

# Energy Statement

Greenacre Lodge  
Ref: PP-12638548  
February 2023

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## 1. Introduction

This Energy Statement summarises the energy strategy and planning SAP assessment for a new single storey annexe at Greenacre, Tregrehan Mills, St Austell, Cornwall, PL25 3TQ. This statement should be read in conjunction with the submitted planning drawings.

## 2. Heating and Hot Water

It is intention for the proposal to have an energy efficient electric combi boiler to supply both hot water and underfloor heating. The property requires hot water to one sink in the kitchen, one sink in the bathroom and one shower so the demand is considered relatively low.

It is the intention to install Wunda's Rapid Response underfloor heating which is a highly efficient system where the pipes are recessed into EPS insulation as shown below:



*Figure 1: Wunda Rapid Response Underfloor Heating*

The property will also have a log burner as a secondary localised heating system in the lounge area.

### **3. Ventilation**

The proposal will have standard kitchen and bathroom extracts and the property will rely on natural ventilation from openable windows. The log burner will also have a standard flue to extract fumes through the roof and outside the property.

### **4. Overheating**

The proposal is well covered by tree canopies from the East and West elevations as shown in the photo below. The building also features high level openable windows on the North and South elevations to allow for cross and purge ventilation in the Summer months.



*Figure 2: Tree canopies on the peripheries of the development area*

The roof slopes towards the North to minimise solar gain.

The building will be constructed completely out of timber with no concrete or stone so as such, has a relatively low thermal mass and reduces risk of overheating in Summer months.

### **5. Renewable Energy**

The proposals do not feature any form of renewable energy at present however, it is the intention in future to install solar PV panels on the site to support both the main dwelling and annexe building when funds are available after the build is completed.

### **6. Water Efficiency**

It is the intention to use low flow rate taps in both the kitchen and bathroom to lower general water consumption. A rainwater collection butt will also be installed on the North elevation so rainwater can be used for watering plants and vegetation around the property.

### **7. Embodied Carbon**

As mentioned, the structure of the building will be constructed completely out of timber so it's embodied carbon is close to net zero.

It is the intention to use ground screws as foundations to minimise the impact of the development on the land with a suspended floor and clearance underneath. An example of the type of product to be used is shown in the images below (image taken from StopDigging UK <https://stopdigging.co.uk/> ). These ground screws are suitable for use where trees / planting is close to the development area.



Figure 3: Stop Digging ground screws

The combination of the ground screws and Rapid Response UFH heating system means that the proposal will not be using at concrete or screed for the construction of foundations and floor of the property.

## 8. Energy Summary Tool Extract

Summary of Energy Summary Tool below (completed version attached separately):

Results				Inputs - general						
Space heat demand	Total energy use	Renewable generation	Renewable deficit	Quantity	Plot Name	Bedrooms	Number of storeys	SAP Floor Area	Volume	Site Exposure
kWh/m <sup>2</sup> <sub>TA</sub> /yr	kWh/m <sup>2</sup> <sub>GIA</sub> /yr	% total energy	kWh/year					m <sup>2</sup>	m <sup>3</sup>	
Required values:				Box numbers from SAP calculation printout --->						
<30	<40	100%	0					[4]	[5]	
29.4	33.4	108%	0	1	EXAMPLE - Semi Detached House	3	2	93.2	235	Normal
57.5	100.8	0%	5865	1	Single Storey Annexe	1	1	58.2	176	Normal

Figure 4: Energy Summary Tool extract

## 9. SAP Report

Full SAP report on following pages:

# Building Regulations England Part L (BREL) Compliance Report

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

Date: Fri 16 Feb 2024 18:08:47

Project Information			
Assessed By	Jessica Tyler	Building Type	Bungalow, Detached
OCDEA Registration	EES/029910	Assessment Date	2024-02-16

Dwelling Details			
Assessment Type	As designed	Total Floor Area	58 m <sup>2</sup>
Site Reference	57879	Plot Reference	As Designed
Address	Greenacre, PL25 3TQ		

Client Details	
Name	Joe Allam
Company	Array
Address	Greenacre, Tregrehan Mills, St Austell, PL25 3TQ

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

1a Target emission rate and dwelling emission rate		
Fuel for main heating system	Electricity	
Target carbon dioxide emission rate	12.77 kgCO <sub>2</sub> /m <sup>2</sup>	
Dwelling carbon dioxide emission rate	5.28 kgCO <sub>2</sub> /m <sup>2</sup>	OK
1b Target primary energy rate and dwelling primary energy		
Target primary energy	68.26 kWh <sub>PE</sub> /m <sup>2</sup>	
Dwelling primary energy	59.11 kWh <sub>PE</sub> /m <sup>2</sup>	OK
1c Target fabric energy efficiency and dwelling fabric energy efficiency		
Target fabric energy efficiency	51.3 kWh/m <sup>2</sup>	
Dwelling fabric energy efficiency	41.6 kWh/m <sup>2</sup>	OK

2a Fabric U-values				
Element	Maximum permitted average U-Value [W/m <sup>2</sup> K]	Dwelling average U-Value [W/m <sup>2</sup> K]	Element with highest individual U-Value	
External walls	0.26	0.18	Walls (1) (0.18)	OK
Party walls	0.2	N/A	N/A	N/A
Curtain walls	1.6	N/A	N/A	N/A
Floors	0.18	0.13	Heatloss Floor (0.13)	OK
Roofs	0.16	0.11	Roof (1) (0.11)	OK
Windows, doors, and roof windows	1.6	0.8	West Elevation Windows (0.8)	OK
Rooflights	2.2	N/A	N/A	N/A

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))		
Name	Net area [m <sup>2</sup> ]	U-Value [W/m <sup>2</sup> K]
Exposed wall: Walls (1)	77.565	0.18
Ground floor: Heatloss Floor , Heatloss Floor	58.2	0.13
Exposed roof: Roof (1)	58.2	0.11

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	Area [m <sup>2</sup> ]	Orientation	Frame factor	U-Value [W/m <sup>2</sup> K]
West Elevation Windows, Windows	2.1	West	0.7	0.8 (!)
East Elevation Windows , Windows	6.699	East	0.7	0.8 (!)
North Elevation Windows , Windows	1.35	North	0.7	0.8 (!)
North Elevation Windows , Windows	2.52	North	0.7	0.8 (!)
North Elevation Windows , Windows	1.89	North	0.7	0.8 (!)
North Elevation Windows , Windows	0.42	North	0.7	0.8 (!)
South Elevation Windows , Windows	1.755	South	0.7	0.8 (!)
South Elevation Windows , Windows	1.26	South	0.7	0.8 (!)
South Elevation Windows , Windows	2.601	South	0.7	0.8 (!)

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

Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E1: Steel lintel with perforated steel base plate	Calculated by person with suitable expertise	0 (!)	
External wall	E3: Sill	Calculated by person with suitable expertise	0 (!)	
External wall	E4: Jamb	Calculated by person with suitable expertise	0 (!)	
External wall	E5: Ground floor (normal)	Calculated by person with suitable expertise	0 (!)	
External wall	E16: Corner (normal)	Calculated by person with suitable expertise	0 (!)	

3 Air permeability (better than typically expected values are flagged with a subsequent (!))				
Maximum permitted air permeability at 50Pa		8 m <sup>3</sup> /hm <sup>2</sup>		
Dwelling air permeability at 50Pa		4 m <sup>3</sup> /hm <sup>2</sup> , Design value		OK
Air permeability test certificate reference				

4 Space heating	
<b>Main heating system 1:</b> Boiler with radiators or underfloor heating - Electricity	
Efficiency	0.0%
Emitter type	Radiators
Flow temperature	
System type	
Manufacturer	Viessmann
Model	Vitotron
Commissioning	
<b>Secondary heating system:</b> N/A	
Fuel	N/A
Efficiency	N/A
Commissioning	

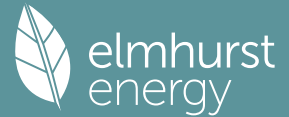
5 Hot water	
<b>Cylinder/store</b> - type: Cylinder	
Capacity	144 litres
Declared heat loss	N/A
Primary pipework insulated	N/A
Manufacturer	
Model	
Commissioning	
<b>Waste water heat recovery system 1</b> - type: N/A	
Efficiency	
Manufacturer	
Model	

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

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

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

# Full SAP Calculation Printout



Property Reference	57879		Issued on Date	16/02/2024	
Assessment Reference	As Designed	Prop Type Ref			
Property	Greenacre, PL25 3TQ				
SAP Rating	83 B	DER	5.28	TER	12.77
Environmental	96 A	% DER < TER	58.65		
CO <sub>2</sub> Emissions (t/year)	0.31	DFEE	41.61	TFEE	51.34
Compliance Check	See BREL	% DFEE < TFEE	18.95		
% DPER < TPER	13.41	DPER	59.11	TPER	68.26
Assessor Details	Miss Jessica Tyler			Assessor ID	CD80-0001
Client	57879, Joe Allam				

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> )	Storey height (m)	Volume (m <sup>3</sup> )
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	58.2000	58.2000 (1b)	x 3.0000 (2b)	= 174.6000 (1b) - (3b)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 174.6000 (5)

### 2. Ventilation rate

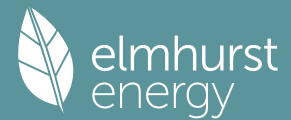
		m3 per hour	
Number of open chimneys		0 * 80 =	0.0000 (6a)
Number of open flues		0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire		0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler		0 * 20 =	0.0000 (6d)
Number of flues attached to other heater		0 * 35 =	0.0000 (6e)
Number of blocked chimneys		0 * 20 =	0.0000 (6f)
Number of intermittent extract fans		0 * 10 =	0.0000 (7a)
Number of passive vents		0 * 10 =	0.0000 (7b)
Number of flueless gas fires		0 * 40 =	0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =		0.0000 / (5) =	0.0000 (8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50			4.0000 (17)
Infiltration rate			0.2000 (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) =	0.2000 (21)

Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind factor	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Adj infilt rate	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Effective ac	0.2550	0.2500	0.2450	0.2200	0.2150	0.1900	0.1900	0.1850	0.2000	0.2150	0.2250	0.2350 (22b)
	0.5325	0.5312	0.5300	0.5242	0.5231	0.5181	0.5181	0.5171	0.5200	0.5231	0.5253	0.5276 (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
Windows (Uw = 0.80)			20.6000	0.7752	15.9690		(27)
Heatloss Floor			58.2000	0.1300	7.5660	20.0000	1164.0000 (28a)
External Walls	98.1600	20.6000	77.5600	0.1800	13.9608	18.0000	1396.0800 (29a)
External Roof	58.2000		58.2000	0.1100	6.4020	9.0000	523.8000 (30)
Total net area of external elements Aum(A, m <sup>2</sup> )			214.5600				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	43.8978		(33)
Internal Walls			124.0200			9.0000	1116.1800 (32c)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	4200.0600 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							72.1660 (35)
List of Thermal Bridges				Length	Psi-value	Total	
K1 Element							
E1 Steel lintel with perforated steel base plate				13.6300	0.0000	0.0000	
E3 Sill				13.6300	0.0000	0.0000	
E4 Jamb				28.5000	0.0000	0.0000	
E5 Ground floor (normal)				32.7200	0.0000	0.0000	
E16 Corner (normal)				12.0000	0.0000	0.0000	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							0.0000 (36)
Point Thermal bridges						(36a) =	0.0000
Total fabric heat loss						(33) + (36) + (36a) =	43.8978 (37)

# Full SAP Calculation Printout



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	30.6823	30.6096	30.5383	30.2034	30.1407	29.8490	29.8490	29.7950	29.9614	30.1407	30.2675	30.4000	(38)
Heat transfer coeff	74.5801	74.5074	74.4361	74.1011	74.0385	73.7468	73.7468	73.6928	73.8592	74.0385	74.1652	74.2978	(39)
Average = Sum(39)m / 12 =												74.1008	
HLP	1.2814	1.2802	1.2790	1.2732	1.2721	1.2671	1.2671	1.2662	1.2691	1.2721	1.2743	1.2766	(40)
HLP (average)												1.2732	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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

Assumed occupancy													1.9303	(42)
Hot water usage for mixer showers													0.0000	(42a)
Hot water usage for baths	65.2042	64.2359	62.8722	60.3578	58.4751	56.3874	55.2598	56.6139	58.0883	60.3222	62.8883	64.9838	64.9838	(42b)
Hot water usage for other uses	34.3983	33.1475	31.8966	30.6458	29.3949	28.1441	28.1441	29.3949	30.6458	31.8966	33.1475	34.3983	34.3983	(42c)
Average daily hot water use (litres/day)													91.7258	(43)
Daily hot water use	99.6025	97.3833	94.7688	91.0036	87.8700	84.5315	83.4039	86.0089	88.7341	92.2188	96.0358	99.3821	99.3821	(44)
Energy conte	157.7461	138.6726	145.6561	124.5794	118.2899	103.9414	100.8698	106.4969	109.4180	125.1401	136.8206	155.6084	155.6084	(45)
Energy content (annual)													1523.2392	
Distribution loss (46)m = 0.15 x (45)m	23.6619	20.8009	21.8484	18.6869	17.7435	15.5912	15.1305	15.9745	16.4127	18.7710	20.5231	23.3413	23.3413	(46)
Water storage loss:													144.0000	(47)
Store volume													0.0206	(51)
b) If manufacturer declared loss factor is not known :													0.9410	(52)
Hot water storage loss factor from Table 2 (kWh/litre/day)													0.6000	(53)
Volume factor from Table 2a													1.6751	(55)
Temperature factor from Table 2b													0.6000	(55)
Enter (49) or (54) in (55)													1.6751	(55)
Total storage loss	51.9289	46.9035	51.9289	50.2537	51.9289	50.2537	51.9289	51.9289	50.2537	51.9289	50.2537	51.9289	51.9289	(56)
If cylinder contains dedicated solar storage	51.9289	46.9035	51.9289	50.2537	51.9289	50.2537	51.9289	51.9289	50.2537	51.9289	50.2537	51.9289	51.9289	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	209.6749	185.5760	197.5850	174.8331	170.2188	154.1951	152.7986	158.4258	159.6718	177.0689	187.0743	207.5372	207.5372	(62)
WWHRs	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRs	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	209.6749	185.5760	197.5850	174.8331	170.2188	154.1951	152.7986	158.4258	159.6718	177.0689	187.0743	207.5372	207.5372	(64)
12Total per year (kWh/year)													2134.6595	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a) m =													0.0000	(64a)
Heat gains from water heating, kWh/month	93.9937	83.6314	89.9737	81.6256	80.8745	74.7635	75.0823	76.9533	76.5845	83.1521	85.6958	93.2829	93.2829	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts	96.5155	96.5155	96.5155	96.5155	96.5155	96.5155	96.5155	96.5155	96.5155	96.5155	96.5155	96.5155	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	84.9312	84.9312	84.9312	84.9312	84.9312	84.9312	84.9312	84.9312	84.9312	84.9312	84.9312	84.9312	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	168.3855	170.1329	165.7297	156.3558	144.5230	133.4019	125.9723	124.2250	128.6281	138.0020	149.8348	160.9559	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.6516	32.6516	32.6516	32.6516	32.6516	32.6516	32.6516	32.6516	32.6516	32.6516	32.6516	32.6516	(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)	-77.2124	-77.2124	-77.2124	-77.2124	-77.2124	-77.2124	-77.2124	-77.2124	-77.2124	-77.2124	-77.2124	-77.2124	(71)
Water heating gains (Table 5)	126.3356	124.4515	120.9324	113.3689	108.7023	103.8382	100.9170	103.4319	106.3673	111.7636	119.0220	125.3802	(72)
Total internal gains	434.6069	443.5700	426.5480	412.4416	393.1111	376.9569	363.7751	364.5427	374.7123	389.6514	411.5736	426.2220	(73)

