

# Building Regulations England Part L (BREL) Compliance Report

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

Date: Wed 31 Jan 2024 08:49:47

Project Information			
Assessed By	John Ashe	Building Type	Bungalow, Detached
OCDEA Registration	EES/027295	Assessment Date	2024-01-31

Dwelling Details			
Assessment Type	As designed	Total Floor Area	105 m <sup>2</sup>
Site Reference	Adjacent To 7 Foster Close	Plot Reference	Adjacent To 7 Foster Close
Address			

Client Details	
Name	N/A
Company	N/A
Address	N/A, N/A, N/A

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	8.46 kgCO <sub>2</sub> /m <sup>2</sup>	
Dwelling carbon dioxide emission rate	2.51 kgCO <sub>2</sub> /m <sup>2</sup>	OK
1b Target primary energy rate and dwelling primary energy		
Target primary energy	45.88 kWh <sub>PE</sub> /m <sup>2</sup>	
Dwelling primary energy	26.35 kWh <sub>PE</sub> /m <sup>2</sup>	OK
1c Target fabric energy efficiency and dwelling fabric energy efficiency		
Target fabric energy efficiency	43.4 kWh/m <sup>2</sup>	
Dwelling fabric energy efficiency	42.5 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	0.17	Walls (1) (0.17)	OK
Party walls	0.2	N/A	N/A	N/A
Curtain walls	1.6	N/A	N/A	N/A
Floors	0.18	0.1	Heatloss Floor 1 (0.1)	OK
Roofs	0.16	0.1	Roof (1) (0.1)	OK
Windows, doors, and roof windows	1.6	1.2	Opening (1.2)	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)	81.1	0.17
Ground floor: Heatloss Floor 1, Heatloss Floor 1	104.8	0.1 (!)
Exposed roof: Roof (1)	104.8	0.1 (!)

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]
Opening, Opening Type 1	8.32	North	0.7	1.2
Opening, Opening Type 1	15.78	South	0.7	1.2
Opening, Opening Type 1	4.64	East	0.7	1.2

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	0.4	
External wall	E3: Sill	Calculated by person with suitable expertise	0.042	
External wall	E4: Jamb	Calculated by person with suitable expertise	0.046	

Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E5: Ground floor (normal)	Calculated by person with suitable expertise	0.057	
External wall	E10: Eaves (insulation at ceiling level)	Calculated by person with suitable expertise	0.108	
External wall	E16: Corner (normal)	Calculated by person with suitable expertise	0.037 (!)	
External wall	E17: Corner (inverted - internal area greater than external area)	Calculated by person with suitable expertise	-0.061	

### 3 Air permeability (better than typically expected values are flagged with a subsequent (!))

Maximum permitted air permeability at 50Pa	8 m <sup>3</sup> /hm <sup>2</sup>	
Dwelling air permeability at 50Pa	5 m <sup>3</sup> /hm <sup>2</sup> , Design value	OK
Air permeability test certificate reference		

### 4 Space heating

#### Main heating system 1: Heat pump with radiators or underfloor heating - Electricity

Efficiency	271.2%
Emitter type	Radiators
Flow temperature	45°C
System type	Heat Pump
Manufacturer	Vaillant Group UK Ltd
Model	aroTHERM 7kW
Commissioning	

#### Secondary heating system: N/A

Fuel	N/A
Efficiency	N/A
Commissioning	

### 5 Hot water

#### Cylinder/store - type: Cylinder

Capacity	210 litres
Declared heat loss	1.77 kWh/day
Primary pipework insulated	Yes
Manufacturer	
Model	
Commissioning	

#### Waste water heat recovery system 1 - type: N/A

Efficiency	
Manufacturer	
Model	

### 6 Controls

#### Main heating 1 - type: Time and temperature zone control by arrangement of plumbing and electrical services

Function	
Ecodesign class	
Manufacturer	
Model	

#### Water heating - type: Cylinder thermostat and HW separately timed

Manufacturer	
Model	

### 7 Lighting

Minimum permitted light source efficacy	75 lm/W	
Lowest light source efficacy	100 lm/W	OK
External lights control	N/A	

