	88.3596	124.4843	130.8162	144.4716 (65)	

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

Metabolic gains (Table 5), Watts													
(66)m	180.5055	180.5055	180.5055	180.5055	180.5055	180.5055	180.5055	180.5055	180.5055	180.5055	180.5055	180.5055 (66)	
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	44.9923	39.9617	32.4991	24.6039	18.3917	15.5270	16.7775	21.8080	29.2707	37.1659	43.3781	46.2427 (67)	
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	560.8549	566.6748	552.0088	520.7866	481.3742	444.3321	419.5857	413.7658	428.4318	459.6540	499.0664	536.1085 (68)	
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	56.0590	56.0590	56.0590	56.0590	56.0590	56.0590	56.0590	56.0590	56.0590	56.0590	56.0590	56.0590 (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)	-120.3370	-120.3370	-120.3370	-120.3370	-120.3370	-120.3370	-120.3370	-120.3370	-120.3370	-120.3370	-120.3370	-120.3370 (71)	
Water heating gains (Table 5)	196.1211	192.7314	186.0059	170.9989	161.8644	118.3172	112.3203	117.0982	122.7217	167.3176	181.6891	194.1822 (72)	
Total internal gains	918.1957	915.5955	886.7413	832.6168	777.8578	694.4038	664.9109	668.8995	696.6517	780.3649	840.3611	892.7609 (73)	

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## 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data g or Table 6b	Specific data FF or Table 6c	Access factor Table 6d	Gains W
North	1.9200	12.7054	0.7600	0.7000	0.7700	8.9936 (74)
East	6.0000	23.7288	0.7600	0.7000	0.7700	52.4894 (76)
South	10.5000	53.5774	0.7600	0.7000	0.7700	207.4032 (78)
West	31.5000	23.7288	0.7600	0.7000	0.7700	275.5696 (80)
North	1.4400	32.0000	0.7600	0.7000	1.0000	22.0631 (82)

Solar gains	566.5189	927.4444	1412.5557	2045.8201	2338.7357	2533.8512	2393.9679	2120.8227	1712.3443	1142.6971	700.5271	458.8593 (83)
Total gains	1484.7146	1843.0399	2299.2969	2878.4370	3116.5934	3228.2549	3058.8789	2789.7222	2408.9960	1923.0621	1540.8882	1351.6202 (84)

## 7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	21.2405	21.3902	21.4384	21.6662	21.6662	21.7917	21.7508	21.8316	21.7508	21.6224	21.5778	21.4384	
alpha	2.4160	2.4260	2.4292	2.4444	2.4444	2.4528	2.4501	2.4554	2.4501	2.4415	2.4385	2.4292	
util living area	0.9482	0.9174	0.8513	0.7268	0.5804	0.4152	0.2960	0.3128	0.5489	0.7893	0.9152	0.9559 (86)	
Living	18.8351	19.1271	19.6422	20.2112	20.5905	20.7875	20.8488	20.8466	20.6977	20.2110	19.4546	18.8112	
Non living	17.3292	17.6983	18.3357	19.0200	19.4446	19.6429	19.6885	19.6920	19.5693	19.0430	18.1227	17.3064	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	20	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	11	28	27	0	0	0	0	0	0	0	0	31	
MIT	20.5649	19.9392	20.1550	20.2112	20.5905	20.7875	20.8488	20.8466	20.6977	20.2110	19.4546	19.7603 (87)	
Th 2	19.8347	19.8419	19.8442	19.8549	19.8549	19.8607	19.8588	19.8625	19.8588	19.8529	19.8508	19.8442 (88)	
util rest of house	0.9400	0.9049	0.8294	0.6895	0.5242	0.3415	0.2068	0.2167	0.4694	0.7474	0.8995	0.9486 (89)	
MIT 2	19.4423	18.8958	19.0697	19.0200	19.4446	19.6429	19.6885	19.6920	19.5693	19.0430	18.1227	18.7241 (90)	
Living area fraction										flA = Living area / (4) =			0.3707 (91)
MIT	19.8585	19.2826	19.4720	19.4616	19.8694	20.0673	20.1187	20.1200	19.9876	19.4760	18.6165	19.1083 (92)	
Temperature adjustment												0.0000	
adjusted MIT	19.8585	19.2826	19.4720	19.4616	19.8694	20.0673	20.1187	20.1200	19.9876	19.4760	18.6165	19.1083 (93)	