## 6. Solar gains

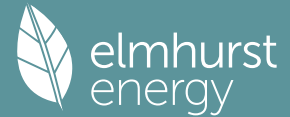
[Jan]	Area	Solar flux	g	FF	Access	Gains							
	m2	Table 6a	Specific data	Specific data	factor	W							
		W/m2	or Table 6b	or Table 6c	Table 6d								
North	6.1800	10.6334	0.6800	0.7000	0.7700	21.6771 (74)							
East	6.7000	19.6403	0.6800	0.7000	0.7700	43.4073 (76)							
South	5.6200	46.7521	0.6800	0.7000	0.7700	86.6717 (78)							
West	2.1000	19.6403	0.6800	0.7000	0.7700	13.6053 (80)							
Solar gains	165.3613	294.9005	434.8784	585.3021	693.5588	704.0600	672.4190	590.0669	487.1343	334.7522	200.5649	139.8477	(83)
Total gains	599.9682	738.4704	861.4264	997.7438	1086.6700	1081.0169	1036.1942	954.6096	861.8466	724.4037	612.1385	566.0697	(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)		



# Full SAP Calculation Printout



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	15.6434	15.6586	15.6736	15.7445	15.7578	15.8201	15.8201	15.8317	15.7961	15.7578	15.7309	15.7028	
alpha	2.0429	2.0439	2.0449	2.0496	2.0505	2.0547	2.0547	2.0554	2.0531	2.0505	2.0487	2.0469	
util living area	0.8693	0.8152	0.7437	0.6356	0.5124	0.3879	0.2928	0.3266	0.4885	0.6925	0.8246	0.8810	(86)
MIT	18.1115	18.6145	19.2481	19.9493	20.4725	20.7888	20.9152	20.8909	20.6446	19.9252	18.8947	18.0038	(87)
Th 2	19.8554	19.8564	19.8573	19.8619	19.8627	19.8667	19.8667	19.8674	19.8652	19.8627	19.8610	19.8592	(88)
util rest of house	0.8550	0.7963	0.7184	0.6010	0.4672	0.3299	0.2235	0.2544	0.4276	0.6536	0.8032	0.8678	(89)
MIT 2	16.5691	17.1823	17.9488	18.7782	19.3697	19.7043	19.8190	19.8025	19.5725	18.7801	17.5445	16.4383	(90)
Living area fraction	17.0019	17.5842	18.3133	19.1068	19.6791	20.0086	20.1266	20.1079	19.8733	19.1014	17.9234	16.8775	(91)
MIT	17.0019	17.5842	18.3133	19.1068	19.6791	20.0086	20.1266	20.1079	19.8733	19.1014	17.9234	16.8775	(92)
Temperature adjustment													0.0000
adjusted MIT	17.0019	17.5842	18.3133	19.1068	19.6791	20.0086	20.1266	20.1079	19.8733	19.1014	17.9234	16.8775	(93)

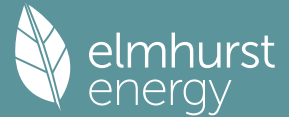
## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8079	0.7499	0.6785	0.5758	0.4594	0.3375	0.2398	0.2703	0.4280	0.6240	0.7577	0.8214	(94)
Useful gains	484.7327	553.8123	584.4504	574.4805	499.2388	364.7987	248.5254	258.0042	368.8964	451.9974	463.8208	464.9898	(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	947.3063	945.0625	879.3379	756.3367	590.7614	398.8678	260.0727	273.2465	426.4114	629.4320	802.7168	941.9124	(97)
Space heating kWh	344.1548	262.9202	219.3963	130.9365	68.0928	0.0000	0.0000	0.0000	0.0000	132.0113	244.0051	354.8304	(98a)
Space heating requirement - total per year (kWh/year)												1756.3476	
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	344.1548	262.9202	219.3963	130.9365	68.0928	0.0000	0.0000	0.0000	0.0000	132.0113	244.0051	354.8304	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1756.3476	
Space heating per m2													(98c) / (4) = 30.1778 (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 %)													0.0000	(206)
Efficiency of main space heating system 2 (in %)													0.0000	(207)
Efficiency of secondary/supplementary heating system, %													0.0000	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement	344.1548	262.9202	219.3963	130.9365	68.0928	0.0000	0.0000	0.0000	0.0000	132.0113	244.0051	354.8304	(98)	
Space heating efficiency (main heating system 1)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(210)	
Space heating fuel (main heating system)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(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	209.6749	185.5760	197.5850	174.8331	170.2188	154.1951	152.7986	158.4258	159.6718	177.0689	187.0743	207.5372	(64)	
Efficiency of water heater (217)m	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	(216)	
Fuel for water heating, kWh/month	209.6749	185.5760	197.5850	174.8331	170.2188	154.1951	152.7986	158.4258	159.6718	177.0689	187.0743	207.5372	(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	3.4822	3.1452	3.4822	3.3699	3.4822	3.3699	3.4822	3.4822	3.3699	3.4822	3.3699	3.4822	(231)	
Lighting	18.0558	14.4850	13.0422	9.5553	7.3808	6.0301	6.7330	8.7518	11.3677	14.9150	16.8465	18.5576	(232)	
Electricity generated by PVs (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233a)	
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)	
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)	
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)	
Electricity generated by PVs (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)	
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)	
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)	
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)	
Annual totals kWh/year														
Space heating fuel - main system 1													0.0000	(211)
Space heating fuel - main system 2													0.0000	(213)
Space heating fuel - secondary													0.0000	(215)
Efficiency of water heater													100.0000	
Water heating fuel used													2134.6595	(219)
Space cooling fuel													0.0000	(221)
Electricity for pumps and fans: central heating pump													41.0000	(230c)
Total electricity for the above, kWh/year													41.0000	(231)
Electricity for lighting (calculated in Appendix L)													145.7207	(232)
Energy saving/generation technologies (Appendices M ,N and Q)														
PV generation													0.0000	(233)
Wind generation													0.0000	(234)
Hydro-electric generation (Appendix N)													0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)													0.0000	(235)
Appendix Q - special features														
Energy saved or generated													-0.0000	(236)
Energy used													0.0000	(237)

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Total delivered energy for all uses

2321.3802 (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 (high-rate cost)	0.0000	0.0000	0.0000 (261)
Space heating - main system 1 (low-rate cost)	0.0000	0.0000	0.0000 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating - high rate cost	640.2126	0.1477	94.5354 (264)
Water heating - low rate cost	1494.4469	0.1239	185.2054 (264)
Space and water heating			279.7408 (265)
Pumps, fans and electric keep-hot	41.0000	0.1432	5.8713 (267)
Energy for lighting	145.7207	0.1490	21.7153 (268)
Total CO2, kg/year			307.3273 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			5.2800 (273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1 (high-rate cost)	0.0000	0.0000	0.0000 (275)
Space heating - main system 1 (low-rate cost)	0.0000	0.0000	0.0000 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating - high rate cost	640.2126	1.5520	993.6038 (278)
Water heating - low rate cost	1494.4469	1.4434	2157.0879 (278)
Space and water heating			3150.6916 (279)
Pumps, fans and electric keep-hot	41.0000	1.5335	62.8729 (281)
Energy for lighting	145.7207	1.5547	226.5585 (282)
Total Primary energy kWh/year			3440.1230 (286)
Dwelling Primary energy Rate (DPER)			59.1100 (287)

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

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	58.2000 (1b)	x 3.0000 (2b)	= 174.6000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	58.2000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 174.6000 (5)

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

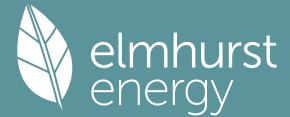
		Air changes per hour
m3 per hour		
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	2 * 10 =	20.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(7a)+(7b)+(7c) =	20.0000 / (5) = 0.1145 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.3645 (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) =	0.3645 (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	0.4648	0.4557	0.4466	0.4010	0.3919	0.3463	0.3463	0.3372	0.3645	0.3919	0.4101	0.4283 (22b)
Effective ac	0.6080	0.6038	0.5997	0.5804	0.5768	0.5600	0.5600	0.5569	0.5664	0.5768	0.5841	0.5917 (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)			14.5400	1.1450	16.6489		(27)
Heatloss Floor			58.2000	0.1300	7.5660		(28a)
External Walls	98.1600	14.5400	83.6200	0.1800	15.0516		(29a)
External Roof	58.2000		58.2000	0.1100	6.4020		(30)
Total net area of external elements Aum(A, m2)			214.5600				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	45.6685	(33)

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Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K										72.1660 (35)		
List of Thermal Bridges												
K1 Element									Length	Psi-value		Total
E1 Steel lintel with perforated steel base plate									13.6300	0.0500		0.6815
E3 Sill									13.6300	0.0500		0.6815
E4 Jamb									28.5000	0.0500		1.4250
E5 Ground floor (normal)									32.7200	0.1600		5.2352
E16 Corner (normal)									12.0000	0.0900		1.0800
Thermal bridges (Sum(L x Psi) calculated using Appendix K)										9.1032 (36)		
Point Thermal bridges										(36a) = 0.0000		
Total fabric heat loss										(33) + (36) + (36a) = 54.7717 (37)		

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	35.0328	34.7911	34.5542	33.4416	33.2334	32.2643	32.2643	32.0848	32.6376	33.2334	33.6545	34.0948 (38)
Average = Sum(39)m / 12 =	89.8045	89.5628	89.3259	88.2132	88.0050	87.0359	87.0359	86.8565	87.4092	88.0050	88.4262	88.8665 (39)
												88.2122
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.5430	1.5389	1.5348	1.5157	1.5121	1.4955	1.4955	1.4924	1.5019	1.5121	1.5194	1.5269 (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												1.9303 (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												
	65.2042	64.2359	62.8722	60.3578	58.4751	56.3874	55.2598	56.6139	58.0883	60.3222	62.8883	64.9838 (42b)
Hot water usage for other uses												
	34.3983	33.1475	31.8966	30.6458	29.3949	28.1441	28.1441	29.3949	30.6458	31.8966	33.1475	34.3983 (42c)
Average daily hot water use (litres/day)												
												91.7258 (43)
Daily hot water use												
	99.6025	97.3833	94.7688	91.0036	87.8700	84.5315	83.4039	86.0089	88.7341	92.2188	96.0358	99.3821 (44)
Energy conte												
	157.7461	138.6726	145.6561	124.5794	118.2899	103.9414	100.8698	106.4969	109.4180	125.1401	136.8206	155.6084 (45)
Energy content (annual)												
	Total = Sum(45)m = 1523.2392											
Distribution loss (46)m = 0.15 x (45)m												
	23.6619	20.8009	21.8484	18.6869	17.7435	15.5912	15.1305	15.9745	16.4127	18.7710	20.5231	23.3413 (46)
Water storage loss:												
Store volume												
												144.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												
Temperature factor from Table 2b												
Enter (49) or (54) in (55)												0.5400 (48)
Total storage loss												0.7349 (55)
	22.7825	20.5777	22.7825	22.0476	22.7825	22.0476	22.7825	22.7825	22.0476	22.7825	22.0476	22.7825 (56)
If cylinder contains dedicated solar storage												
	22.7825	20.5777	22.7825	22.0476	22.7825	22.0476	22.7825	22.7825	22.0476	22.7825	22.0476	22.7825 (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												
	203.7910	180.2615	191.7010	169.1389	164.3348	148.5009	146.9146	152.5418	153.9776	171.1849	181.3802	201.6533 (62)
MWHRS												
	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												
	203.7910	180.2615	191.7010	169.1389	164.3348	148.5009	146.9146	152.5418	153.9776	171.1849	181.3802	201.6533 (64)
Total per year (kWh/year)												
	Total per year (kWh/year) = Sum(64)m = 2065.3805 (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												
	89.2865	79.3798	85.2666	77.0703	76.1673	70.2082	70.3751	72.2461	72.0291	78.4450	81.1405	88.5757 (65)

5. Internal gains (see Table 5 and 5a)												
Metabolic gains (Table 5), Watts												
(66)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	96.5155	96.5155	96.5155	96.5155	96.5155	96.5155	96.5155	96.5155	96.5155	96.5155	96.5155	96.5155 (66)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	84.9312	84.9312	84.9312	87.7622	84.9312	87.7622	84.9312	84.9312	87.7622	84.9312	87.7622	84.9312 (67)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	168.3855	170.1329	165.7297	156.3558	144.5230	133.4019	125.9723	124.2250	128.6281	138.0020	149.8348	160.9559 (68)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)												
	-77.2124	-77.2124	-77.2124	-77.2124	-77.2124	-77.2124	-77.2124	-77.2124	-77.2124	-77.2124	-77.2124	-77.2124 (71)
Water heating gains (Table 5)												
	120.0087	118.1247	114.6056	107.0421	102.3754	97.5113	94.5902	97.1050	100.0405	105.4368	112.6951	119.0533 (72)
Total internal gains												
	428.2801	437.2431	420.2211	406.1148	386.7843	370.6301	357.4483	358.2158	368.3855	383.3246	405.2468	419.8951 (73)

6. Solar gains												
[Jan]		Area	Solar flux	g	FF	Access	Gains					
		m <sup>2</sup>	Table 6a	Specific data	Specific data	factor	W					
			W/m <sup>2</sup>	or Table 6b	or Table 6c	Table 6d						
North		4.3600	10.6334	0.6300	0.7000	0.7700	14.1687 (74)					
East		4.7300	19.6403	0.6300	0.7000	0.7700	28.3910 (76)					
South		3.9700	46.7521	0.6300	0.7000	0.7700	56.7235 (78)					
West		1.4800	19.6403	0.6300	0.7000	0.7700	8.8834 (80)					

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Solar gains	108.1666	192.8923	284.4302	382.7849	453.5616	460.4200	439.7320	385.8921	318.5977	218.9533	131.1924	91.4787 (83)
Total gains	536.4467	630.1354	704.6513	788.8997	840.3459	831.0501	797.1803	744.1079	686.9832	602.2779	536.4392	511.3738 (84)