### 8 Mechanical ventilation

#### System type: 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	
Technology type: <b>Photovoltaic system (1)</b>	
Peak power	2 kWp
Orientation	South
Pitch	30°
Overshading	None or very little
Manufacturer	
MCS certificate	
10 Heat networks	
N/A	
11 Supporting documentary evidence	
N/A	
12 Declarations	
a. Assessor Declaration	
<p>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.</p>	
<p>Signed:</p>  <p>Name:</p>	<p>Assessor ID:</p>  <p>Date:</p>
b. Client Declaration	
N/A	

# Full SAP Calculation Printout



Property Reference	Adjacent To 7 Foster Close		Issued on Date	31/01/2024	
Assessment Reference	Adjacent To 7 Foster Close	Prop Type Ref	Adjacent To 7 Foster Close		
Property					
SAP Rating	89 B	DER	2.51	TER	8.46
Environmental	98 A	% DER < TER			70.33
CO <sub>2</sub> Emissions (t/year)	0.23	DFEE	42.46	TFEE	43.44
Compliance Check	See BREL	% DFEE < TFEE			2.25
% DPER < TPER	42.56	DPER	26.35	TPER	45.88
Assessor Details	Mr. John Ashe			Assessor ID	AV69-0001
Client	N/A, N/A				

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

### 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	104.8000 (1b)	2.4300 (2b)	254.6640 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	104.8000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	254.6640 (5)

### 2. Ventilation rate

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

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c)	0.0000 / (5) =	0.0000 (8)
Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design AP50		5.0000 (17)
Infiltration rate		0.2500 (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) =	0.2500 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate												
Effective ac	0.3187	0.3125	0.3063	0.2750	0.2687	0.2375	0.2375	0.2313	0.2500	0.2687	0.2812	0.2938 (22b)
	0.5508	0.5488	0.5469	0.5378	0.5361	0.5282	0.5282	0.5267	0.5312	0.5361	0.5396	0.5431 (25)

### 3. Heat losses and heat loss parameter

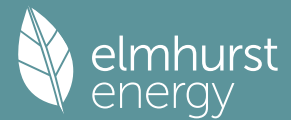
Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
Opening Type 1 (Uw = 1.20)			28.7400	1.1450	32.9084		(27)
Heatloss Floor 1			104.8000	0.1000	10.4800	110.0000	11528.0000 (28a)
External Wall 1	109.8400	28.7400	81.1000	0.1700	13.7870	60.0000	4866.0000 (29a)
External Roof 1	104.8000		104.8000	0.1000	10.4800	9.0000	943.2000 (30)
Total net area of external elements Aum(A, m <sup>2</sup> )			319.4400				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.6554		(33)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	17337.2000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K		165.4313 (35)

#### List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	15.8100	0.4000	6.3240
E3 Sill	4.9500	0.0420	0.2079
E4 Jamb	41.4000	0.0460	1.9044
E5 Ground floor (normal)	45.2000	0.0570	2.5764
E10 Eaves (insulation at ceiling level)	45.2000	0.1080	4.8816
E16 Corner (normal)	12.1500	0.0370	0.4496
E17 Corner (inverted - internal area greater than external area)	2.4300	-0.0610	-0.1482
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			16.1956 (36)
Point Thermal bridges			(36a) = 0.0000

# Full SAP Calculation Printout



Total fabric heat loss												(33) + (36) + (36a) =	83.8510 (37)
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(38)
Heat transfer coeff	46.2888	46.1230	45.9605	45.1973	45.0545	44.3897	44.3897	44.2666	44.6458	45.0545	45.3434	45.6454	(38)
Average = Sum(39)m / 12 =	130.1398	129.9740	129.8116	129.0483	128.9055	128.2407	128.2407	128.1176	128.4968	128.9055	129.1944	129.4964	(39)
	129.0476											129.0476	(39)
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(40)
HLP (average)	1.2418	1.2402	1.2387	1.2314	1.2300	1.2237	1.2237	1.2225	1.2261	1.2300	1.2328	1.2357	(40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	(40)