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9401	0.8979	0.8214	0.6753	0.5250	0.3554	0.2276	0.2391	0.4791	0.7314	0.8779	0.9431 (94)	
Useful gains	1395.8510	1654.8567	1888.6195	1943.9352	1636.1839	1147.4093	696.3122	666.9546	1154.0700	1406.4912	1352.7964	1274.6563 (95)	
Ext temp.	5.0000	5.4000	7.1000	9.5000	12.6000	15.4000	17.4000	17.5000	15.0000	11.7000	8.1000	5.2000 (96)	
Heat loss rate W	3983.4770	3695.7909	3286.2430	2618.1820	1910.5991	1219.6201	711.7540	683.3992	1305.7843	2047.8812	2775.3361	3694.2871 (97)	
Space heating kWh	1925.1937	1371.5077	1039.8319	485.4577	204.1649	0.0000	0.0000	0.0000	0.0000	477.1942	1024.2286	1800.2053 (98a)	
Space heating requirement - total per year (kWh/year)												8327.7840	
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	1925.1937	1371.5077	1039.8319	485.4577	204.1649	0.0000	0.0000	0.0000	0.0000	477.1942	1024.2286	1800.2053 (98c)	
Space heating requirement after solar contribution - total per year (kWh/year)												8327.7840	
Space heating per m2												(98c) / (4) =	40.6233 (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 %)												298.5133 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement	1925.1937	1371.5077	1039.8319	485.4577	204.1649	0.0000	0.0000	0.0000	0.0000	477.1942	1024.2286	1800.2053 (98)
Space heating efficiency (main heating system 1)	298.5133	298.5133	298.5133	298.5133	298.5133	0.0000	0.0000	0.0000	0.0000	298.5133	298.5133	298.5133 (210)
Space heating fuel (main heating system)	644.9273	459.4461	348.3369	162.6251	68.3939	0.0000	0.0000	0.0000	0.0000	159.8569	343.1099	603.0570 (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)												

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	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	(215)
Water heating requirement															
Water heating requirement	405.0611	359.0110	382.4275	337.5947	328.4086	266.5074	261.9723	272.6634	276.0450	340.6106	360.7435	400.7227	400.7227	400.7227	(64)
Efficiency of water heater (217)m	185.8327	185.8327	185.8327	185.8327	185.8327	185.8327	185.8327	185.8327	185.8327	185.8327	185.8327	185.8327	185.8327	185.8327	(216)
Fuel for water heating, kWh/month	217.9708	193.1904	205.7913	181.6659	176.7227	143.4125	140.9721	146.7252	148.5449	183.2888	194.1227	215.6363	215.6363	215.6363	(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	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	0.0000	0.0000	(231)
Lighting	39.3815	31.5933	28.4462	20.8409	16.0981	13.1523	14.6853	19.0885	24.7940	32.5311	36.7438	40.4760	40.4760	40.4760	(232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-109.2461	-156.8701	-251.2546	-317.4258	-342.7647	-321.3255	-314.5576	-293.2069	-248.7450	-199.5723	-127.3040	-88.9372	-88.9372	-88.9372	(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	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	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	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	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	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	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	0.0000	(235d)
Annual totals kWh/year															
Space heating fuel - main system 1															2789.7530 (211)
Space heating fuel - main system 2															0.0000 (213)
Space heating fuel - secondary															0.0000 (215)
Efficiency of water heater															185.8327
Water heating fuel used															2148.0438 (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)															317.8310 (232)
Energy saving/generation technologies (Appendices M ,N and Q)															
PV generation															-2771.2099 (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															2484.4178 (238)

## 10a. Fuel costs - using BEDF prices (516)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	2789.7530	18.3900	513.0356 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2148.0438	18.3900	395.0253 (247)
Energy for instantaneous electric shower(s)	0.0000	18.3900	0.0000 (247a)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (249)
Energy for lighting	317.8310	18.3900	58.4491 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-2771.2099	18.3900	-509.6255
PV Unit electricity exported	0.0000	5.8100	0.0000
Total			-509.6255 (252)
Total energy cost			456.8844 (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	2789.7530	0.1563	436.0619 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2148.0438	0.1415	304.0330 (264)
Space and water heating			740.0949 (265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (267)
Energy for lighting	317.8310	0.1443	45.8728 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-2771.2099	0.1333	-369.5077
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-369.5077 (269)
Total CO2, kg/year			416.4601 (272)