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	12.9914	13.0264	13.0610	13.2257	13.2570	13.4046	13.4046	13.4323	13.3474	13.2570	13.1939	13.1285
alpha	1.8661	1.8684	1.8707	1.8817	1.8838	1.8936	1.8936	1.8955	1.8898	1.8838	1.8796	1.8752
util living area	0.9005	0.8678	0.8232	0.7460	0.6446	0.5192	0.4096	0.4453	0.6107	0.7782	0.8694	0.9076 (86)
MIT	17.3412	17.7735	18.4181	19.2584	19.9920	20.5398	20.7932	20.7498	20.3287	19.3736	18.2298	17.2743 (87)
Th 2	19.6554	19.6585	19.6615	19.6758	19.6784	19.6909	19.6909	19.6932	19.6861	19.6784	19.6730	19.6674 (88)
util rest of house	0.8876	0.8511	0.8003	0.7119	0.5933	0.4429	0.3076	0.3432	0.5388	0.7406	0.8501	0.8956 (89)
MIT 2	15.5702	16.0980	16.8837	17.8948	18.7449	19.3443	19.5809	19.5513	19.1420	18.0602	16.6753	15.4912 (90)
Living area fraction	FLA = Living area / (4) = 0.2806 (91)											
MIT	16.0671	16.5681	17.3142	18.2774	19.0948	19.6798	19.9211	19.8876	19.4750	18.4287	17.1114	15.9915 (92)
Temperature adjustment	0.0000											
adjusted MIT	16.0671	16.5681	17.3142	18.2774	19.0948	19.6798	19.9211	19.8876	19.4750	18.4287	17.1114	15.9915 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.8378	0.7985	0.7483	0.6684	0.5675	0.4422	0.3268	0.3596	0.5257	0.6962	0.7988	0.8472 (94)
Useful gains	449.4510	503.1610	527.2743	527.2633	476.8860	367.4737	260.5562	267.6064	361.1426	419.2847	428.4849	433.2522 (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	1056.7424	1045.0278	965.9910	827.2091	650.7822	442.1212	289.0527	302.9188	469.8219	688.9634	885.2737	1047.8707 (97)
Space heating kWh	451.8248	364.1345	326.4052	215.9610	129.3787	0.0000	0.0000	0.0000	0.0000	200.6410	328.8880	457.2762 (98a)
Space heating requirement - total per year (kWh/year)												2474.5093
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	451.8248	364.1345	326.4052	215.9610	129.3787	0.0000	0.0000	0.0000	0.0000	200.6410	328.8880	457.2762 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2474.5093
Space heating per m <sup>2</sup>												(98c) / (4) = 42.5173 (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	451.8248	364.1345	326.4052	215.9610	129.3787	0.0000	0.0000	0.0000	0.0000	200.6410	328.8880	457.2762 (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)	489.5176	394.5119	353.6351	233.9772	140.1720	0.0000	0.0000	0.0000	0.0000	217.3792	356.3250	495.4239 (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	203.7910	180.2615	191.7010	169.1389	164.3348	148.5009	146.9146	152.5418	153.9776	171.1849	181.3802	201.6533 (64)
Efficiency of water heater												79.8000 (216)
(217)m	85.7924	85.6032	85.2428	84.6089	83.5291	79.8000	79.8000	79.8000	79.8000	84.4168	85.3773	85.8373 (217)
Fuel for water heating, kWh/month	237.5397	210.5780	224.8881	199.9067	196.7395	186.0914	184.1035	191.1551	192.9544	202.7855	212.4455	234.9249 (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	17.6470	14.1571	12.7469	9.3389	7.2137	5.8936	6.5805	8.5536	11.1103	14.5773	16.4651	18.1375 (232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	-45.8017	-60.6248	-81.9275	-86.5036	-88.9077	-81.5659	-80.6036	-78.1768	-73.3345	-66.5888	-48.9537	-40.0855 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233b)m	-39.4146	-80.8620	-157.0644	-230.8046	-300.4122	-300.0708	-296.4677	-253.0848	-188.3667	-113.7542	-51.9858	-31.3189 (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												2680.9418 (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												2474.1124 (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)												142.4216 (232)

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Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-2876.6808 (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	2506.7950 (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	2680.9418	0.2100	562.9978 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2474.1124	0.2100	519.5636 (264)
Space and water heating			1082.5614 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	142.4216	0.1443	20.5558 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-833.0741	0.1359	-113.2259
PV Unit electricity exported	-2043.6067	0.1266	-258.6348
Total			-371.8608 (269)
Total CO2, kg/year			743.1857 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			12.7700 (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	2680.9418	1.1300	3029.4643 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2474.1124	1.1300	2795.7470 (278)
Space and water heating			5825.2113 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	142.4216	1.5338	218.4509 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-833.0741	1.5024	-1251.5979
PV Unit electricity exported	-2043.6067	0.4646	-949.4289
Total			-2201.0268 (283)
Total Primary energy kWh/year			3972.7362 (286)
Target Primary Energy Rate (TPER)			68.2600 (287)

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 SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)  
 CALCULATION OF FABRIC ENERGY EFFICIENCY  
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-----  
 1. Overall dwelling characteristics  
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	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	58.2000 (1b)	x 3.0000 (2b)	= 174.6000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	58.2000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 174.6000 (5)

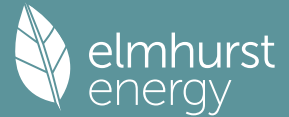
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 2. Ventilation rate  
 -----

	m <sup>3</sup> per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	2 * 10 = 20.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)

Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1145 (8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		4.0000	(17)
Infiltration rate		0.3145	(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) =		0.3145 (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	0.4010	0.3932	0.3853	0.3460	0.3381	0.2988	0.2988	0.2910	0.3145	0.3381	0.3539	0.3696 (22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.0000 (23b)

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If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0.0000 (23c)  
 Effective ac 0.5804 0.5773 0.5742 0.5599 0.5572 0.5446 0.5446 0.5423 0.5495 0.5572 0.5626 0.5683 (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
Windows (Uw = 0.80)			20.6000	0.7752	15.9690		
Heatloss Floor			58.2000	0.1300	7.5660	20.0000	1164.0000 (27)
External Walls	98.1600	20.6000	77.5600	0.1800	13.9608	18.0000	1396.0800 (28a)
External Roof	58.2000		58.2000	0.1100	6.4020	9.0000	523.8000 (30)
Total net area of external elements Aum(A, m2)			214.5600				
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		43.8978		
Internal Walls			124.0200			9.0000	1116.1800 (32c)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 4200.0600 (34)  
 Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 72.1660 (35)

#### List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	13.6300	0.0000	0.0000
E3 Sill	13.6300	0.0000	0.0000
E4 Jamb	28.5000	0.0000	0.0000
E5 Ground floor (normal)	32.7200	0.0000	0.0000
E16 Corner (normal)	12.0000	0.0000	0.0000

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

Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	43.8978 (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	33.4426	33.2627	33.0863	32.2579	32.1030	31.3815	31.3815	31.2478	31.6594	32.1030	32.4165	32.7443 (38)
Average = Sum(39)m / 12 =	77.3404	77.1605	76.9841	76.1557	76.0007	75.2792	75.2792	75.1456	75.5572	76.0007	76.3143	76.6421 (39)

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.3289	1.3258	1.3228	1.3085	1.3059	1.2935	1.2935	1.2912	1.2982	1.3059	1.3112	1.3169 (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													1.9303 (42)
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (42a)
Hot water usage for baths	24.4564	24.0932	23.5817	22.6387	21.9325	21.1495	20.7265	21.2344	21.7874	22.6253	23.5878	24.3737 (42b)	
Hot water usage for other uses	34.3983	33.1475	31.8966	30.6458	29.3949	28.1441	28.1441	29.3949	30.6458	31.8966	33.1475	34.3983 (42c)	
Average daily hot water use (litres/day)													53.9461 (43)

Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	58.8547	57.2407	55.4783	53.2844	51.3274	49.2935	48.8706	50.6293	52.4332	54.5219	56.7353	58.7721 (44)
Energy content (annual)	93.2115	81.5100	85.2682	72.9437	69.0966	60.6122	59.1047	62.6897	64.6554	73.9857	80.8298	92.0228 (45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)

Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)

Total heat required for water heating calculated for each month

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
WWHRS	79.2298	69.2835	72.4779	62.0022	58.7321	51.5203	50.2390	53.2862	54.9571	62.8879	68.7053	78.2194 (62)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63a)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63b)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63c)
Output from w/h	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63d)

12Total per year (kWh/year) = Sum(64)m = 761.5406 (64)

Electric shower(s)	45.3148	40.3758	44.0889	42.0735	42.8630	40.8871	42.2500	42.8630	42.0735	44.0889	43.2598	45.3148 (64a)	
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =													515.4528 (64a)

Heat gains from water heating, kWh/month	31.1361	27.4148	29.1417	26.0189	25.3988	23.1019	23.1223	24.0373	24.2576	26.7442	27.9913	30.8835 (65)
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### 5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	96.5155	96.5155	96.5155	96.5155	96.5155	96.5155	96.5155	96.5155	96.5155	96.5155	96.5155	96.5155 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	84.9312	84.9312	84.9312	84.9312	84.9312	84.9312	84.9312	84.9312	84.9312	84.9312	84.9312	84.9312 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	168.3855	170.1329	165.7297	156.3558	144.5230	133.4019	125.9723	124.2250	128.6281	138.0020	149.8348	160.9559 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.6516	32.6516	32.6516	32.6516	32.6516	32.6516	32.6516	32.6516	32.6516	32.6516	32.6516	32.6516 (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)	-77.2124	-77.2124	-77.2124	-77.2124	-77.2124	-77.2124	-77.2124	-77.2124	-77.2124	-77.2124	-77.2124	-77.2124 (71)
Water heating gains (Table 5)	41.8496	40.7959	39.1689	36.1374	34.1381	32.0859	31.0783	32.3082	33.6912	35.9465	38.8768	41.5101 (72)
Total internal gains	347.1210	356.9143	341.7845	332.2101	315.5470	305.2047	293.9364	293.4190	302.0362	310.8343	328.4284	339.3519 (73)

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## 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			6.1800	10.6334	0.6800	0.7000	0.7700	21.6771 (74)				
East			6.7000	19.6403	0.6800	0.7000	0.7700	43.4073 (76)				
South			5.6200	46.7521	0.6800	0.7000	0.7700	86.6717 (78)				
West			2.1000	19.6403	0.6800	0.7000	0.7700	13.6053 (80)				
Solar gains	165.3613	294.9005	434.8784	585.3021	693.5588	704.0600	672.4190	590.0669	487.1343	334.7522	200.5649	139.8477 (83)
Total gains	512.4823	651.8148	776.6629	917.5122	1009.1058	1009.2646	966.3554	883.4859	789.1704	645.5865	528.9933	479.1996 (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	15.0850	15.1202	15.1549	15.3197	15.3509	15.4981	15.4981	15.5256	15.4411	15.3509	15.2879	15.2225
alpha	2.0057	2.0080	2.0103	2.0213	2.0234	2.0332	2.0332	2.0350	2.0294	2.0234	2.0192	2.0148
util living area	0.8993	0.8480	0.7792	0.6705	0.5456	0.4153	0.3162	0.3538	0.5255	0.7342	0.8598	0.9097 (86)
MIT	17.7477	18.2970	18.9941	19.7909	20.3825	20.7513	20.8980	20.8685	20.5773	19.7498	18.6110	17.6497 (87)
Th 2	19.8183	19.8207	19.8231	19.8342	19.8362	19.8460	19.8460	19.8478	19.8422	19.8362	19.8320	19.8276 (88)
util rest of house	0.8873	0.8310	0.7552	0.6361	0.4988	0.3538	0.2411	0.2758	0.4619	0.6968	0.8412	0.8989 (89)
MIT 2	16.8997	17.4311	18.0997	18.8511	19.3816	19.6956	19.8010	19.7863	19.5674	18.8402	17.7556	16.8104 (90)
Living area fraction	fLA = Living area / (4) = 0.2806 (91)											
MIT	17.1377	17.6741	18.3506	19.1148	19.6625	19.9918	20.1088	20.0900	19.8508	19.0954	17.9956	17.0459 (92)
Temperature adjustment	0.0000											
adjusted MIT	17.1377	17.6741	18.3506	19.1148	19.6625	19.9918	20.1088	20.0900	19.8508	19.0954	17.9956	17.0459 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.8512	0.7926	0.7199	0.6125	0.4913	0.3619	0.2588	0.2929	0.4624	0.6693	0.8040	0.8642 (94)
Useful gains	436.2192	516.6183	559.1045	561.9932	495.7570	365.2480	250.1297	258.7390	364.9331	432.0792	425.3042	414.1264 (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	992.8693	985.6547	912.3111	777.9132	605.1536	405.8895	264.1396	277.2849	434.5130	645.6551	831.4933	984.5376 (97)
Space heating kWh	414.1477	315.1924	262.7857	155.4625	81.3910	0.0000	0.0000	0.0000	0.0000	158.9004	292.4561	424.3859 (98a)
Space heating requirement - total per year (kWh/year)	2104.7218											
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	414.1477	315.1924	262.7857	155.4625	81.3910	0.0000	0.0000	0.0000	0.0000	158.9004	292.4561	424.3859 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)	2104.7218											
Space heating per m <sup>2</sup>	(98c) / (4) = 36.1636 (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	707.6249	557.0664	571.1068	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8138	0.8583	0.8333	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	575.8410	478.1177	475.9158	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1148.6700	1100.1889	1004.9628	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	412.4369	462.8210	393.6109	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	103.1092	115.7053	98.4027	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement	317.2172 (107)											
Energy for space heating	36.1636 (99)											
Energy for space cooling	5.4505 (108)											
Total	41.6141 (109)											
Fabric Energy Efficiency (DFEE)	41.6 (109)											

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

## 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	58.2000 (1b)	x 3.0000 (2b)	= 174.6000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	58.2000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	174.6000 (5)





# Full SAP Calculation Printout



Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63d)
Output from w/h	79.2298	69.2835	72.4779	62.0022	58.7321	51.5203	50.2390	53.2862	54.9571	62.8879	68.7053	78.2194	(64)
Total per year (kWh/year) = Sum(64)m =												761.5406 (64)	
12Total per year (kWh/year)													762 (64)
Electric shower(s)	45.3148	40.3758	44.0889	42.0735	42.8630	40.8871	42.2500	42.8630	42.0735	44.0889	43.2598	45.3148	(64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												515.4528 (64a)	
Heat gains from water heating, kWh/month	31.1361	27.4148	29.1417	26.0189	25.3988	23.1019	23.1223	24.0373	24.2576	26.7442	27.9913	30.8835	(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	96.5155	96.5155	96.5155	96.5155	96.5155	96.5155	96.5155	96.5155	96.5155	96.5155	96.5155	96.5155	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	84.9312	84.9312	84.9312	84.9312	84.9312	84.9312	84.9312	84.9312	84.9312	84.9312	84.9312	84.9312	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	168.3855	170.1329	165.7297	156.3558	144.5230	133.4019	125.9723	124.2250	128.6281	138.0020	149.8348	160.9559	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.6516	32.6516	32.6516	32.6516	32.6516	32.6516	32.6516	32.6516	32.6516	32.6516	32.6516	32.6516	(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)	-77.2124	-77.2124	-77.2124	-77.2124	-77.2124	-77.2124	-77.2124	-77.2124	-77.2124	-77.2124	-77.2124	-77.2124	(71)
Water heating gains (Table 5)	41.8496	40.7959	39.1689	36.1374	34.1381	32.0859	31.0783	32.3082	33.6912	35.9465	38.8768	41.5101	(72)
Total internal gains	347.1210	356.9143	341.7845	332.2101	315.5470	305.2047	293.9364	293.4190	302.0362	310.8343	328.4284	339.3519	(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	4.3600	10.6334	0.6300	0.7000	0.7700	14.1687	(74)						
East	4.7300	19.6403	0.6300	0.7000	0.7700	28.3910	(76)						
South	3.9700	46.7521	0.6300	0.7000	0.7700	56.7235	(78)						
West	1.4800	19.6403	0.6300	0.7000	0.7700	8.8834	(80)						
Solar gains	108.1666	192.8923	284.4302	382.7849	453.5616	460.4200	439.7320	385.8921	318.5977	218.9533	131.1924	91.4787	(83)
Total gains	455.2876	549.8066	626.2146	714.9950	769.1086	765.6247	733.6684	679.3111	620.6339	529.7876	459.6209	430.8306	(84)