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

Assumed occupancy												2.7797 (42)	
Hot water usage for mixer showers													0.0000 (42a)
Hot water usage for baths													79.8726 (42b)
Hot water usage for other uses													43.0973 (42c)
Average daily hot water use (litres/day)												113.2402 (43)	
Daily hot water use													122.9699 (44)
Energy content (annual)													181.0330 (45)
Distribution loss (46)m = 0.15 x (45)m												27.1549 (46)	
Water storage loss:													
Store volume													210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):													
Temperature factor from Table 2b													1.7700 (48)
Enter (49) or (54) in (55)													0.5400 (49)
Total storage loss													0.9558 (55)
If cylinder contains dedicated solar storage													29.6298 (56)
Primary loss													23.2624 (57)
Combi loss													0.0000 (59)
Total heat required for water heating calculated for each month													233.9252 (62)
WWHRS													0.0000 (63a)
PV diverter													-9.9290 (63b)
Solar input													0.0000 (63c)
FGHRS													0.0000 (63d)
Output from w/h													223.9961 (64)
Total per year (kWh/year)												1783.5054 (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													102.5072 (65)

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

Metabolic gains (Table 5), Watts													
(66)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	138.9870	138.9870	138.9870	138.9870	138.9870	138.9870	138.9870	138.9870	138.9870	138.9870	138.9870	138.9870	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	133.0882	147.3477	133.0882	137.5245	133.0882	137.5245	133.0882	133.0882	137.5245	133.0882	137.5245	133.0882	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	263.8623	266.6004	259.7005	245.0116	226.4694	209.0425	197.4001	194.6621	201.5619	216.2509	234.7930	252.2200	(69)
Pumps, fans	36.8987	36.8987	36.8987	36.8987	36.8987	36.8987	36.8987	36.8987	36.8987	36.8987	36.8987	36.8987	(70)
Losses e.g. evaporation (negative values) (Table 5)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(71)
Water heating gains (Table 5)	-111.1896	-111.1896	-111.1896	-111.1896	-111.1896	-111.1896	-111.1896	-111.1896	-111.1896	-111.1896	-111.1896	-111.1896	(72)
Total internal gains	137.7785	135.5675	131.5377	124.9052	119.5854	112.4919	107.1098	112.7621	115.4582	122.5774	131.1106	137.5391	(73)
	599.4251	614.2116	589.0225	572.1374	543.8392	523.7550	502.2943	505.2085	519.2407	536.6126	568.1242	587.5434	(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	8.3200	10.6334	0.6300	0.7000	0.7700	27.0375 (74)						
East	4.6400	19.6403	0.6300	0.7000	0.7700	27.8508 (76)						
South	15.7800	46.7521	0.6300	0.7000	0.7700	225.4653 (78)						
Solar gains	280.3535	475.4061	647.8883	803.5003	904.3243	900.6714	867.0699	790.7618	701.2679	524.4291	335.3341	240.2657 (83)
Total gains	879.7787	1089.6177	1236.9108	1375.6377	1448.1635	1424.4263	1369.3641	1295.9702	1220.5086	1061.0417	903.4583	827.8091 (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	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(85)
	37.0055	37.0527	37.0991	37.3185	37.3598	37.5535	37.5535	37.5896	37.4787	37.3598	37.2763	37.1894	(85)