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## 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	2789.7530	1.5787	4404.0748 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2148.0438	1.5234	3272.3405 (278)
Space and water heating			7676.4153 (279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (281)
Energy for lighting	317.8310	1.5338	487.4998 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-2771.2099	1.4927	-4136.6671
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-4136.6671 (283)
Total Primary energy kWh/year			4027.2481 (286)

## SAP 10 EPC IMPROVEMENTS

00001

Current energy efficiency rating: B 88  
 Current environmental impact rating: A 97

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

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

Measures omitted - SAP change or cost saving too small:  
 N Solar water heating + 0.9 -£ 50 -34 kg (8.3%)

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

Potential energy efficiency rating: B 88  
 Potential environmental impact rating: A 97

Fuel prices for cost data on this page from database revision number 516 TEST (28 Apr 2023)  
 Recommendation texts revision number 6.1 (11 Jun 2019)

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

	Current £967	Potential £967	East £0	Saving
Electricity				
Space heating	£513	£513	£0	
Water heating	£395	£395	£0	
Lighting	£58	£58	£0	
Generated (PV)	-£510	-£510	£0	
Total cost of fuels	£457	£457	£0	
Total cost of uses	£456	£456	£0	
Delivered energy	12 kWh/m²	12 kWh/m²	0 kWh/m²	
Carbon dioxide emissions	0.4 tonnes	0.4 tonnes	0.0 tonnes	
CO2 emissions per m²	2 kg/m²	2 kg/m²	0 kg/m²	
Primary energy	20 kWh/m²	20 kWh/m²	0 kWh/m²	

## 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 (m2)	Storey height (m)	Volume (m3)
Ground floor	205.0000 (1b)	x 2.8000 (2b)	= 574.0000 (1b) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	205.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 574.0000 (5)



## 2. Ventilation rate

												m3 per hour	
Number of open chimneys												0 * 80 = 0.0000 (6a)	
Number of open flues												0 * 20 = 0.0000 (6b)	
Number of chimneys / flues attached to closed fire												0 * 10 = 0.0000 (6c)	
Number of flues attached to solid fuel boiler												0 * 20 = 0.0000 (6d)	
Number of flues attached to other heater												0 * 35 = 0.0000 (6e)	
Number of blocked chimneys												0 * 20 = 0.0000 (6f)	
Number of intermittent extract fans												5 * 10 = 50.0000 (7a)	
Number of passive vents												0 * 10 = 0.0000 (7b)	
Number of flueless gas fires												0 * 40 = 0.0000 (7c)	
												Air changes per hour	
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =											50.0000 / (5) = 0.0871 (8)	
Pressure test												Yes	
Pressure Test Method												Blower Door	
Measured/design AP50												5.0000 (17)	
Infiltration rate												0.3371 (18)	
Number of sides sheltered												0 (19)	
Shelter factor												(20) = 1 - [0.075 x (19)] = 1.0000 (20)	
Infiltration rate adjusted to include shelter factor												(21) = (18) x (20) = 0.3371 (21)	
-----													
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate													
	0.4298	0.4214	0.4130	0.3708	0.3624	0.3203	0.3203	0.3118	0.3371	0.3624	0.3792	0.3961	(22b)
Effective ac	0.5924	0.5888	0.5853	0.5688	0.5657	0.5513	0.5513	0.5486	0.5568	0.5657	0.5719	0.5784	(25)

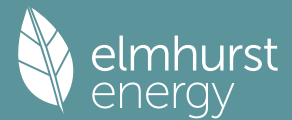
## 3. Heat losses and heat loss parameter