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area, nil,m (see Table 9a)	12.9914	13.0264	13.0610	13.2257	13.2570	13.4046	13.4046	13.4323	13.3474	13.2570	13.1939	13.1285	21.0000 (85)
tau	1.8661	1.8684	1.8707	1.8817	1.8838	1.8936	1.8936	1.8955	1.8898	1.8838	1.8796	1.8752	
util living area	0.9222	0.8910	0.8486	0.7732	0.6733	0.5472	0.4360	0.4753	0.6446	0.8105	0.8953	0.9288	(86)
MIT	17.1138	17.5683	18.2424	19.1286	19.9053	20.4937	20.7688	20.7187	20.2574	19.2304	18.0305	17.0427	(87)
Th 2	19.6554	19.6585	19.6615	19.6758	19.6784	19.6909	19.6932	19.6861	19.6784	19.6784	19.6730	19.6674	(88)
util rest of house	0.9116	0.8766	0.8280	0.7410	0.6231	0.4698	0.3299	0.3696	0.5735	0.7762	0.8790	0.9192	(89)
MIT 2	16.1864	16.6313	17.2889	18.1454	18.8666	19.3852	19.5921	19.5648	19.2021	18.2662	17.1024	16.1239	(90)
Living area fraction	16.4466	16.8942	17.5565	18.4213	19.1581	19.6962	19.9222	19.8885	19.4982	18.5368	17.3628	16.3817	(92)
Temperature adjustment	16.4466	16.8942	17.5565	18.4213	19.1581	19.6962	19.9222	19.8885	19.4982	18.5368	17.3628	16.3817	(93)
adjusted MIT	16.4466	16.8942	17.5565	18.4213	19.1581	19.6962	19.9222	19.8885	19.4982	18.5368	17.3628	16.3817	(93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8758	0.8364	0.7861	0.7041	0.6005	0.4702	0.3502	0.3868	0.5618	0.7388	0.8400	0.8849	(94)
Useful gains	398.7182	459.8466	492.2862	503.4307	461.8142	359.9608	256.9306	262.7843	348.6764	391.4291	386.1015	381.2385	(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	1090.8207	1074.2313	987.6279	839.9020	656.3474	443.5546	289.1545	303.0021	471.8537	698.4749	907.5037	1082.5466	(97)
Space heating kWh	514.9243	412.8665	368.5342	242.2593	144.7327	0.0000	0.0000	0.0000	0.0000	228.4420	375.4096	521.7733	(98a)
Space heating requirement - total per year (kWh/year)													2808.9419
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	514.9243	412.8665	368.5342	242.2593	144.7327	0.0000	0.0000	0.0000	0.0000	228.4420	375.4096	521.7733	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)													2808.9419
Space heating per m2													(98c) / (4) = 48.2636 (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	818.1378	644.0659	660.1092	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.6721	0.7329	0.7022	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	549.8452	472.0045	463.5386	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	863.8960	828.2171	766.3169	0.0000	0.0000	0.0000	0.0000	(103)

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Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	226.1165	265.0222	225.2670	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	56.5291	66.2555	56.3168	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement												179.1014 (107)
Energy for space heating												48.2636 (99)
Energy for space cooling												3.0773 (108)
Total												51.3410 (109)
Fabric Energy Efficiency (TFEE)												51.3 (109)

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 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						58.2000 (1b)	x	3.0000 (2b)	=	174.6000 (1b)	- (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)						58.2000				174.6000 (4)	
Dwelling volume										(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	174.6000 (5)

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

												m3 per hour
Number of open chimneys												0 * 80 = 0.0000 (6a)
Number of open flues												0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire												0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler												0 * 20 = 0.0000 (6d)
Number of flues attached to other heater												0 * 35 = 0.0000 (6e)
Number of blocked chimneys												0 * 20 = 0.0000 (6f)
Number of intermittent extract fans												0 * 10 = 0.0000 (7a)
Number of passive vents												0 * 10 = 0.0000 (7b)
Number of flueless gas fires												0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =												0.0000 / (5) = 0.0000 (8)
Pressure test												Yes
Pressure Test Method												Blower Door
Measured/design AP50												4.0000 (17)
Infiltration rate												0.2000 (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) = 0.2000 (21)

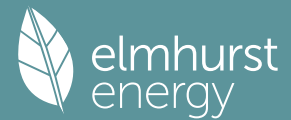
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate												
	0.2550	0.2500	0.2450	0.2200	0.2150	0.1900	0.1900	0.1850	0.2000	0.2150	0.2250	0.2350 (22b)
Effective ac	0.5325	0.5312	0.5300	0.5242	0.5231	0.5181	0.5181	0.5171	0.5200	0.5231	0.5253	0.5276 (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
Windows (Uw = 0.80)			20.6000	0.7752	15.9690		
Heatloss Floor			58.2000	0.1300	7.5660	20.0000	1164.0000 (28a)
External Walls	98.1600	20.6000	77.5600	0.1800	13.9608	18.0000	1396.0800 (29a)
External Roof	58.2000		58.2000	0.1100	6.4020	9.0000	523.8000 (30)
Total net area of external elements Aum(A, m <sup>2</sup> )			214.5600				
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	43.8978		
Internal Walls			124.0200			9.0000	1116.1800 (32c)
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 4200.0600 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							72.1660 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value	Total	
E1 Steel lintel with perforated steel base plate				13.6300	0.0000	0.0000	
E3 Sill				13.6300	0.0000	0.0000	
E4 Jamb				28.5000	0.0000	0.0000	
E5 Ground floor (normal)				32.7200	0.0000	0.0000	
E16 Corner (normal)				12.0000	0.0000	0.0000	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							0.0000 (36)
Point Thermal bridges							(36a) = 0.0000
Total fabric heat loss							(33) + (36) + (36a) = 43.8978 (37)

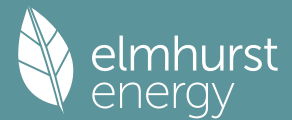
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	30.6823	30.6096	30.5383	30.2034	30.1407	29.8490	29.8490	29.7950	29.9614	30.1407	30.2675	30.4000 (38)
Average = Sum(39)m / 12 =	74.5801	74.5074	74.4361	74.1011	74.0385	73.7468	73.7468	73.6928	73.8592	74.0385	74.1652	74.2978 (39)
												74.1008
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.2814	1.2802	1.2790	1.2732	1.2721	1.2671	1.2671	1.2662	1.2691	1.2721	1.2743	1.2766 (40)
												1.2732

# Full SAP Calculation Printout



Days in mont	31	28	31	30	31	30	31	31	30	31	30	31
-----												
4. Water heating energy requirements (kWh/year)												
-----												
Assumed occupancy												1.9303 (42)
Hot water usage for mixer showers												0.0000 (42a)
Hot water usage for baths	65.2042	64.2359	62.8722	60.3578	58.4751	56.3874	55.2598	56.6139	58.0883	60.3222	62.8883	64.9838 (42b)
Hot water usage for other uses	34.3983	33.1475	31.8966	30.6458	29.3949	28.1441	28.1441	29.3949	30.6458	31.8966	33.1475	34.3983 (42c)
Average daily hot water use (litres/day)												91.7258 (43)
-----												
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	99.6025	97.3833	94.7688	91.0036	87.8700	84.5315	83.4039	86.0089	88.7341	92.2188	96.0358	99.3821 (44)
Energy content (annual)	157.7461	138.6726	145.6561	124.5794	118.2899	103.9414	100.8698	106.4969	109.4180	125.1401	136.8206	155.6084 (45)
Distribution loss (46)m = 0.15 x (45)m												Total = Sum(45)m = 1523.2392
Water storage loss:	23.6619	20.8009	21.8484	18.6869	17.7435	15.5912	15.1305	15.9745	16.4127	18.7710	20.5231	23.3413 (46)
Store volume												144.0000 (47)
b) If manufacturer declared loss factor is not known :												
Hot water storage loss factor from Table 2 (kWh/litre/day)												0.0206 (51)
Volume factor from Table 2a												0.9410 (52)
Temperature factor from Table 2b												0.6000 (53)
Enter (49) or (54) in (55)												1.6751 (55)
Total storage loss	51.9289	46.9035	51.9289	50.2537	51.9289	50.2537	51.9289	51.9289	50.2537	51.9289	50.2537	51.9289 (56)
If cylinder contains dedicated solar storage	51.9289	46.9035	51.9289	50.2537	51.9289	50.2537	51.9289	51.9289	50.2537	51.9289	50.2537	51.9289 (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	209.6749	185.5760	197.5850	174.8331	170.2188	154.1951	152.7986	158.4258	159.6718	177.0689	187.0743	207.5372 (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	209.6749	185.5760	197.5850	174.8331	170.2188	154.1951	152.7986	158.4258	159.6718	177.0689	187.0743	207.5372 (64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (64a)
Heat gains from water heating, kWh/month	93.9937	83.6314	89.9737	81.6256	80.8745	74.7635	75.0823	76.9533	76.5845	83.1521	85.6958	93.2829 (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	115.8186	115.8186	115.8186	115.8186	115.8186	115.8186	115.8186	115.8186	115.8186	115.8186	115.8186	115.8186 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	20.6283	18.3219	14.9003	11.2805	8.4323	7.1189	7.6922	9.9987	13.4202	17.0400	19.8882	21.2016 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	251.3217	253.9296	247.3577	233.3669	215.7060	199.1073	188.0183	185.4104	191.9823	205.9731	223.6340	240.2327 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	48.5122	48.5122	48.5122	48.5122	48.5122	48.5122	48.5122	48.5122	48.5122	48.5122	48.5122	48.5122 (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)	-77.2124	-77.2124	-77.2124	-77.2124	-77.2124	-77.2124	-77.2124	-77.2124	-77.2124	-77.2124	-77.2124	-77.2124 (71)
Water heating gains (Table 5)	126.3356	124.4515	120.9324	113.3689	108.7023	103.8382	100.9170	103.4319	106.3673	111.7636	119.0220	125.3802 (72)
Total internal gains	488.4039	486.8214	473.3089	448.1347	422.9590	397.1828	383.7460	385.9593	398.8882	424.8951	452.6626	476.9329 (73)
-----												
6. Solar gains												
-----												
[Jan]			Area m <sup>2</sup>	Solar flux Table 6a W/m <sup>2</sup>		Specific data or Table 6b		Specific data or Table 6c		Access factor Table 6d		Gains W
North			6.1800	10.6334		0.6800		0.7000		0.7700		21.6771 (74)
East			6.7000	19.6403		0.6800		0.7000		0.7700		43.4073 (76)
South			5.6200	46.7521		0.6800		0.7000		0.7700		86.6717 (78)
West			2.1000	19.6403		0.6800		0.7000		0.7700		13.6053 (80)
-----												
Solar gains	165.3613	294.9005	434.8784	585.3021	693.5588	704.0600	672.4190	590.0669	487.1343	334.7522	200.5649	139.8477 (83)
Total gains	653.7652	781.7218	908.1873	1033.4369	1116.5178	1101.2427	1056.1650	976.0262	886.0224	759.6474	653.2274	616.7806 (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	15.6434	15.6586	15.6736	15.7445	15.7578	15.8201	15.8201	15.8317	15.7961	15.7578	15.7309	15.7028
alpha	2.0429	2.0439	2.0449	2.0496	2.0505	2.0547	2.0547	2.0554	2.0531	2.0505	2.0487	2.0469
util living area	0.8518	0.8007	0.7275	0.6234	0.5029	0.3821	0.2879	0.3205	0.4789	0.6767	0.8085	0.8647 (86)
MIT	18.2526	18.7101	19.3282	19.9895	20.4913	20.7948	20.9179	20.8948	20.6579	19.9751	18.9883	18.1422 (87)
Th 2	19.8554	19.8564	19.8573	19.8619	19.8627	19.8667	19.8667	19.8674	19.8652	19.8627	19.8610	19.8592 (88)
util rest of house	0.8361	0.7809	0.7015	0.5886	0.4579	0.3247	0.2196	0.2493	0.4185	0.6373	0.7859	0.8501 (89)
MIT 2	16.7402	17.2962	18.0415	18.8222	19.3883	19.7092	19.8206	19.8050	19.5843	18.8342	17.6551	16.6069 (90)
Living area fraction												fLA = Living area / (4) = 0.2806 (91)

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MIT	17.1645	17.6929	18.4025	19.1497	19.6977	20.0138	20.1285	20.1108	19.8855	19.1543	18.0292	17.0377 (92)
Temperature adjustment												0.0000
adjusted MIT	17.1645	17.6929	18.4025	19.1497	19.6977	20.0138	20.1285	20.1108	19.8855	19.1543	18.0292	17.0377 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.7887	0.7353	0.6632	0.5648	0.4510	0.3325	0.2358	0.2651	0.4197	0.6095	0.7412	0.8031	(94)
Useful gains	515.6485	574.8252	602.3407	583.6861	503.5950	366.1087	249.0327	258.7577	371.8217	462.9962	484.1926	495.3090	(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	959.4383	953.1641	885.9772	759.5160	592.1410	399.2490	260.2135	273.4582	427.3139	633.3501	810.5660	953.8124	(97)
Space heating kWh	330.1796	254.2437	211.0256	126.5976	65.8782	0.0000	0.0000	0.0000	0.0000	126.7432	234.9889	341.1266	(98a)
Space heating requirement - total per year (kWh/year)												1690.7834	
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	330.1796	254.2437	211.0256	126.5976	65.8782	0.0000	0.0000	0.0000	0.0000	126.7432	234.9889	341.1266	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1690.7834	
Space heating per m2										(98c) / (4) =		29.0513	(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 %)													0.0000	(206)
Efficiency of main space heating system 2 (in %)													0.0000	(207)
Efficiency of secondary/supplementary heating system, %													0.0000	(208)
Space heating requirement	330.1796	254.2437	211.0256	126.5976	65.8782	0.0000	0.0000	0.0000	0.0000	126.7432	234.9889	341.1266	(98)	
Space heating efficiency (main heating system 1)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(210)	
Space heating fuel (main heating system)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(211)	
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)	
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)	
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)	
Water heating requirement	209.6749	185.5760	197.5850	174.8331	170.2188	154.1951	152.7986	158.4258	159.6718	177.0689	187.0743	207.5372	(64)	
Efficiency of water heater (217)m	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	(216)	
Fuel for water heating, kWh/month	209.6749	185.5760	197.5850	174.8331	170.2188	154.1951	152.7986	158.4258	159.6718	177.0689	187.0743	207.5372	(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	3.4822	3.1452	3.4822	3.3699	3.4822	3.3699	3.4822	3.4822	3.3699	3.4822	3.3699	3.4822	(231)	
Lighting	18.0558	14.4850	13.0422	9.5553	7.3808	6.0301	6.7330	8.7518	11.3677	14.9150	16.8465	18.5576	(232)	
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233a)	
Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)	
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)	
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)	
Electricity generated by PVs (Appendix M) (negative quantity) (233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)	
Electricity generated by wind turbines (Appendix M) (negative quantity) (234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)	
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)	
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)	
Annual totals kWh/year														
Space heating fuel - main system 1													0.0000	(211)
Space heating fuel - main system 2													0.0000	(213)
Space heating fuel - secondary													0.0000	(215)
Efficiency of water heater													100.0000	
Water heating fuel used													2134.6595	(219)
Space cooling fuel													0.0000	(221)
Electricity for pumps and fans: central heating pump													41.0000	(230c)
Total electricity for the above, kWh/year													41.0000	(231)
Electricity for lighting (calculated in Appendix L)													145.7207	(232)
Energy saving/generation technologies (Appendices M ,N and Q)														
PV generation													0.0000	(233)
Wind generation													0.0000	(234)
Hydro-electric generation (Appendix N)													0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)													0.0000	(235)
Appendix Q - special features														
Energy saved or generated													-0.0000	(236)
Energy used													0.0000	(237)
Total delivered energy for all uses													2321.3802	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1 (high-rate cost)	0.0000	18.5800	0.0000 (240)
Space heating - main system 1 (low-rate cost)	0.0000	0.0000	0.0000 (240)
Total CO2 associated with community systems			0.0000 (473)