# Full SAP Calculation Printout



alpha	3.4670	3.4702	3.4733	3.4879	3.4907	3.5036	3.5036	3.5060	3.4986	3.4907	3.4851	3.4793
util living area	0.9737	0.9474	0.9058	0.8236	0.6990	0.5376	0.4010	0.4386	0.6413	0.8582	0.9525	0.9782 (86)
Living	19.2025	19.5520	19.9592	20.4136	20.7445	20.9246	20.9793	20.9714	20.8575	20.4113	19.7204	19.1328
Non living	17.8252	18.2626	18.7652	19.3094	19.6756	19.8525	19.8926	19.8894	19.7973	19.3232	18.4844	17.7405
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10
MIT	20.0805	19.5520	19.9592	20.4136	20.7445	20.9246	20.9793	20.9714	20.8575	20.4113	19.7204	19.3940 (87)
Th 2	19.8867	19.8880	19.8892	19.8950	19.8961	19.9011	19.9011	19.9020	19.8992	19.8961	19.8939	19.8916 (88)
util rest of house	0.9680	0.9366	0.8868	0.7890	0.6429	0.4579	0.3056	0.3407	0.5631	0.8220	0.9408	0.9735 (89)
MIT 2	19.0649	18.2626	18.7652	19.3094	19.6756	19.8525	19.8926	19.8894	19.7973	19.3232	18.4844	18.1282 (90)
Living area fraction										fLA = Living area / (4) =		0.3229 (91)
MIT	19.3928	18.6790	19.1508	19.6660	20.0208	20.1987	20.2435	20.2388	20.1396	19.6745	18.8835	18.5369 (92)
Temperature adjustment												0.0000
adjusted MIT	19.3928	18.6790	19.1508	19.6660	20.0208	20.1987	20.2435	20.2388	20.1396	19.6745	18.8835	18.5369 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9649	0.9217	0.8717	0.7810	0.6497	0.4803	0.3360	0.3715	0.5812	0.8136	0.9270	0.9657 (94)
Useful gains	848.9298	1004.2872	1078.1689	1074.3884	940.8301	684.1390	460.0746	481.4679	709.4057	863.2584	837.5050	799.4381 (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	1964.1754	1790.9084	1642.2168	1389.3291	1072.5908	717.9821	467.2469	491.8148	776.0737	1169.7582	1522.3603	1856.5770 (97)
Space heating kWh	829.7427	528.6095	419.6516	226.7574	98.0299	0.0000	0.0000	0.0000	0.0000	228.0359	493.0958	786.5113 (98a)
Space heating requirement - total per year (kWh/year)												3610.4340
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	829.7427	528.6095	419.6516	226.7574	98.0299	0.0000	0.0000	0.0000	0.0000	228.0359	493.0958	786.5113 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3610.4340
Space heating per m2										(98c) / (4) =		34.4507 (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 %)												271.1944 (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	829.7427	528.6095	419.6516	226.7574	98.0299	0.0000	0.0000	0.0000	0.0000	228.0359	493.0958	786.5113 (98)
Space heating efficiency (main heating system 1)	271.1944	271.1944	271.1944	271.1944	271.1944	0.0000	0.0000	0.0000	0.0000	271.1944	271.1944	271.1944 (210)
Space heating fuel (main heating system)	305.9587	194.9190	154.7420	83.6143	36.1475	0.0000	0.0000	0.0000	0.0000	84.0858	181.8237	290.0175 (211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)
Water heating												
Water heating requirement	223.9961	185.2993	175.8404	130.0919	100.8333	77.8238	72.5298	101.0904	123.0631	168.7403	198.5817	225.6153 (64)
Efficiency of water heater (217)m	171.1358	171.1358	171.1358	171.1358	171.1358	171.1358	171.1358	171.1358	171.1358	171.1358	171.1358	171.1358 (216)
Fuel for water heating, kWh/month	130.8879	108.2761	102.7490	76.0168	58.9200	45.4749	42.3814	59.0703	71.9096	98.6002	116.0375	131.8341 (219)
Space cooling fuel requirement												
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (231)
Lighting	36.7175	29.4561	26.5220	19.4311	15.0092	12.2626	13.6919	17.7972	23.1168	30.3305	34.2582	37.7380 (232)
Electricity generated by PVs (Appendix M) (negative quantity)	-38.9395	-57.7341	-86.6490	-99.0900	-105.3891	-94.2080	-92.5937	-88.0944	-77.5271	-66.0442	-43.3773	-33.1700 (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)	-0.1147	-1.9355	-6.6747	-15.6696	-27.6458	-33.2840	-32.9787	-26.2818	-17.8434	-6.1672	-1.1895	-0.1059 (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												1331.3085 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												171.1358
Water heating fuel used												1042.1578 (219)
Space cooling fuel												0.0000 (221)
Electricity for pumps and fans:												
Total electricity for the above, kWh/year												0.0000 (231)
Electricity for lighting (calculated in Appendix L)												296.3311 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-1052.7072 (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												