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						
Opening Type 1 (Uw = 1.60)			49.9200	1.5038	75.0677			(27)					
Opening			1.4400	1.5038	2.1654			(27a)					
Heatloss Floor 1			205.0000	0.1200	24.6000			(28a)					
External Wall 1	263.2000	49.9200	213.2800	0.1100	23.4608			(29a)					
External Roof 1	225.0000	1.4400	223.5600	0.1000	22.3560			(30)					
Total net area of external elements Aum(A, m2)			693.2000					(31)					
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 147.6499			(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							100.0000	(35)					
List of Thermal Bridges				Length	Psi-value		Total						
K1 Element													
E1 Steel lintel with perforated steel base plate				28.4000	0.0060		0.1704						
E3 Sill				28.4000	0.0190		0.5396						
E4 Jamb				12.0000	0.0060		0.0720						
E5 Ground floor (normal)				94.0000	0.0930		8.7420						
E16 Corner (normal)				11.2000	0.0350		0.3920						
R11 Upstands or kerbs of rooflights				8.4000	0.0380		0.3192						
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.2352	(36)					
Point Thermal bridges							0.0000	(36a)					
Total fabric heat loss							(33) + (36) + (36a) = 157.8851	(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	
	112.2066	111.5272	110.8613	107.7332	107.1480	104.4236	104.4236	103.9191	105.4730	107.1480	108.3319	109.5697	(38)
Heat transfer coeff													
	270.0917	269.4123	268.7463	265.6183	265.0331	262.3087	262.3087	261.8042	263.3581	265.0331	266.2170	267.4548	(39)
Average = Sum(39)m / 12 =													265.6155
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	1.3175	1.3142	1.3110	1.2957	1.2928	1.2796	1.2796	1.2771	1.2847	1.2928	1.2986	1.3047	(40)
HLP (average)													1.2957
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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

Assumed occupancy													3.0084 (42)
Hot water usage for mixer showers													111.9919 110.3089 107.8564 103.1640 99.7011 95.8393 93.6443 96.0782 98.7463 102.8926 107.6858 111.5628 (42a)
Hot water usage for baths													33.9263 33.4225 32.7129 31.4047 30.4251 29.3389 28.7521 29.4567 30.2239 31.3862 32.7213 33.8116 (42b)
Hot water usage for other uses													47.8308 46.0915 44.3522 42.6129 40.8736 39.1343 39.1343 40.8736 42.6129 44.3522 46.0915 47.8308 (42c)
Average daily hot water use (litres/day)													178.1904 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

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Energy conte	193.7490	189.8229	184.9215	177.1816	170.9998	164.3125	161.5308	166.4086	171.5831	178.6310	186.4987	193.2052 (44)
Energy content (annual)	306.8511	270.3052	284.2175	242.5527	230.1986	202.0414	195.3575	206.0486	211.5791	242.4006	265.7016	302.5127 (45)
Distribution loss (46)m = 0.15 x (45)m	46.0277	40.5458	42.6326	36.3829	34.5298	30.3062	29.3036	30.9073	31.7369	36.3601	39.8552	2959.7666
Water storage loss:												
Store volume												210.0000 (47)
b) If manufacturer declared loss factor is not known :												
Hot water storage loss factor from Table 2 (kWh/litre/day)												0.0103 (51)
Volume factor from Table 2a												0.8298 (52)
Temperature factor from Table 2b												0.7800 (53)
Enter (49) or (54) in (55)												1.3985 (55)
Total storage loss	43.3524	39.1570	43.3524	41.9540	43.3524	41.9540	43.3524	43.3524	41.9540	43.3524	41.9540	43.3524 (56)
If cylinder contains dedicated solar storage	43.3524	39.1570	43.3524	41.9540	43.3524	41.9540	43.3524	43.3524	41.9540	43.3524	41.9540	43.3524 (57)
Primary loss	54.8576	49.5488	54.8576	53.0880	54.8576	22.5120	23.2624	23.2624	22.5120	54.8576	53.0880	54.8576 (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	405.0611	359.0110	382.4275	337.5947	328.4086	266.5074	261.9723	272.6634	276.0450	340.6106	360.7435	400.7227 (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	405.0611	359.0110	382.4275	337.5947	328.4086	266.5074	261.9723	272.6634	276.0450	340.6106	360.7435	400.7227 (64)
												Total per year (kWh/year) = Sum(64)m = 3991.7679 (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	145.9141	129.5155	138.3884	123.1192	120.4271	85.1884	83.5663	87.1211	88.3596	124.4843	130.8162	144.4716 (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	180.5055	180.5055	180.5055	180.5055	180.5055	180.5055	180.5055	180.5055	180.5055	180.5055	180.5055	180.5055 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	44.9923	39.9617	32.4991	24.6039	18.3917	15.5270	16.7775	21.8080	29.2707	37.1659	43.3781	46.2427 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	560.8549	566.6748	552.0088	520.7866	481.3742	444.3321	419.5857	413.7658	428.4318	459.6540	499.0664	536.1085 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	56.0590	56.0590	56.0590	56.0590	56.0590	56.0590	56.0590	56.0590	56.0590	56.0590	56.0590	56.0590 (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)	-120.3370	-120.3370	-120.3370	-120.3370	-120.3370	-120.3370	-120.3370	-120.3370	-120.3370	-120.3370	-120.3370	-120.3370 (71)
Water heating gains (Table 5)	196.1211	192.7314	186.0059	170.9989	161.8644	118.3172	112.3203	117.0982	122.7217	167.3176	181.6891	194.1822 (72)
Total internal gains	918.1957	915.5955	886.7413	832.6168	777.8578	694.4038	664.9109	668.8995	696.6517	780.3649	840.3611	892.7609 (73)