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Water heating (electric off-peak tariff)				
High-rate fraction			0.2999	(243)
Low-rate fraction			0.7001	(244)
High-rate cost	640.2126	19.6000	125.4817	(245)
Low-rate cost	1494.4469	9.4000	140.4780	(246)
Energy for instantaneous electric shower(s)	0.0000	18.5800	0.0000	(247a)
Pumps, fans and electric keep-hot (0.90*19.60 + 0.10*9.40)	41.0000	18.5800	7.6178	(249)
Energy for lighting (0.90*19.60 + 0.10*9.40)	145.7207	18.5800	27.0749	(250)
Additional standing charges			7.0000	(251)
Total energy cost			307.6524	(255)

## 11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600	(256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	1.0732	(257)
SAP value		82.6033	
SAP rating (Section 12)		83	(258)
SAP band		B	

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1 (high-rate cost)	0.0000	0.0000	0.0000	(261)
Space heating - main system 1 (low-rate cost)	0.0000	0.0000	0.0000	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating - high rate cost	640.2126	0.1477	94.5354	(264)
Water heating - low rate cost	1494.4469	0.1239	185.2054	(264)
Space and water heating			279.7408	(265)
Pumps, fans and electric keep-hot	41.0000	0.1432	5.8713	(267)
Energy for lighting	145.7207	0.1490	21.7153	(268)
Total CO2, kg/year			307.3273	(272)
CO2 emissions per m2			5.2800	(273)
EI value			96.0095	
EI rating			96	(274)
EI band			A	

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

### 1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)	
Ground floor	58.2000 (1b)	x 3.0000 (2b)	= 174.6000 (1b) - (3b)	(4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	58.2000			(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	174.6000 (5)	(5)

### 2. Ventilation rate

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	0 * 10 =	0.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		4.0000	(17)
Infiltration rate		0.2000	(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) =	0.2000	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	6.3000	5.9000	5.8000	5.2000	5.2000	4.6000	4.7000	4.6000	4.9000	5.7000	5.8000	6.3000
Wind factor	1.5750	1.4750	1.4500	1.3000	1.3000	1.1500	1.1750	1.1500	1.2250	1.4250	1.4500	1.5750
Adj infltr rate	0.3150	0.2950	0.2900	0.2600	0.2600	0.2300	0.2350	0.2300	0.2450	0.2850	0.2900	0.3150
Effective ac	0.5496	0.5435	0.5421	0.5338	0.5338	0.5264	0.5276	0.5264	0.5300	0.5406	0.5421	0.5496

### 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
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Windows (Uw = 0.80)			20.6000	0.7752	15.9690				(27)
Heatloss Floor			58.2000	0.1300	7.5660	20.0000	1164.0000		(28a)
External Walls	98.1600	20.6000	77.5600	0.1800	13.9608	18.0000	1396.0800		(29a)
External Roof	58.2000		58.2000	0.1100	6.4020	9.0000	523.8000		(30)
Total net area of external elements Aum(A, m2)			214.5600						(31)
Fabric heat loss, W/K = Sum (A x U)			(26) ... (30) + (32) =	43.8978					(33)
Internal Walls			124.0200			9.0000	1116.1800		(32c)

Heat capacity Cm = Sum(A x k) (28) ... (30) + (32) + (32a) ... (32e) = 4200.0600 (34)  
 Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 72.1660 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	13.6300	0.0000	0.0000
E3 Sill	13.6300	0.0000	0.0000
E4 Jamb	28.5000	0.0000	0.0000
E5 Ground floor (normal)	32.7200	0.0000	0.0000
E16 Corner (normal)	12.0000	0.0000	0.0000

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 0.0000 (36)  
 Point Thermal bridges (36a) = 0.0000  
 Total fabric heat loss (33) + (36) + (36a) = 43.8978 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	31.6676	31.3161	31.2318	30.7565	30.7565	30.3330	30.4000	30.3330	30.5383	31.1490	31.2318	31.6676
Heat transfer coeff	75.5654	75.2139	75.1296	74.6543	74.6543	74.2308	74.2978	74.2308	74.4361	75.0468	75.1296	75.5654
Average = Sum(39)m / 12 =												74.8462

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.2984	1.2923	1.2909	1.2827	1.2827	1.2754	1.2766	1.2754	1.2790	1.2895	1.2909	1.2984
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

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

Assumed occupancy 1.9303 (42)

Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Hot water usage for baths	65.2042	64.2359	62.8722	60.3578	58.4751	56.3874	55.2598	56.6139	58.0883	60.3222	62.8883	64.9838
Hot water usage for other uses	34.3983	33.1475	31.8966	30.6458	29.3949	28.1441	28.1441	29.3949	30.6458	31.8966	33.1475	34.3983
Average daily hot water use (litres/day)												91.7258

Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	99.6025	97.3833	94.7688	91.0036	87.8700	84.5315	83.4039	86.0089	88.7341	92.2188	96.0358	99.3821
Energy conte	157.7461	138.6726	145.6561	124.5794	118.2899	103.9414	100.8698	106.4969	109.4180	125.1401	136.8206	155.6084
Energy content (annual)										Total = Sum(45)m =		1523.2392
Distribution loss (46)m = 0.15 x (45)m	23.6619	20.8009	21.8484	18.6869	17.7435	15.5912	15.1305	15.9745	16.4127	18.7710	20.5231	23.3413
Water storage loss:												
Store volume												144.0000
b) If manufacturer declared loss factor is not known :												
Hot water storage loss factor from Table 2 (kWh/litre/day)												0.0206
Volume factor from Table 2a												0.9410
Temperature factor from Table 2b												0.6000
Enter (49) or (54) in (55)												1.6751
Total storage loss	51.9289	46.9035	51.9289	50.2537	51.9289	50.2537	51.9289	51.9289	50.2537	51.9289	50.2537	51.9289
If cylinder contains dedicated solar storage	51.9289	46.9035	51.9289	50.2537	51.9289	50.2537	51.9289	51.9289	50.2537	51.9289	50.2537	51.9289
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total heat required for water heating calculated for each month	209.6749	185.5760	197.5850	174.8331	170.2188	154.1951	152.7986	158.4258	159.6718	177.0689	187.0743	207.5372
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Output from w/h	209.6749	185.5760	197.5850	174.8331	170.2188	154.1951	152.7986	158.4258	159.6718	177.0689	187.0743	207.5372
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
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												0.0000
Heat gains from water heating, kWh/month	93.9937	83.6314	89.9737	81.6256	80.8745	74.7635	75.0823	76.9533	76.5845	83.1521	85.6958	93.2829

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

Metabolic gains (Table 5), Watts

(66)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	20.6283	18.3219	14.9003	11.2805	8.4323	7.1189	7.6922	9.9987	13.4202	17.0400	19.8882	21.2016
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	251.3217	253.9296	247.3577	233.3669	215.7060	199.1073	188.0183	185.4104	191.9823	205.9731	223.6340	240.2327
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	48.5122	48.5122	48.5122	48.5122	48.5122	48.5122	48.5122	48.5122	48.5122	48.5122	48.5122	48.5122
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
Losses e.g. evaporation (negative values) (Table 5)	-77.2124	-77.2124	-77.2124	-77.2124	-77.2124	-77.2124	-77.2124	-77.2124	-77.2124	-77.2124	-77.2124	-77.2124
Water heating gains (Table 5)	126.3356	124.4515	120.9324	113.3689	108.7023	103.8382	100.9170	103.4319	106.3673	111.7636	119.0220	125.3802
Total internal gains	488.4039	486.8214	473.3089	448.1347	422.9590	397.1828	383.7460	385.9593	398.8882	424.8951	452.6626	476.9329

#### 6. Solar gains

[Jan]	Area	Solar flux	g	FF	Access	Gains
-------	------	------------	---	----	--------	-------

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	m2	Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c	factor Table 6d	W
North	6.1800	14.5581	0.6800	0.7000	0.7700	29.6780 (74)
East	6.7000	27.2691	0.6800	0.7000	0.7700	60.2679 (76)
South	5.6200	60.4813	0.6800	0.7000	0.7700	112.1237 (78)
West	2.1000	27.2691	0.6800	0.7000	0.7700	18.8899 (80)

Solar gains	220.9596	329.7925	475.5917	658.0674	733.0720	804.4218	685.4754	651.7714	553.1802	379.4814	251.3796	187.4263 (83)
Total gains	709.3635	816.6139	948.9006	1106.2022	1156.0310	1201.6046	1069.2214	1037.7306	952.0684	804.3766	704.0421	664.3593 (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	15.4394	15.5115	15.5289	15.6278	15.6278	15.7170	15.7028	15.7170	15.6736	15.5461	15.5289	15.4394
alpha	2.0293	2.0341	2.0353	2.0419	2.0419	2.0478	2.0469	2.0478	2.0449	2.0364	2.0353	2.0293
util living area	0.8025	0.7573	0.6827	0.5803	0.4817	0.3480	0.2979	0.3056	0.4209	0.6027	0.7415	0.8121 (86)
MIT	18.8837	19.1839	19.6629	20.1661	20.5415	20.8318	20.9071	20.9026	20.7572	20.3017	19.5812	18.8856 (87)
Th 2	19.8421	19.8468	19.8480	19.8544	19.8544	19.8601	19.8592	19.8601	19.8573	19.8491	19.8480	19.8421 (88)
util rest of house	0.7804	0.7321	0.6518	0.5428	0.4356	0.2921	0.2304	0.2367	0.3573	0.5533	0.7093	0.7900 (89)
MIT 2	17.5129	17.8709	18.4362	19.0168	19.4344	19.7350	19.8048	19.8029	19.6729	19.1963	18.3659	17.5204 (90)
Living area fraction									FLA = Living area / (4) =			0.2806 (91)
MIT	17.8975	18.2393	18.7804	19.3393	19.7450	20.0427	20.1141	20.1115	19.9771	19.5065	18.7069	17.9034 (92)
Temperature adjustment												0.0000
adjusted MIT	17.8975	18.2393	18.7804	19.3393	19.7450	20.0427	20.1141	20.1115	19.9771	19.5065	18.7069	17.9034 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.7350	0.6906	0.6194	0.5246	0.4310	0.3014	0.2459	0.2524	0.3643	0.5371	0.6718	0.7443 (94)
Useful gains	521.3810	563.9616	587.7960	580.3678	498.2511	362.1500	262.9409	261.8794	346.8266	432.0059	472.9893	494.4668 (95)
Ext temp.	6.4000	6.7000	7.9000	9.6000	12.0000	14.8000	16.4000	16.4000	14.8000	12.2000	9.3000	6.8000 (96)
Heat loss rate W	868.8151	867.9160	817.4387	727.0780	578.2001	389.1733	275.9489	275.5061	385.3660	548.3263	706.7379	839.0357 (97)
Space heating kWh	258.4909	204.2574	170.8542	105.6313	59.4821	0.0000	0.0000	0.0000	0.0000	86.5424	168.2989	256.3592 (98a)
Space heating requirement - total per year (kWh/year)												1309.9165
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	258.4909	204.2574	170.8542	105.6313	59.4821	0.0000	0.0000	0.0000	0.0000	86.5424	168.2989	256.3592 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1309.9165
Space heating per m2												(98c) / (4) = 22.5072 (99)

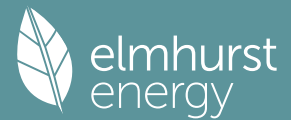
## 9a. Energy requirements - Individual heating systems, including micro-CHP

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 %) 0.0000 (206)  
 Efficiency of main space heating system 2 (in %) 0.0000 (207)  
 Efficiency of secondary/supplementary heating system, % 0.0000 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	258.4909	204.2574	170.8542	105.6313	59.4821	0.0000	0.0000	0.0000	0.0000	86.5424	168.2989	256.3592 (98)
Space heating efficiency (main heating system 1)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (210)
Space heating fuel (main heating system)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Water heating requirement	209.6749	185.5760	197.5850	174.8331	170.2188	154.1951	152.7986	158.4258	159.6718	177.0689	187.0743	207.5372 (64)
Efficiency of water heater (217)m	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000 (216)
Fuel for water heating, kWh/month	209.6749	185.5760	197.5850	174.8331	170.2188	154.1951	152.7986	158.4258	159.6718	177.0689	187.0743	207.5372 (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	3.4822	3.1452	3.4822	3.3699	3.4822	3.3699	3.4822	3.4822	3.3699	3.4822	3.3699	3.4822 (231)
Lighting	18.0558	14.4850	13.0422	9.5553	7.3808	6.0301	6.7330	8.7518	11.3677	14.9150	16.8465	18.5576 (232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity) (233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)
Annual totals kWh/year												
Space heating fuel - main system 1												0.0000 (211)

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Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	100.0000	
Water heating fuel used	2134.6595	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
central heating pump	41.0000	(230c)
Total electricity for the above, kWh/year	41.0000	(231)
Electricity for lighting (calculated in Appendix L)	145.7207	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	0.0000	(233)
Wind generation	0.0000	(234)
Hydro-electric generation (Appendix N)	0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(235)
Appendix Q - special features		
Energy saved or generated	-0.0000	(236)
Energy used	0.0000	(237)
Total delivered energy for all uses	2321.3802	(238)

## 10a. Fuel costs - using BEDF prices (536)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1 (high-rate cost)	0.0000	28.2800	0.0000 (240)
Space heating - main system 1 (low-rate cost)	0.0000	0.0000	0.0000 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (electric off-peak tariff)			
High-rate fraction			0.2999 (243)
Low-rate fraction			0.7001 (244)
High-rate cost	640.2126	29.8000	190.7834 (245)
Low-rate cost	1494.4469	14.6000	218.1892 (246)
Energy for instantaneous electric shower(s)	0.0000	28.2800	0.0000 (247a)
Pumps, fans and electric keep-hot (0.90*29.80 + 0.10*14.60)	41.0000	28.2800	11.5948 (249)
Energy for lighting (0.90*29.80 + 0.10*14.60)	145.7207	28.2800	41.2098 (250)
Additional standing charges			4.0000 (251)
Total energy cost			465.7772 (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 (high-rate cost)	0.0000	0.0000	0.0000 (261)
Space heating - main system 1 (low-rate cost)	0.0000	0.0000	0.0000 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating - high rate cost	640.2126	0.1477	94.5354 (264)
Water heating - low rate cost	1494.4469	0.1239	185.2054 (264)
Space and water heating			279.7408 (265)
Pumps, fans and electric keep-hot	41.0000	0.1432	5.8713 (267)
Energy for lighting	145.7207	0.1490	21.7153 (268)
Total CO2, kg/year			307.3273 (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 (high-rate cost)	0.0000	0.0000	0.0000 (275)
Space heating - main system 1 (low-rate cost)	0.0000	0.0000	0.0000 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating - high rate cost	640.2126	1.5520	993.6038 (278)
Water heating - low rate cost	1494.4469	1.4434	2157.0879 (278)
Space and water heating			3150.6916 (279)
Pumps, fans and electric keep-hot	41.0000	1.5335	62.8729 (281)
Energy for lighting	145.7207	1.5547	226.5585 (282)
Total Primary energy kWh/year			3440.1230 (286)