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Energy saved or generated	-0.0000 (236)
Energy used	0.0000 (237)
Total delivered energy for all uses	1617.0903 (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	1331.3085	0.1560	207.6261 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1042.1578	0.1449	150.9978 (264)
Space and water heating			358.6238 (265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (267)
Energy for lighting	296.3311	0.1443	42.7697 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-882.8164	0.1345	-118.7696
PV Unit electricity exported	-169.8908	0.1152	-19.5641
Total			-138.3337 (269)
Total CO2, kg/year			263.0599 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			2.5100 (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	1331.3085	1.5773	2099.9030 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1042.1578	1.5359	1600.6899 (278)
Space and water heating			3700.5929 (279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (281)
Energy for lighting	296.3311	1.5338	454.5226 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-882.8164	1.4972	-1321.7803
PV Unit electricity exported	-169.8908	0.4221	-71.7042
Total			-1393.4845 (283)
Total Primary energy kWh/year			2761.6310 (286)
Dwelling Primary energy Rate (DPER)			26.3500 (287)

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

### 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	104.8000 (1b)	x 2.4300 (2b)	= 254.6640 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	104.8000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	254.6640 (5)

### 2. Ventilation rate

Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	4 * 10 =	40.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1571 (8)
Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design AP50	5.0000 (17)	
Infiltration rate	0.4071 (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) =	0.4071 (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	0.5190	0.5088	0.4987	0.4478	0.4376	0.3867	0.3867	0.3765	0.4071	0.4376	0.4580	0.4783 (22b)
Effective ac	0.6347	0.6295	0.6243	0.6003	0.5957	0.5748	0.5748	0.5709	0.5829	0.5957	0.6049	0.6144 (25)

### 3. Heat losses and heat loss parameter

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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)			26.2000	1.1450	30.0000		(27)
Heatloss Floor 1			104.8000	0.1300	13.6240		(28a)
External Wall 1	109.8400	26.2000	83.6400	0.1800	15.0552		(29a)
External Roof 1	104.8000		104.8000	0.1100	11.5280		(30)
Total net area of external elements Aum(A, m2)			319.4400				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	70.2072	(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 165.4313 (35)

List of Thermal Bridges	Length	Psi-value	Total
K1 Element	15.8100	0.0500	0.7905
E1 Steel lintel with perforated steel base plate	4.9500	0.0500	0.2475
E3 Sill	41.4000	0.0500	2.0700
E4 Jamb	45.2000	0.1600	7.2320
E5 Ground floor (normal)	45.2000	0.0600	2.7120
E10 Eaves (insulation at ceiling level)	12.1500	0.0900	1.0935
E16 Corner (normal)	2.4300	-0.0900	-0.2187
E17 Corner (inverted - internal area greater than external area)			

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 13.9268 (36)

Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	84.1340 (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	53.3386	52.8991	52.4682	50.4446	50.0660	48.3036	48.3036	47.9772	48.9824	50.0660	50.8320	51.6327 (38)
Average = Sum(39)m / 12 =	137.4726	137.0331	136.6022	134.5786	134.2000	132.4376	132.4376	132.1112	133.1164	134.2000	134.9660	135.7667 (39)