## 6. Solar gains

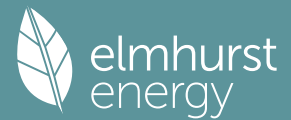
[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
North	1.9200	10.6334	0.7600	0.7000	0.7700	7.5269 (74)
East	6.0000	19.6403	0.7600	0.7000	0.7700	43.4454 (76)
South	10.5000	46.7521	0.7600	0.7000	0.7700	180.9818 (78)
West	31.5000	19.6403	0.7600	0.7000	0.7700	228.0882 (80)
North	1.4400	26.0000	0.7600	0.7000	1.0000	17.9263 (82)

Solar gains	477.9685	879.1946	1342.9680	1845.2144	2193.4902	2223.0218	2125.1011	1865.1688	1520.4837	1012.6112	585.1336	400.4346 (83)
Total gains	1396.1643	1794.7901	2229.7093	2677.8313	2971.3480	2917.4256	2790.0121	2534.0683	2217.1354	1792.9762	1425.4947	1293.1956 (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	21.0834	21.1365	21.1889	21.4384	21.4858	21.7089	21.7089	21.7508	21.6224	21.4858	21.3902	21.2912
alpha	2.4056	2.4091	2.4126	2.4292	2.4324	2.4473	2.4473	2.4501	2.4415	2.4324	2.4260	2.4194
util living area	0.9581	0.9264	0.8693	0.7698	0.6400	0.5012	0.3843	0.4316	0.6361	0.8408	0.9368	0.9645 (86)
Living	18.6358	18.9851	19.4894	20.0557	20.4740	20.7205	20.8166	20.7962	20.5848	19.9867	19.1961	18.5753
Non living	17.0717	17.5118	18.1394	18.8319	19.3134	19.5815	19.6662	19.6546	19.4551	18.7734	17.7930	17.0018
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0
24 / 9	20	0	0	0	0	0	0	0	0	0	0	0
16 / 9	11	28	28	0	0	0	0	0	0	0	0	31
MIT	20.5249	19.8588	20.0811	20.0557	20.4740	20.7205	20.8166	20.7962	20.5848	19.9867	19.1961	19.6267 (87)
Th 2	19.8271	19.8297	19.8323	19.8442	19.8464	19.8569	19.8569	19.8588	19.8529	19.8464	19.8419	19.8372 (88)