## SAP 10 EPC IMPROVEMENTS

As Designed

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

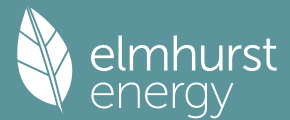
N Solar water heating	SAP increase too small		
U Solar photovoltaic panels	Recommended		
V2 Wind turbine	Not applicable		
Recommended measures:	SAP change	Cost change	CO2 change
U Solar photovoltaic panels	+ 7.6	-£ 222	-110 kg (35.7%)
Measures omitted - SAP change or cost saving too small:			
N Solar water heating	+ 0.8	-£ 52	-59 kg (19.1%)

Recommended measures	Typical annual savings	Energy efficiency impact	Environmental impact
Solar photovoltaic panels	£222	1.88 kg/m <sup>2</sup>	B 90 A 97
Total Savings	£222	1.88 kg/m <sup>2</sup>	
Potential energy efficiency rating:			B 90
Potential environmental impact rating:			A 97

Fuel prices for cost data on this page from database revision number 536 TEST (31 Jan 2024)



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Recommendation texts revision number 6.1 (11 Jun 2019)

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

	Current	Potential	Saving
Electricity	£466	£466	£0
Space heating	£16	£16	£0
Water heating	£409	£409	£0
Lighting	£41	£41	£0
Generated (PV)	-£0	-£222	£222
Total cost of fuels	£466	£244	£222
Total cost of uses	£466	£244	£222
Delivered energy	40 kWh/m <sup>2</sup>	26 kWh/m <sup>2</sup>	14 kWh/m <sup>2</sup>
Carbon dioxide emissions	0.3 tonnes	0.2 tonnes	0.1 tonnes
CO2 emissions per m <sup>2</sup>	5 kg/m <sup>2</sup>	3 kg/m <sup>2</sup>	2 kg/m <sup>2</sup>
Primary energy	59 kWh/m <sup>2</sup>	39 kWh/m <sup>2</sup>	21 kWh/m <sup>2</sup>

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

## 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	58.2000 (1b)	x 3.0000 (2b)	= 174.6000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	58.2000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 174.6000 (5)

## 2. Ventilation rate

		m <sup>3</sup> per hour
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	0 * 10 =	0.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000 (8)
Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design AP50	4.0000	(17)
Infiltration rate	0.2000	(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) =	0.2000 (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	0.2550	0.2500	0.2450	0.2200	0.2150	0.1900	0.1900	0.1850	0.2000	0.2150	0.2250	0.2350 (22b)
Effective ac	0.5325	0.5312	0.5300	0.5242	0.5231	0.5181	0.5181	0.5171	0.5200	0.5231	0.5253	0.5276 (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
Windows (Uw = 0.80)			20.6000	0.7752	15.9690		(27)
Heatloss Floor			58.2000	0.1300	7.5660	20.0000	1164.0000 (28a)
External Walls	98.1600	20.6000	77.5600	0.1800	13.9608	18.0000	1396.0800 (29a)
External Roof	58.2000		58.2000	0.1100	6.4020	9.0000	523.8000 (30)
Total net area of external elements Aum(A, m <sup>2</sup> )			214.5600				(31)
Fabric heat loss, W/K = Sum (A x U)				(26) ... (30) + (32) =	43.8978		(33)
Internal Walls			124.0200			9.0000	1116.1800 (32c)
Heat capacity Cm = Sum(A x k)						(28) ... (30) + (32) + (32a) ... (32e) =	4200.0600 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							72.1660 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value	Total	
E1 Steel lintel with perforated steel base plate				13.6300	0.0000	0.0000	
E3 Sill				13.6300	0.0000	0.0000	
E4 Jamb				28.5000	0.0000	0.0000	
E5 Ground floor (normal)				32.7200	0.0000	0.0000	
E16 Corner (normal)				12.0000	0.0000	0.0000	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							0.0000 (36)
Point Thermal bridges						(36a) =	0.0000
Total fabric heat loss						(33) + (36) + (36a) =	43.8978 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	30.6823	30.6096	30.5383	30.2034	30.1407	29.8490	29.8490	29.7950	29.9614	30.1407	30.2675	30.4000 (38)
Heat transfer coeff												

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Average = Sum(39)m / 12 =	74.5801	74.5074	74.4361	74.1011	74.0385	73.7468	73.7468	73.6928	73.8592	74.0385	74.1652	74.2978 (39) 74.1008
HLP	Jan 1.2814	Feb 1.2802	Mar 1.2790	Apr 1.2732	May 1.2721	Jun 1.2671	Jul 1.2671	Aug 1.2662	Sep 1.2691	Oct 1.2721	Nov 1.2743	Dec 1.2766 (40) 1.2732
HLP (average)												1.2732
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

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

Assumed occupancy												1.9303 (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	65.2042	64.2359	62.8722	60.3578	58.4751	56.3874	55.2598	56.6139	58.0883	60.3222	62.8883	64.9838 (42b)
Hot water usage for other uses	34.3983	33.1475	31.8966	30.6458	29.3949	28.1441	28.1441	29.3949	30.6458	31.8966	33.1475	34.3983 (42c) 91.7258 (43)
Average daily hot water use (litres/day)												
Daily hot water use	Jan 99.6025	Feb 97.3833	Mar 94.7688	Apr 91.0036	May 87.8700	Jun 84.5315	Jul 83.4039	Aug 86.0089	Sep 88.7341	Oct 92.2188	Nov 96.0358	Dec 99.3821 (44)
Energy conte	157.7461	138.6726	145.6561	124.5794	118.2899	103.9414	100.8698	106.4969	109.4180	125.1401	136.8206	155.6084 (45)
Energy content (annual)												Total = Sum(45)m = 1523.2392
Distribution loss (46)m = 0.15 x (45)m	23.6619	20.8009	21.8484	18.6869	17.7435	15.5912	15.1305	15.9745	16.4127	18.7710	20.5231	23.3413 (46)
Water storage loss:												
Store volume												144.0000 (47)
b) If manufacturer declared loss factor is not known :												
Hot water storage loss factor from Table 2 (kWh/litre/day)												0.0206 (51)
Volume factor from Table 2a												0.9410 (52)
Temperature factor from Table 2b												0.6000 (53)
Enter (49) or (54) in (55)												1.6751 (55)
Total storage loss	51.9289	46.9035	51.9289	50.2537	51.9289	50.2537	51.9289	51.9289	50.2537	51.9289	50.2537	51.9289 (56)
If cylinder contains dedicated solar storage	51.9289	46.9035	51.9289	50.2537	51.9289	50.2537	51.9289	51.9289	50.2537	51.9289	50.2537	51.9289 (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	209.6749	185.5760	197.5850	174.8331	170.2188	154.1951	152.7986	158.4258	159.6718	177.0689	187.0743	207.5372 (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	209.6749	185.5760	197.5850	174.8331	170.2188	154.1951	152.7986	158.4258	159.6718	177.0689	187.0743	207.5372 (64)
												Total per year (kWh/year) = Sum(64)m = 2134.6595 (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	93.9937	83.6314	89.9737	81.6256	80.8745	74.7635	75.0823	76.9533	76.5845	83.1521	85.6958	93.2829 (65)

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

Metabolic gains (Table 5), Watts												
(66)m	Jan 115.8186	Feb 115.8186	Mar 115.8186	Apr 115.8186	May 115.8186	Jun 115.8186	Jul 115.8186	Aug 115.8186	Sep 115.8186	Oct 115.8186	Nov 115.8186	Dec 115.8186 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	20.6283	18.3219	14.9003	11.2805	8.4323	7.1189	7.6922	9.9987	13.4202	17.0400	19.8882	21.2016 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	251.3217	253.9296	247.3577	233.3669	215.7060	199.1073	188.0183	185.4104	191.9823	205.9731	223.6340	240.2327 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	48.5122	48.5122	48.5122	48.5122	48.5122	48.5122	48.5122	48.5122	48.5122	48.5122	48.5122	48.5122 (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)	-77.2124	-77.2124	-77.2124	-77.2124	-77.2124	-77.2124	-77.2124	-77.2124	-77.2124	-77.2124	-77.2124	-77.2124 (71)
Water heating gains (Table 5)	126.3356	124.4515	120.9324	113.3689	108.7023	103.8382	100.9170	103.4319	106.3673	111.7636	119.0220	125.3802 (72)
Total internal gains	488.4039	486.8214	473.3089	448.1347	422.9590	397.1828	383.7460	385.9593	398.8882	424.8951	452.6626	476.9329 (73)

## 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W						
North	6.1800	10.6334	0.6800	0.7000	0.7700	21.6771 (74)						
East	6.7000	19.6403	0.6800	0.7000	0.7700	43.4073 (76)						
South	5.6200	46.7521	0.6800	0.7000	0.7700	86.6717 (78)						
West	2.1000	19.6403	0.6800	0.7000	0.7700	13.6053 (80)						
Solar gains	165.3613	294.9005	434.8784	585.3021	693.5588	704.0600	672.4190	590.0669	487.1343	334.7522	200.5649	139.8477 (83)
Total gains	653.7652	781.7218	908.1873	1033.4369	1116.5178	1101.2427	1056.1650	976.0262	886.0224	759.6474	653.2274	616.7806 (84)

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
tau	Jan 15.6434	Feb 15.6586	Mar 15.6736	Apr 15.7445	May 15.7578	Jun 15.8201	Jul 15.8201	Aug 15.8317	Sep 15.7961	Oct 15.7578	Nov 15.7309	Dec 15.7028
alpha	2.0429	2.0439	2.0449	2.0496	2.0505	2.0547	2.0547	2.0554	2.0531	2.0505	2.0487	2.0469
util living area	0.8518	0.8007	0.7275	0.6234	0.5029	0.3821	0.2879	0.3205	0.4789	0.6767	0.8085	0.8647 (86)

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MIT	18.2526	18.7101	19.3282	19.9895	20.4913	20.7948	20.9179	20.8948	20.6579	19.9751	18.9883	18.1422 (87)
Th 2	19.8554	19.8564	19.8573	19.8619	19.8627	19.8667	19.8667	19.8674	19.8652	19.8627	19.8610	19.8592 (88)
util rest of house												
	0.8361	0.7809	0.7015	0.5886	0.4579	0.3247	0.2196	0.2493	0.4185	0.6373	0.7859	0.8501 (89)
MIT 2	16.7402	17.2962	18.0415	18.8222	19.3883	19.7092	19.8206	19.8050	19.5843	18.8342	17.6551	16.6069 (90)
Living area fraction									fLA = Living area / (4) =			0.2806 (91)
MIT	17.1645	17.6929	18.4025	19.1497	19.6977	20.0138	20.1285	20.1108	19.8855	19.1543	18.0292	17.0377 (92)
Temperature adjustment												0.0000
adjusted MIT	17.1645	17.6929	18.4025	19.1497	19.6977	20.0138	20.1285	20.1108	19.8855	19.1543	18.0292	17.0377 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.7887	0.7353	0.6632	0.5648	0.4510	0.3325	0.2358	0.2651	0.4197	0.6095	0.7412	0.8031 (94)
Useful gains	515.6485	574.8252	602.3407	583.6861	503.5950	366.1087	249.0327	258.7577	371.8217	462.9962	484.1926	495.3090 (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												
	959.4383	953.1641	885.9772	759.5160	592.1410	399.2490	260.2135	273.4582	427.3139	633.3501	810.5660	953.8124 (97)
Space heating kWh	330.1796	254.2437	211.0256	126.5976	65.8782	0.0000	0.0000	0.0000	0.0000	126.7432	234.9889	341.1266 (98a)
Space heating requirement - total per year (kWh/year)												1690.7834
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	330.1796	254.2437	211.0256	126.5976	65.8782	0.0000	0.0000	0.0000	0.0000	126.7432	234.9889	341.1266 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1690.7834
Space heating per m2												29.0513 (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 %)												0.0000 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	330.1796	254.2437	211.0256	126.5976	65.8782	0.0000	0.0000	0.0000	0.0000	126.7432	234.9889	341.1266 (98)
Space heating efficiency (main heating system 1)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (210)
Space heating fuel (main heating system)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (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	209.6749	185.5760	197.5850	174.8331	170.2188	154.1951	152.7986	158.4258	159.6718	177.0689	187.0743	207.5372 (64)
Efficiency of water heater (217)m	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000 (216)
Fuel for water heating, kWh/month	209.6749	185.5760	197.5850	174.8331	170.2188	154.1951	152.7986	158.4258	159.6718	177.0689	187.0743	207.5372 (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	3.4822	3.1452	3.4822	3.3699	3.4822	3.3699	3.4822	3.4822	3.3699	3.4822	3.3699	3.4822 (231)
Lighting	18.0558	14.4850	13.0422	9.5553	7.3808	6.0301	6.7330	8.7518	11.3677	14.9150	16.8465	18.5576 (232)
Electricity generated by PVs (Appendix M) (negative quantity)	-32.8956	-46.9517	-68.4505	-77.8609	-84.9429	-79.6563	-78.6621	-74.1057	-65.5617	-54.2510	-36.4046	-28.3871 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)
Annual totals kWh/year												
Space heating fuel - main system 1												0.0000 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												100.0000
Water heating fuel used												2134.6595 (219)
Space cooling fuel												0.0000 (221)
Electricity for pumps and fans:												
central heating pump												41.0000 (230c)
Total electricity for the above, kWh/year												41.0000 (231)
Electricity for lighting (calculated in Appendix L)												145.7207 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-728.1302 (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												1593.2500 (238)

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

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	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1 (high-rate cost)	0.0000	18.5800	0.0000 (240)
Space heating - main system 1 (low-rate cost)	0.0000	0.0000	0.0000 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (electric off-peak tariff)			
High-rate fraction			0.2999 (243)
Low-rate fraction			0.7001 (244)
High-rate cost	640.2126	19.6000	125.4817 (245)
Low-rate cost	1494.4469	9.4000	140.4780 (246)
Energy for instantaneous electric shower(s)	0.0000	18.5800	0.0000 (247a)
Pumps, fans and electric keep-hot (0.90*19.60 + 0.10*9.40)	41.0000	18.5800	7.6178 (249)
Energy for lighting (0.90*19.60 + 0.10*9.40)	145.7207	18.5800	27.0749 (250)
Additional standing charges			7.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-728.1302	18.5800	-135.2866
PV Unit electricity exported	0.0000	5.5900	0.0000
Total			-135.2866 (252)
Total energy cost			172.3658 (255)