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.3118	1.3076	1.3035	1.2841	1.2805	1.2637	1.2637	1.2606	1.2702	1.2805	1.2878	1.2955 (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												
Hot water usage for mixer showers	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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 (42)
Hot water usage for baths	81.6938	80.4805	78.7720	75.6217	73.2629	70.6473	69.2345	70.9311	72.7783	75.5771	78.7922	81.4176 (42b)
Hot water usage for other uses	43.0973	41.5301	39.9630	38.3958	36.8286	35.2614	35.2614	36.8286	38.3958	39.9630	41.5301	43.0973 (42c)
Average daily hot water use (litres/day)	124.7911	122.0106	118.7349	114.0175	110.0915	105.9087	104.4959	107.7597	111.1741	115.5401	120.3223	124.5149 (44)
Energy content (annual)	197.6386	173.7415	182.4912	156.0843	148.2043	130.2271	126.3787	133.4290	137.0888	156.7868	171.4212	194.9603 (45)
Distribution loss (46)m = 0.15 x (45)m	29.6458	26.0612	27.3737	23.4126	22.2306	19.5341	18.9568	20.0143	20.5633	23.5180	25.7132	29.2440 (46)
Water storage loss:												210.0000 (47)
Store volume												1.7016 (48)
a) If manufacturer declared loss factor is known (kWh/day):												0.5400 (49)
Temperature factor from Table 2b												0.9188 (55)
Enter (49) or (54) in (55)												
Total storage loss	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842 (56)
If cylinder contains dedicated solar storage	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842 (57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)
Total heat required for water heating calculated for each month	249.3852	220.4804	234.2378	206.1616	199.9509	180.3045	178.1253	185.1756	187.1661	208.5334	221.4986	246.7068 (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	249.3852	220.4804	234.2378	206.1616	199.9509	180.3045	178.1253	185.1756	187.1661	208.5334	221.4986	246.7068 (64)
Total per year (kWh/year)												2517.7262 (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	107.1121	95.1601	102.0756	91.9599	90.6752	83.3624	83.4182	85.7624	85.6439	93.5289	97.0594	106.2216 (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	133.0882	147.3477	133.0882	137.5245	133.0882	137.5245	133.0882	133.0882	137.5245	133.0882	137.5245	133.0882 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	263.8623	266.6004	259.7005	245.0116	226.4694	209.0425	197.4001	194.6621	201.5619	216.2509	234.7930	252.2200 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.8987	36.8987	36.8987	36.8987	36.8987	36.8987	36.8987	36.8987	36.8987	36.8987	36.8987	36.8987 (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)	-111.1896	-111.1896	-111.1896	-111.1896	-111.1896	-111.1896	-111.1896	-111.1896	-111.1896	-111.1896	-111.1896	-111.1896 (71)
Water heating gains (Table 5)	143.9679	141.6074	137.1984	127.7221	121.8753	115.7811	112.1212	115.2721	118.9499	125.7109	134.8048	142.7709 (72)
Total internal gains	608.6145	623.2515	597.6832	577.9543	549.1290	527.0442	507.3057	507.7185	522.7324	542.7460	574.8184	595.7752 (73)

#### 6. Solar gains



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[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		7.5800	10.6334	0.6300	0.7000	0.7700	24.6327 (74)
East		4.2300	19.6403	0.6300	0.7000	0.7700	25.3898 (76)
South		14.3900	46.7521	0.6300	0.7000	0.7700	205.6049 (78)