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util rest of house	0.9515	0.9153	0.8500	0.7369	0.5894	0.4296	0.2943	0.3383	0.5664	0.8092	0.9254	0.9589 (89)
MIT 2	19.3956	18.8066	18.9936	18.8319	19.3134	19.5815	19.6662	19.6546	19.4551	18.7734	17.7930	18.5857 (90)
Living area fraction									fLA = Living area / (4) =			0.3707 (91)
MIT	19.8142	19.1967	19.3967	19.2856	19.7437	20.0038	20.0927	20.0779	19.8739	19.2232	18.3132	18.9716 (92)
Temperature adjustment												0.0000
adjusted MIT	19.8142	19.1967	19.3967	19.2856	19.7437	20.0038	20.0927	20.0779	19.8739	19.2232	18.3132	18.9716 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9514	0.9084	0.8418	0.7188	0.5846	0.4393	0.3136	0.3572	0.5678	0.7887	0.9055	0.9539 (94)
Useful gains	1328.3747	1630.3429	1877.0745	1924.9268	1736.9059	1281.6112	874.9532	905.0626	1258.8823	1414.2010	1290.8328	1233.5393 (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	4190.2677	3851.7070	3465.9506	2758.5980	2131.8394	1417.4597	916.1597	962.8788	1520.6126	2285.4299	2985.1389	3950.7413 (97)
Space heating kWh	2129.2484	1492.7566	1182.1238	600.2433	293.8306	0.0000	0.0000	0.0000	0.0000	648.1943	1219.9004	2021.5983 (98a)
Space heating requirement - total per year (kWh/year)												9587.8957
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	2129.2484	1492.7566	1182.1238	600.2433	293.8306	0.0000	0.0000	0.0000	0.0000	648.1943	1219.9004	2021.5983 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												9587.8957
Space heating per m2										(98c) / (4) =		46.7702 (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 %)		299.0088 (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	2129.2484	1492.7566	1182.1238	600.2433	293.8306	0.0000	0.0000	0.0000	0.0000	648.1943	1219.9004	2021.5983 (98)
Space heating efficiency (main heating system 1)	299.0088	299.0088	299.0088	299.0088	299.0088	0.0000	0.0000	0.0000	0.0000	299.0088	299.0088	299.0088 (210)
Space heating fuel (main heating system)	712.1022	499.2350	395.3475	200.7443	98.2682	0.0000	0.0000	0.0000	0.0000	216.7810	407.9814	676.0999 (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	405.0611	359.0110	382.4275	337.5947	328.4086	266.5074	261.9723	272.6634	276.0450	340.6106	360.7435	400.7227 (64)
Efficiency of water heater (217)m	185.8383	185.8383	185.8383	185.8383	185.8383	185.8383	185.8383	185.8383	185.8383	185.8383	185.8383	185.8383 (216)
Fuel for water heating, kWh/month	217.9643	193.1846	205.7851	181.6605	176.7174	143.4082	140.9679	146.7208	148.5404	183.2833	194.1169	215.6298 (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	39.3815	31.5933	28.4462	20.8409	16.0981	13.1523	14.6853	19.0885	24.7940	32.5311	36.7438	40.4760 (232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-92.8126	-149.4440	-241.3642	-295.5878	-332.2076	-297.0723	-292.8004	-269.5973	-227.9638	-181.1278	-107.7868	-78.0051 (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												3206.5594 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												185.8383
Water heating fuel used												2147.9793 (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)												317.8310 (232)

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

PV generation	-2565.7697	(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	3106.6000	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	3206.5594	16.4900	528.7616 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2147.9793	16.4900	354.2018 (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	317.8310	16.4900	52.4103 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-2565.7697	16.4900	-423.0954
PV Unit electricity exported	0.0000	5.5900	0.0000
Total			-423.0954 (252)
Total energy cost			512.2783 (255)

## 11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600 (256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	0.7377 (257)
SAP value		88.0422
SAP rating (Section 12)		88 (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	3206.5594	0.1557	499.4079 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2147.9793	0.1415	304.0239 (264)
Space and water heating			803.4319 (265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (267)
Energy for lighting	317.8310	0.1443	45.8728 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-2565.7697	0.1332	-341.8687
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-341.8687 (269)
Total CO2, kg/year			507.4360 (272)
CO2 emissions per m2			2.4800 (273)
EI value			97.2801
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)
Ground floor	205.0000 (1b)	x 2.8000 (2b)	= 574.0000 (1b) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	205.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	574.0000 (5)