## 11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600 (256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	0.6013 (257)
SAP value		90.2533
SAP rating (Section 12)		90 (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 (high-rate cost)	0.0000	0.0000	0.0000 (261)
Space heating - main system 1 (low-rate cost)	0.0000	0.0000	0.0000 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating - high rate cost	640.2126	0.1477	94.5354 (264)
Water heating - low rate cost	1494.4469	0.1239	185.2054 (264)
Space and water heating			279.7408 (265)
Pumps, fans and electric keep-hot	41.0000	0.1432	5.8713 (267)
Energy for lighting	145.7207	0.1490	21.7153 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-728.1302	0.1386	-100.9455
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-100.9455 (269)
Total CO2, kg/year			206.3819 (272)
CO2 emissions per m2			3.5500 (273)
EI value			97.3202
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	58.2000 (1b)	x 3.0000 (2b)	= 174.6000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	58.2000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 174.6000 (5)

### 2. Ventilation rate

	m3 per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	0 * 10 = 0.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c)	0.0000 / (5) = 0.0000 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	4.0000 (17)
Infiltration rate	0.2000 (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) = 0.2000 (21)

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	6.3000	5.9000	5.8000	5.2000	5.2000	4.6000	4.7000	4.6000	4.9000	5.7000	5.8000	6.3000	(22)
Wind factor	1.5750	1.4750	1.4500	1.3000	1.3000	1.1500	1.1750	1.1500	1.2250	1.4250	1.4500	1.5750	(22a)
Adj infilt rate													
Effective ac	0.3150	0.2950	0.2900	0.2600	0.2600	0.2300	0.2350	0.2300	0.2450	0.2850	0.2900	0.3150	(22b)
	0.5496	0.5435	0.5421	0.5338	0.5338	0.5264	0.5276	0.5264	0.5300	0.5406	0.5421	0.5496	(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	
Windows (Uw = 0.80)			20.6000	0.7752	15.9690			(27)
Heatloss Floor			58.2000	0.1300	7.5660	20.0000	1164.0000	(28a)
External Walls	98.1600	20.6000	77.5600	0.1800	13.9608	18.0000	1396.0800	(29a)
External Roof	58.2000		58.2000	0.1100	6.4020	9.0000	523.8000	(30)
Total net area of external elements Aum(A, m2)			214.5600					(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	43.8978		(33)
Internal Walls			124.0200			9.0000	1116.1800	(32c)

Heat capacity Cm = Sum(A x k)  
 Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K  
 (28)...(30) + (32) + (32a)...(32e) = 4200.0600 (34)  
 72.1660 (35)

#### List of Thermal Bridges

K1 Element	Length	Psi-value	Total	
E1 Steel lintel with perforated steel base plate	13.6300	0.0000	0.0000	
E3 Sill	13.6300	0.0000	0.0000	
E4 Jamb	28.5000	0.0000	0.0000	
E5 Ground floor (normal)	32.7200	0.0000	0.0000	
E16 Corner (normal)	12.0000	0.0000	0.0000	

Thermal bridges (Sum(L x Psi) calculated using Appendix K)  
 Point Thermal bridges  
 Total fabric heat loss (33) + (36) + (36a) = 43.8978 (37)

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

(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat transfer coeff	31.6676	31.3161	31.2318	30.7565	30.7565	30.3330	30.4000	30.3330	30.5383	31.1490	31.2318	31.6676	(38)
Average = Sum(39)m / 12 =	75.5654	75.2139	75.1296	74.6543	74.6543	74.2308	74.2978	74.2308	74.4361	75.0468	75.1296	75.5654	(39)
												74.8462	(39)

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP (average)	1.2984	1.2923	1.2909	1.2827	1.2827	1.2754	1.2766	1.2754	1.2790	1.2895	1.2909	1.2984	(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													1.9303	(42)
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)
Hot water usage for baths	65.2042	64.2359	62.8722	60.3578	58.4751	56.3874	55.2598	56.6139	58.0883	60.3222	62.8883	64.9838	64.9838	(42b)
Hot water usage for other uses	34.3983	33.1475	31.8966	30.6458	29.3949	28.1441	28.1441	29.3949	30.6458	31.8966	33.1475	34.3983	34.3983	(42c)
Average daily hot water use (litres/day)	23.6619	20.8009	21.8484	18.6869	17.7435	15.5912	15.1305	15.9745	16.4127	18.7710	20.5231	23.3413	23.3413	(43)

Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy conte	99.6025	97.3833	94.7688	91.0036	87.8700	84.5315	83.4039	86.0089	88.7341	92.2188	96.0358	99.3821	(44)
Energy content (annual)	157.7461	138.6726	145.6561	124.5794	118.2899	103.9414	100.8698	106.4969	109.4180	125.1401	136.8206	155.6084	(45)
Distribution loss (46)m = 0.15 x (45)m	23.6619	20.8009	21.8484	18.6869	17.7435	15.5912	15.1305	15.9745	16.4127	18.7710	20.5231	23.3413	(46)

Water storage loss:  
 Store volume 144.0000 (47)

b) If manufacturer declared loss factor is not known :  
 Hot water storage loss factor from Table 2 (kWh/litre/day)  
 Volume factor from Table 2a  
 Temperature factor from Table 2b

Enter (49) or (54) in (55)  
 Total storage loss

If cylinder contains dedicated solar storage	51.9289	46.9035	51.9289	50.2537	51.9289	50.2537	51.9289	51.9289	50.2537	51.9289	50.2537	51.9289	51.9289	(56)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(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	0.0000	(59)
Total heat required for water heating calculated for each month	209.6749	185.5760	197.5850	174.8331	170.2188	154.1951	152.7986	158.4258	159.6718	177.0689	187.0743	207.5372	207.5372	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)

Output from w/h  
 Total per year (kWh/year) = Sum(64)m = 2134.6595 (64)

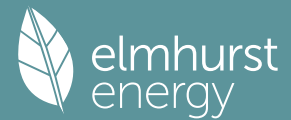
Electric shower(s)  
 Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)

Heat gains from water heating, kWh/month  
 93.9937 83.6314 89.9737 81.6256 80.8745 74.7635 75.0823 76.9533 76.5845 83.1521 85.6958 93.2829 (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	115.8186	115.8186	115.8186	115.8186	115.8186	115.8186	115.8186	115.8186	115.8186	115.8186	115.8186	115.8186	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	20.6283	18.3219	14.9003	11.2805	8.4323	7.1189	7.6922	9.9987	13.4202	17.0400	19.8882	21.2016	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	251.3217	253.9296	247.3577	233.3669	215.7060	199.1073	188.0183	185.4104	191.9823	205.9731	223.6340	240.2327	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													

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Pumps, fans	48.5122	48.5122	48.5122	48.5122	48.5122	48.5122	48.5122	48.5122	48.5122	48.5122	48.5122	48.5122 (69)
Losses e.g. evaporation	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)
negative values) (Table 5)												
Water heating gains (Table 5)	-77.2124	-77.2124	-77.2124	-77.2124	-77.2124	-77.2124	-77.2124	-77.2124	-77.2124	-77.2124	-77.2124	-77.2124 (71)
Total internal gains	126.3356	124.4515	120.9324	113.3689	108.7023	103.8382	100.9170	103.4319	106.3673	111.7636	119.0220	125.3802 (72)
	488.4039	486.8214	473.3089	448.1347	422.9590	397.1828	383.7460	385.9593	398.8882	424.8951	452.6626	476.9329 (73)

## 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c	FF	Access factor Table 6d	Gains W					
North	6.1800	14.5581	0.6800	0.7000	0.7700	29.6780 (74)						
East	6.7000	27.2691	0.6800	0.7000	0.7700	60.2679 (76)						
South	5.6200	60.4813	0.6800	0.7000	0.7700	112.1237 (78)						
West	2.1000	27.2691	0.6800	0.7000	0.7700	18.8899 (80)						
Solar gains	220.9596	329.7925	475.5917	658.0674	733.0720	804.4218	685.4754	651.7714	553.1802	379.4814	251.3796	187.4263 (83)
Total gains	709.3635	816.6139	948.9006	1106.2022	1156.0310	1201.6046	1069.2214	1037.7306	952.0684	804.3766	704.0421	664.3593 (84)

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation factor for gains for living area, nil,m (see Table 9a)	15.4394	15.5115	15.5289	15.6278	15.7170	15.7028	15.7170	15.6736	15.5461	15.5289	15.4394	15.4394
tau	2.0293	2.0341	2.0353	2.0419	2.0419	2.0478	2.0469	2.0478	2.0449	2.0364	2.0353	2.0293
util living area	0.8025	0.7573	0.6827	0.5803	0.4817	0.3480	0.2979	0.3056	0.4209	0.6027	0.7415	0.8121 (86)
MIT	18.8837	19.1839	19.6629	20.1661	20.5415	20.8318	20.9071	20.9026	20.7572	20.3017	19.5812	18.8856 (87)
Th 2	19.8421	19.8468	19.8480	19.8544	19.8544	19.8601	19.8592	19.8601	19.8573	19.8491	19.8480	19.8421 (88)
util rest of house	0.7804	0.7321	0.6518	0.5428	0.4356	0.2921	0.2304	0.2367	0.3573	0.5533	0.7093	0.7900 (89)
MIT 2	17.5129	17.8709	18.4362	19.0168	19.4344	19.7350	19.8048	19.8029	19.6729	19.1963	18.3659	17.5204 (90)
Living area fraction	17.8975	18.2393	18.7804	19.3393	19.7450	20.0427	20.1141	20.1115	19.9771	19.5065	18.7069	17.9034 (92)
Temperature adjustment	17.8975	18.2393	18.7804	19.3393	19.7450	20.0427	20.1141	20.1115	19.9771	19.5065	18.7069	0.0000
adjusted MIT	17.8975	18.2393	18.7804	19.3393	19.7450	20.0427	20.1141	20.1115	19.9771	19.5065	18.7069	17.9034 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.7350	0.6906	0.6194	0.5246	0.4310	0.3014	0.2459	0.2524	0.3643	0.5371	0.6718	0.7443 (94)
Useful gains	521.3810	563.9616	587.7960	580.3678	498.2511	362.1500	262.9409	261.8794	346.8266	432.0059	472.9893	494.4668 (95)
Ext temp.	6.4000	6.7000	7.9000	9.6000	12.0000	14.8000	16.4000	16.4000	14.8000	12.2000	9.3000	6.8000 (96)
Heat loss rate W	868.8151	867.9160	817.4387	727.0780	578.2001	389.1733	275.9489	275.5061	385.3660	548.3263	706.7379	839.0357 (97)
Space heating kWh	258.4909	204.2574	170.8542	105.6313	59.4821	0.0000	0.0000	0.0000	0.0000	86.5424	168.2989	256.3592 (98a)
Space heating requirement - total per year (kWh/year)	1309.9165											
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	258.4909	204.2574	170.8542	105.6313	59.4821	0.0000	0.0000	0.0000	0.0000	86.5424	168.2989	256.3592 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)	1309.9165											
Space heating per m2	(98c) / (4) = 22.5072 (99)											

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

Fraction of space heat from secondary/supplementary system (Table 11)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Fraction of space heat from main system(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (201)
Efficiency of main space heating system 1 (in %)	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000 (202)
Efficiency of main space heating system 2 (in %)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (206)
Efficiency of secondary/supplementary heating system, %	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (207)
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (208)
Space heating requirement	258.4909	204.2574	170.8542	105.6313	59.4821	0.0000	0.0000	0.0000	0.0000	86.5424	168.2989	256.3592 (98)
Space heating efficiency (main heating system 1)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (210)
Space heating fuel (main heating system)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (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	209.6749	185.5760	197.5850	174.8331	170.2188	154.1951	152.7986	158.4258	159.6718	177.0689	187.0743	207.5372 (64)
Water heating requirement	209.6749	185.5760	197.5850	174.8331	170.2188	154.1951	152.7986	158.4258	159.6718	177.0689	187.0743	207.5372 (216)
Efficiency of water heater (217)m	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000 (217)
Fuel for water heating, kWh/month	209.6749	185.5760	197.5850	174.8331	170.2188	154.1951	152.7986	158.4258	159.6718	177.0689	187.0743	207.5372 (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	3.4822	3.1452	3.4822	3.3699	3.4822	3.3699	3.4822	3.4822	3.3699	3.4822	3.3699	3.4822 (231)
Lighting	18.0558	14.4850	13.0422	9.5553	7.3808	6.0301	6.7330	8.7518	11.3677	14.9150	16.8465	18.5576 (232)
Electricity generated by PVs (Appendix M) (negative quantity)	-41.5540	-51.2260	-72.7683	-83.0198	-87.2197	-84.3963	-79.3490	-77.8286	-70.5114	-59.2599	-43.4202	-36.1304 (233a)

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Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(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												0.0000	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												100.0000	
Water heating fuel used												2134.6595	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans: central heating pump												41.0000	(230c)
Total electricity for the above, kWh/year												41.0000	(231)
Electricity for lighting (calculated in Appendix L)												145.7207	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-786.6837	(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												1534.6966	(238)

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10a. Fuel costs - using BEDF prices (536)  
-----

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1 (high-rate cost)	0.0000	28.2800	0.0000	(240)
Space heating - main system 1 (low-rate cost)	0.0000	0.0000	0.0000	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (electric off-peak tariff)				
High-rate fraction			0.2999	(243)
Low-rate fraction			0.7001	(244)
High-rate cost	640.2126	29.8000	190.7834	(245)
Low-rate cost	1494.4469	14.6000	218.1892	(246)
Energy for instantaneous electric shower(s)	0.0000	28.2800	0.0000	(247a)
Pumps, fans and electric keep-hot (0.90*29.80 + 0.10*14.60)	41.0000	28.2800	11.5948	(249)
Energy for lighting (0.90*29.80 + 0.10*14.60)	145.7207	28.2800	41.2098	(250)
Additional standing charges			4.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-786.6837	28.2800	-222.4741	
PV Unit electricity exported	0.0000	5.8100	0.0000	
Total			-222.4741	(252)
Total energy cost			243.3031	(255)

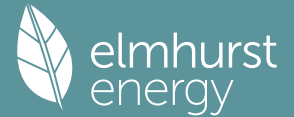
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12a. Carbon dioxide emissions - Individual heating systems including micro-CHP  
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	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1 (high-rate cost)	0.0000	0.0000	0.0000	(261)
Space heating - main system 1 (low-rate cost)	0.0000	0.0000	0.0000	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating - high rate cost	640.2126	0.1477	94.5354	(264)
Water heating - low rate cost	1494.4469	0.1239	185.2054	(264)
Space and water heating			279.7408	(265)
Pumps, fans and electric keep-hot	41.0000	0.1432	5.8713	(267)
Energy for lighting	145.7207	0.1490	21.7153	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-786.6837	0.1394	-109.6793	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-109.6793	(269)
Total CO2, kg/year			197.6481	(272)

-----  
13a. Primary energy - Individual heating systems including micro-CHP  
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	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1 (high-rate cost)	0.0000	0.0000	0.0000	(275)
Space heating - main system 1 (low-rate cost)	0.0000	0.0000	0.0000	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating - high rate cost	640.2126	1.5520	993.6038	(278)
Water heating - low rate cost	1494.4469	1.4434	2157.0879	(278)
Space and water heating			3150.6916	(279)
Pumps, fans and electric keep-hot	41.0000	1.5335	62.8729	(281)
Energy for lighting	145.7207	1.5547	226.5585	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-786.6837	1.5197	-1195.5081	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-1195.5081	(283)
Total Primary energy kWh/year			2244.6149	(286)