Solar gains	255.6274	433.4701	590.7184	732.5662	824.4589	821.1152	790.4873	720.9406	639.3767	478.1636	305.7577	219.0760 (83)
Total gains	864.2419	1056.7216	1188.4016	1310.5204	1373.5880	1348.1594	1297.7930	1228.6590	1162.1091	1020.9096	880.5760	814.8512 (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	35.0316	35.1440	35.2548	35.7849	35.8859	36.3635	36.3635	36.4533	36.1780	35.8859	35.6822	35.4718
alpha	3.3354	3.3429	3.3503	3.3857	3.3924	3.4242	3.4242	3.4302	3.4119	3.3924	3.3788	3.3648
util living area	0.9757	0.9536	0.9190	0.8476	0.7340	0.5741	0.4326	0.4712	0.6754	0.8755	0.9572	0.9796 (86)
MIT	19.0503	19.3896	19.8049	20.3007	20.6757	20.8999	20.9711	20.9610	20.8189	20.3213	19.6053	19.0021 (87)
Th 2	19.8316	19.8349	19.8381	19.8533	19.8561	19.8694	19.8694	19.8718	19.8643	19.8561	19.8504	19.8444 (88)
util rest of house	0.9703	0.9437	0.9016	0.8151	0.6781	0.4899	0.3284	0.3652	0.5955	0.8415	0.9464	0.9751 (89)
MIT 2	17.5983	18.0258	18.5428	19.1495	19.5732	19.8043	19.8576	19.8545	19.7332	19.1913	18.3130	17.5456 (90)
Living area fraction									FLA = Living area / (4) = 0.3229 (91)			
MIT	18.0672	18.4662	18.9503	19.5213	19.9292	20.1581	20.2171	20.2118	20.0838	19.5562	18.7303	18.0159 (92)
Temperature adjustment												0.0000
adjusted MIT	18.0672	18.4662	18.9503	19.5213	19.9292	20.1581	20.2171	20.2118	20.0838	19.5562	18.7303	18.0159 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9588	0.9285	0.8852	0.8043	0.6820	0.5125	0.3614	0.3983	0.6122	0.8308	0.9324	0.9649 (94)
Useful gains	828.6772	981.2164	1051.9936	1054.0185	936.8343	690.9119	468.9595	489.3680	711.3897	848.2196	821.0087	786.2248 (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	1892.6072	1859.0140	1700.7400	1429.3940	1104.3533	736.0996	479.0407	503.5822	796.5401	1201.9175	1569.6897	1875.7434 (97)
Space heating kWh	791.5639	589.8800	482.6674	270.2704	124.6342	0.0000	0.0000	0.0000	0.0000	263.1513	539.0503	810.6018 (98a)
Space heating requirement - total per year (kWh/year)												3871.8193
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	791.5639	589.8800	482.6674	270.2704	124.6342	0.0000	0.0000	0.0000	0.0000	263.1513	539.0503	810.6018 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3871.8193
Space heating per m2												(98c) / (4) = 36.9448 (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	791.5639	589.8800	482.6674	270.2704	124.6342	0.0000	0.0000	0.0000	0.0000	263.1513	539.0503	810.6018 (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)	857.5990	639.0900	522.9332	292.8173	135.0316	0.0000	0.0000	0.0000	0.0000	285.1043	584.0199	878.2252 (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	249.3852	220.4804	234.2378	206.1616	199.9509	180.3045	178.1253	185.1756	187.1661	208.5334	221.4986	246.7068 (64)
Efficiency of water heater (217)m	86.4638	86.1563	85.6440	84.6679	83.0313	79.8000	79.8000	79.8000	79.8000	84.5826	85.9760	79.8000 (216)
Fuel for water heating, kWh/month	288.4273	255.9076	273.5015	243.4943	240.8138	225.9455	223.2147	232.0496	234.5440	246.5440	257.6283	86.5231 (217)
Space cooling fuel requirement												
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	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	27.6531	22.1843	19.9745	14.6342	11.3039	9.2354	10.3118	13.4036	17.4100	22.8429	25.8010	28.4217 (232)
Electricity generated by PVs (Appendix M) (negative quantity)	-77.9206	-101.0222	-133.6688	-137.9641	-139.1317	-126.5139	-124.8134	-122.2337	-116.7675	-109.0749	-82.3914	-68.4426 (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)	-75.5272	-153.7514	-296.6809	-433.4086	-561.9116	-560.6945	-554.1741	-474.2649	-354.4746	-215.6664	-99.3691	-60.1344 (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												4194.8205 (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	79.8000	
Water heating fuel used	3007.2050	(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)	223.1764	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-5180.0026	(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	2331.1993	(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	4194.8205	0.2100	880.9123 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	3007.2050	0.2100	631.5130 (264)
Space and water heating			1512.4253 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	223.1764	0.1443	32.2113 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1339.9448	0.1364	-182.8134
PV Unit electricity exported	-3840.0578	0.1267	-486.6517
Total			-669.4651 (269)
Total CO2, kg/year			887.1008 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			8.4600 (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	4194.8205	1.1300	4740.1472 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	3007.2050	1.1300	3398.1416 (278)
Space and water heating			8138.2888 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	223.1764	1.5338	342.3154 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1339.9448	1.5043	-2015.7258
PV Unit electricity exported	-3840.0578	0.4652	-1786.4855
Total			-3802.2113 (283)
Total Primary energy kWh/year			4808.4936 (286)
Target Primary Energy Rate (TPER)			45.8800 (287)