### 2. Ventilation rate

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													m3 per hour
Number of open chimneys													0 * 80 = 0.0000 (6a)
Number of open flues													0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire													0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler													0 * 20 = 0.0000 (6d)
Number of flues attached to other heater													0 * 35 = 0.0000 (6e)
Number of blocked chimneys													0 * 20 = 0.0000 (6f)
Number of intermittent extract fans													5 * 10 = 50.0000 (7a)
Number of passive vents													0 * 10 = 0.0000 (7b)
Number of flueless gas fires													0 * 40 = 0.0000 (7c)
													Air changes per hour
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =											50.0000 / (5) =	0.0871 (8)
Pressure test													Yes
Pressure Test Method													Blower Door
Measured/design AP50													5.0000 (17)
Infiltration rate													0.3371 (18)
Number of sides sheltered													0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =											1.0000 (20)	
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =											0.3371 (21)	
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	4.8000	4.5000	4.4000	3.9000	3.9000	3.6000	3.7000	3.5000	3.7000	4.0000	4.1000	4.4000	(22)
Wind factor	1.2000	1.1250	1.1000	0.9750	0.9750	0.9000	0.9250	0.8750	0.9250	1.0000	1.0250	1.1000	(22a)
Adj infilt rate													
	0.4045	0.3792	0.3708	0.3287	0.3287	0.3034	0.3118	0.2950	0.3118	0.3371	0.3455	0.3708	(22b)
Effective ac	0.5818	0.5719	0.5688	0.5540	0.5540	0.5460	0.5486	0.5435	0.5486	0.5568	0.5597	0.5688	(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						
Opening Type 1 (Uw = 1.60)			49.9200	1.5038	75.0677		(27)						
Opening			1.4400	1.5038	2.1654		(27a)						
Heatloss Floor 1			205.0000	0.1200	24.6000		(28a)						
External Wall 1	263.2000	49.9200	213.2800	0.1100	23.4608		(29a)						
External Roof 1	225.0000	1.4400	223.5600	0.1000	22.3560		(30)						
Total net area of external elements Aum(A, m2)			693.2000				(31)						
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 147.6499		(33)						
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							100.0000 (35)						
List of Thermal Bridges													
K1 Element				Length	Psi-value	Total							
E1 Steel lintel with perforated steel base plate				28.4000	0.0060	0.1704							
E3 Sill				28.4000	0.0190	0.5396							
E4 Jamb				12.0000	0.0060	0.0720							
E5 Ground floor (normal)				94.0000	0.0930	8.7420							
E16 Corner (normal)				11.2000	0.0350	0.3920							
R11 Upstands or kerbs of rooflights				8.4000	0.0380	0.3192							
Thermal bridges (Sum(L x Psi) calculated using Appendix K)						10.2352	(36)						
Point Thermal bridges						(36a) = 0.0000							
Total fabric heat loss						(33) + (36) + (36a) = 157.8851	(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	
	110.2087	108.3319	107.7332	104.9416	104.9416	103.4280	103.9191	102.9504	103.9191	105.4730	106.0179	107.7332	(38)
Heat transfer coeff													
	268.0938	266.2170	265.6183	262.8267	262.8267	261.3131	261.8042	260.8355	261.8042	263.3581	263.9030	265.6183	(39)
Average = Sum(39)m / 12 =												263.6849	(39)
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	1.3078	1.2986	1.2957	1.2821	1.2821	1.2747	1.2771	1.2724	1.2771	1.2847	1.2873	1.2957	(40)
HLP (average)												1.2863	
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													3.0084 (42)
	111.9919	110.3089	107.8564	103.1640	99.7011	95.8393	93.6443	96.0782	98.7463	102.8926	107.6858	111.5628	(42a)
Hot water usage for baths													
	33.9263	33.4225	32.7129	31.4047	30.4251	29.3389	28.7521	29.4567	30.2239	31.3862	32.7213	33.8116	(42b)
Hot water usage for other uses													
	47.8308	46.0915	44.3522	42.6129	40.8736	39.1343	39.1343	40.8736	42.6129	44.3522	46.0915	47.8308	(42c)
Average daily hot water use (litres/day)													178.1904 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	193.7490	189.8229	184.9215	177.1816	170.9998	164.3125	161.5308	166.4086	171.5831	178.6310	186.4987	193.2052	(44)
Energy conte	306.8511	270.3052	284.2175	242.5527	230.1986	202.0414	195.3575	206.0486	211.5791	242.4006	265.7016	302.5127	(45)
Energy content (annual)													Total = Sum(45)m = 2959.7666
Distribution loss (46)m = 0.15 x (45)m													
	46.0277	40.5458	42.6326	36.3829	34.5298	30.3062	29.3036	30.9073	31.7369	36.3601	39.8552	45.3769	(46)