# Predicted Energy Assessment

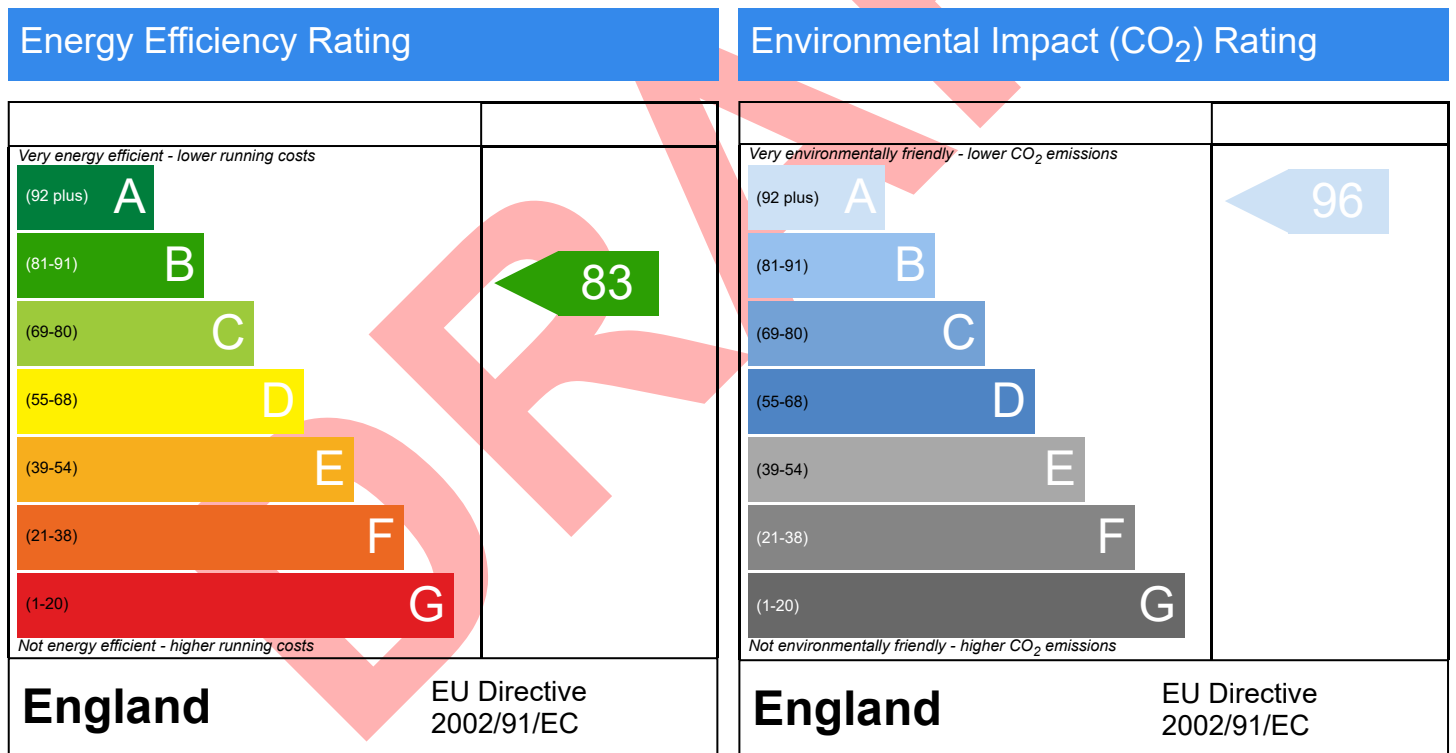


Greenacre, PL25 3TQ

Dwelling type: Bungalow, Detached  
 Date of assessment: 16/02/2024  
 Produced by: Jessica Tyler  
 Total floor area: 58.2 m<sup>2</sup>  
 DRRN:

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

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



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

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



# Summary for Input Data



Property Reference	57879	Issued on Date	16/02/2024
Assessment Reference	As Designed	Prop Type Ref	
Property	Greenacre, PL25 3TQ		

SAP Rating	83 B	DER	5.28	TER	12.77
Environmental	96 A	% DER < TER			58.65
CO <sub>2</sub> Emissions (t/year)	0.31	DFEE	41.61	TFEE	51.34
Compliance Check	See BREL	% DFEE < TFEE			18.95
% DPER < TPER	13.41	DPER	59.11	TPER	68.26

Assessor Details	Miss Jessica Tyler	Assessor ID	CD80-0001
Client	57879, Joe Allam		

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

Orientation	West
Property Tenure	ND
Transaction Type	5
Terrain Type	Suburban
1.0 Property Type	Bungalow, Detached
2.0 Number of Storeys	1
3.0 Date Built	2024
4.0 Sheltered Sides	0
5.0 Sunlight/Shade	Average or unknown
6.0 Thermal Mass Parameter	Precise calculation

7.0 Electricity Tariff	7 Hour Off Peak
Smart electricity meter fitted	No
Smart gas meter fitted	No

7.0 Measurements		Heat Loss Perimeter	Internal Floor Area	Average Storey Height
	Ground floor:	32.72 m	58.20 m <sup>2</sup>	3.00 m

8.0 Living Area	16.33	m <sup>2</sup>
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Description	Type	Construction	U-Value (W/m <sup>2</sup> K)	Kappa (kJ/m <sup>2</sup> K)	Gross Area(m <sup>2</sup> )	Nett Area (m <sup>2</sup> )	Shelter Res	Shelter	Openings	Area Calculation Type
External Walls	Timber Frame	Other	0.18	18.00	98.16	77.57	0.00	None	20.59	Enter Gross Area

Description	Construction	Kappa (kJ/m <sup>2</sup> K)	Area (m <sup>2</sup> )
Internal Walls	Plasterboard on timber frame	9.00	124.02

Description	Type	Construction	U-Value (W/m <sup>2</sup> K)	Kappa (kJ/m <sup>2</sup> K)	Gross Area(m <sup>2</sup> )	Nett Area (m <sup>2</sup> )	Shelter Code	Shelter Factor	Calculation Type	Openings
External Roof	External Slope Roof	Plasterboard, insulated slope	0.11	9.00	58.20	58.20	None	0.00	Enter Gross Area	0.00

Description	Type	Storey Index	Construction	U-Value (W/m <sup>2</sup> K)	Shelter Code	Shelter Factor	Kappa (kJ/m <sup>2</sup> K)	Area (m <sup>2</sup> )
Heatloss Floor	Ground Floor - Timber	Lowest occupied	Suspended timber, insulation between joists	0.13	None	0.00	20.00	58.20

Description	Data Source	Type	Glazing	Glazing Gap	Filling Type	G-value	Frame Type	Frame Factor	U Value (W/m <sup>2</sup> K)
Windows	Manufacturer	Window	Triple glazed			0.68		0.70	0.80

Name	Opening Type	Location	Orientation	Area (m <sup>2</sup> )	Pitch
West Elevation Windows	Windows	External Walls	West	2.10	
East Elevation Windows	Windows	External Walls	East	6.70	
North Elevation Windows	Windows	External Walls	North	6.18	
South Elevation Windows	Windows	External Walls	South	5.62	

# Summary for Input Data



14.0 Conservatory

15.0 Draught Proofing  %

16.0 Draught Lobby

17.0 Thermal Bridging

17.1 List of Bridges

Bridge Type	Source Type	Length	Psi	Adjusted Reference:	Imported
E1 Steel lintel with perforated steel base plate	Independently assessed	13.63	0.00	0.00	Yes
E3 Sill	Independently assessed	13.63	0.00	0.00	Yes
E4 Jamb	Independently assessed	28.50	0.00	0.00	Yes
E5 Ground floor (normal)	Independently assessed	32.72	0.00	0.00	Yes
E16 Corner (normal)	Independently assessed	12.00	0.00	0.00	Yes

Y-value  W/m²K

18.0 Pressure Testing

Designed AP<sub>50</sub>  m³/(h.m²) @ 50 Pa

Test Method

19.0 Mechanical Ventilation

Mechanical Ventilation

Mechanical Ventilation System Present

20.0 Fans, Open Fireplaces, Flues

21.0 Fixed Cooling System

22.0 Lighting

No Fixed Lighting

Name	Efficacy	Power	Capacity	Count
Lighting 1	75.00	6	450	15

24.0 Main Heating 1

Manufacturer

Percentage of Heat  %

Fuel Type

SAP Code

In Winter

In Summer

Model Name

Manufacturer

Controls SAP Code

Delayed Start Stat

Is MHS Pumped

Heating Pump Age

Heat Emitter

Boiler Interlock

25.0 Main Heating 2

26.0 Heat Networks

Heat Source	Fuel Type	Heating Use	Efficiency	Percentage Of Heat	Heat	Heat Power Ratio	Electrical	Fuel Factor	Efficiency type
Heat source 1									
Heat source 2									
Heat source 3									
Heat source 4									
Heat source 5									

28.0 Water Heating

Water Heating

SAP Code

Fuel Type

# Summary for Input Data



Flue Gas Heat Recovery System	No
Waste Water Heat Recovery Instantaneous System 1	No
Waste Water Heat Recovery Instantaneous System 2	No
Waste Water Heat Recovery Storage System	No
Solar Panel	No
Water use <= 125 litres/person/day	Yes
Immersion Heater	Single
Cold Water Source	From mains
Bath Count	1

## 28.3 Waste Water Heat Recovery System

<b>29.0 Hot Water Cylinder</b>	Hot Water Cylinder
Cylinder In Heated Space	Yes
Insulation Type	Jacket
Insulation Thickness Type	100 mm
Cylinder Volume	144.00 L
In Airing Cupboard	No

## 34.0 Small-scale Hydro

None	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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### Recommendations

Lower cost measures

None

Further measures to achieve even higher standards

Typical Cost	Typical savings per year	Ratings after improvement	
		SAP rating	Environmental Impact
£3,500 - £5,500	£222	B 83	A 97
		B 90	A 97
		0	0

# Thermal Bridging



Property Reference	57879	Issued on Date	16/02/2024
Assessment Reference	As Designed	Prop Type Ref	Detached Bungalow
Property	Greenacre, PL25 3TQ		

SAP Rating	83 B	DER	5.28	TER	12.77
Environmental	96 A	% DER < TER			58.65
CO <sub>2</sub> Emissions (t/year)	0.31	DFEE	41.61	TFEE	51.34
Compliance Check	See BREL	% DFEE < TFEE			18.95
% DPER < TPER	13.41	DPER	59.11	TPER	68.26

Assessor Details	Miss Jessica Tyler	Assessor ID	CD80-0001
Client	57879, Joe Allam		

	Junction details	Source Type	Psi (W/mK)	Length (m)	Result	Reference
External wall	E1 Steel lintel with perforated steel base plate	Independently assessed	0.000	13.63	0.00	
External wall	E3 Sill	Independently assessed	0.000	13.63	0.00	
External wall	E4 Jamb	Independently assessed	0.000	28.50	0.00	
External wall	E5 Ground floor (normal)	Independently assessed	0.000	32.72	0.00	
External wall	E16 Corner (normal)	Independently assessed	0.000	12.00	0.00	

Total: 100.48 W/mK:  
 Y-Value: 0.00 W/m²K:

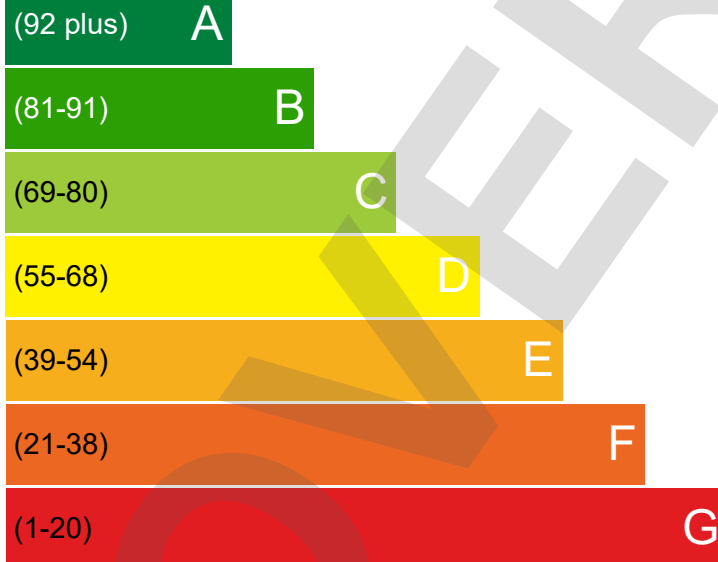
Dwelling Address	Greenacre, PL25 3TQ
Report Date	16/02/2024
Property Type	Bungalow, Detached
Floor Area [m <sup>2</sup> ]	58

This document is not an Energy Performance Certificate (EPC) as required by the Energy Performance of Buildings Regulations

## Energy Rating

The current energy rating represents the overall energy efficiency of the dwelling. The potential energy rating is the overall energy rating of the dwelling after all of the recommend measures provided on the next page have been installed. A higher score represents a more energy efficient dwelling with lower fuel bills.

Most energy efficient - lower running costs



CURRENT

83

POTENTIAL

90

Least energy efficient - higher running costs

## Breakdown of property's energy performance

Each feature is assessed as one of the following:



Feature	Description	Energy Performance
Walls	Average thermal transmittance 0.18 W/m <sup>2</sup> K	Very Good
Roof	Average thermal transmittance 0.11 W/m <sup>2</sup> K	Very Good
Floor	Average thermal transmittance 0.13 W/m <sup>2</sup> K	Very Good
Windows	High performance glazing	Very Good
Main heating	Boiler and radiators, electric	Very Good
Main heating controls	Time and temperature zone control	Very Good
Secondary heating	None	
Hot water	Electric immersion, off-peak	Poor
Lighting	Good lighting efficiency	Good
Air tightness	Air permeability [AP50] = 4.0 m <sup>3</sup> /h.m <sup>2</sup> (assumed)	Good

## Primary Energy use

The primary energy use for this property per year is 59 kilowatt hour (kWh) per square metre

## Estimated CO<sub>2</sub> emissions of the dwelling





The estimated CO rating provides an indication of the dwelling's impact on the environment in terms of carbon dioxide emissions; the higher the rating the less impact it has on the environment.

The estimated CO emissions for this dwellings is: **0.3** per year

With the recommended measures the potential CO emissions could be: **0.2** per year

## Recommendations

The recommended measures provided below will help to improve the energy efficiency of the dwelling. To reach the dwelling's potential energy rating all of the recommended measures shown below would need to be installed. Having these measures installed individually or in any other order may give a different result when compared with the cumulative potential rating.

Recommended measure	Typical Yearly Saving	Potential Rating after measure installed	Cumulative savings (per year)	Cumulative Potential Rating
Solar water heating		 0	£52	 B 83
Photovoltaic	£222	 7	£274	 B 90

## Estimated energy use and potential savings

Estimated energy cost for this property over a year

**£466**

Over a year you could save

**£222**

The estimated cost and savings show how much the average household would spend in this property for heating, lighting and hot water. It is not based on how energy is used by the people living at the property.

## Contacting the assessor and the accreditation scheme

## Assessor contact details

Assessor name	Miss Jessica Tyler
Assessor's accreditation number	
Email Address	

## Accreditation scheme contact details

Accreditation scheme	
Telephone	
Email Address	

## Assessment details

Related party disclosure	
Date of assessment	16/02/2024
Date of certificate	16/02/2024
Type of assessment	SAP, new dwelling