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Temperature adjustment													0.0000
adjusted MIT	19.8585	19.2826	19.4720	19.4616	19.8694	20.0673	20.1187	20.1200	19.9876	19.4760	18.6165	19.1083	(93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9401	0.8979	0.8214	0.6753	0.5250	0.3554	0.2276	0.2391	0.4791	0.7314	0.8779	0.9431	(94)
Useful gains	1395.8510	1654.8567	1888.6195	1943.9352	1636.1839	1147.4093	696.3122	666.9546	1154.0700	1406.4912	1352.7964	1274.6563	(95)
Ext temp.	5.0000	5.4000	7.1000	9.5000	12.6000	15.4000	17.4000	17.5000	15.0000	11.7000	8.1000	5.2000	(96)
Heat loss rate W	3983.4770	3695.7909	3286.2430	2618.1820	1910.5991	1219.6201	711.7540	683.3992	1305.7843	2047.8812	2775.3361	3694.2871	(97)
Space heating kWh	1925.1937	1371.5077	1039.8319	485.4577	204.1649	0.0000	0.0000	0.0000	0.0000	477.1942	1024.2286	1800.2053	(98a)
Space heating requirement - total per year (kWh/year)												8327.7840	
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	1925.1937	1371.5077	1039.8319	485.4577	204.1649	0.0000	0.0000	0.0000	0.0000	477.1942	1024.2286	1800.2053	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												8327.7840	
Space heating per m2										(98c) / (4) =		40.6233	(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 %)													298.5133	(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	1925.1937	1371.5077	1039.8319	485.4577	204.1649	0.0000	0.0000	0.0000	0.0000	477.1942	1024.2286	1800.2053	(98)	
Space heating efficiency (main heating system 1)	298.5133	298.5133	298.5133	298.5133	298.5133	0.0000	0.0000	0.0000	0.0000	298.5133	298.5133	298.5133	(210)	
Space heating fuel (main heating system)	644.9273	459.4461	348.3369	162.6251	68.3939	0.0000	0.0000	0.0000	0.0000	159.8569	343.1099	603.0570	(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	405.0611	359.0110	382.4275	337.5947	328.4086	266.5074	261.9723	272.6634	276.0450	340.6106	360.7435	400.7227	(64)	
Efficiency of water heater (217)m	185.8327	185.8327	185.8327	185.8327	185.8327	185.8327	185.8327	185.8327	185.8327	185.8327	185.8327	185.8327	(216)	
Fuel for water heating, kWh/month	217.9708	193.1904	205.7913	181.6659	176.7227	143.4125	140.9721	146.7252	148.5449	183.2888	194.1227	215.6363	(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	39.3815	31.5933	28.4462	20.8409	16.0981	13.1523	14.6853	19.0885	24.7940	32.5311	36.7438	40.4760	(232)	
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-109.2461	-156.8701	-251.2546	-317.4258	-342.7647	-321.3255	-314.5576	-293.2069	-248.7450	-199.5723	-127.3040	-88.9372	(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													2789.7530	(211)
Space heating fuel - main system 2													0.0000	(213)
Space heating fuel - secondary													0.0000	(215)
Efficiency of water heater													185.8327	
Water heating fuel used													2148.0438	(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)													317.8310	(232)
Energy saving/generation technologies (Appendices M ,N and Q)														
PV generation													-2771.2099	(233)
Wind generation													0.0000	(234)
Hydro-electric generation (Appendix N)													0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)													0.0000	(235)



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## Appendix Q - special features

Energy saved or generated	-0.0000	(236)
Energy used	0.0000	(237)
Total delivered energy for all uses	2484.4178	(238)

### 10a. Fuel costs - using BEDF prices (516)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	2789.7530	18.3900	513.0356 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2148.0438	18.3900	395.0253 (247)
Energy for instantaneous electric shower(s)	0.0000	18.3900	0.0000 (247a)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (249)
Energy for lighting	317.8310	18.3900	58.4491 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-2771.2099	18.3900	-509.6255
PV Unit electricity exported	0.0000	5.8100	0.0000
Total			-509.6255 (252)
Total energy cost			456.8844 (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	2789.7530	0.1563	436.0619 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2148.0438	0.1415	304.0330 (264)
Space and water heating			740.0949 (265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (267)
Energy for lighting	317.8310	0.1443	45.8728 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-2771.2099	0.1333	-369.5077
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-369.5077 (269)
Total CO2, kg/year			416.4601 (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	2789.7530	1.5787	4404.0748 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2148.0438	1.5234	3272.3405 (278)
Space and water heating			7676.4153 (279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (281)
Energy for lighting	317.8310	1.5338	487.4998 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-2771.2099	1.4927	-4136.6671
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-4136.6671 (283)
Total Primary energy kWh/year			4027.2481 (286)