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

### 1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	104.8000 (1b)	x 2.4300 (2b)	= 254.6640 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	104.8000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 254.6640 (5)

### 2. Ventilation rate

	m3 per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	4 * 10 = 40.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) = 0.1571 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.4071 (18)
Number of sides sheltered	0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 1.0000 (20)

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Infiltration rate adjusted to include shelter factor												(21) = (18) x (20) =	0.4071 (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)
	0.5190	0.5088	0.4987	0.4478	0.4376	0.3867	0.3867	0.3765	0.4071	0.4376	0.4580	0.4783	(22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)													
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =													
Effective ac	0.6347	0.6295	0.6243	0.6003	0.5957	0.5748	0.5748	0.5709	0.5829	0.5957	0.6049	0.6144	(25)

### 3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1 (Uw = 1.20)			28.7400	1.1450	32.9084			(27)
Heatloss Floor 1			104.8000	0.1000	10.4800	110.0000	11528.0000	(28a)
External Wall 1	109.8400	28.7400	81.1000	0.1700	13.7870	60.0000	4866.0000	(29a)
External Roof 1	104.8000		104.8000	0.1000	10.4800	9.0000	943.2000	(30)
Total net area of external elements Aum(A, m2)			319.4400					(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	67.6554		(33)
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) =	17337.2000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K								165.4313 (35)

#### List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	15.8100	0.4000	6.3240
E3 Sill	4.9500	0.0420	0.2079
E4 Jamb	41.4000	0.0460	1.9044
E5 Ground floor (normal)	45.2000	0.0570	2.5764
E10 Eaves (insulation at ceiling level)	45.2000	0.1080	4.8816
E16 Corner (normal)	12.1500	0.0370	0.4496
E17 Corner (inverted - internal area greater than external area)	2.4300	-0.0610	-0.1482
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			16.1956 (36)
Point Thermal bridges			(36a) = 0.0000
Total fabric heat loss			(33) + (36) + (36a) = 83.8510 (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	53.3386	52.8991	52.4682	50.4446	50.0660	48.3036	48.3036	47.9772	48.9824	50.0660	50.8320	51.6327 (38)
Average = Sum(39)m / 12 =	137.1896	136.7501	136.3193	134.2957	133.9171	132.1546	132.1546	131.8282	132.8335	133.9171	134.6830	135.4837 (39)
												134.2939
HLP	1.3091	1.3049	1.3008	1.2814	1.2778	1.2610	1.2610	1.2579	1.2675	1.2778	1.2851	1.2928 (40)
HLP (average)												1.2814
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

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

Assumed occupancy												2.7797 (42)
Hot water usage for mixer showers												0.0000 (42a)
Hot water usage for baths												29.8994 (42b)
Hot water usage for other uses												43.0973 (42c)
Average daily hot water use (litres/day)												66.9032 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	72.9967	70.9782	68.7689	66.2402	63.8064	61.0462	60.1412	62.8151	64.9631	67.7123	70.5085	72.9730 (44)
Energy content (annual)	107.4637	93.9185	98.2693	86.5262	82.2210	70.5979	66.4578	73.9345	75.3539	87.2542	95.2945	107.1662 (45)
Distribution loss (46)m = 0.15 x (45)m												Total = Sum(45)m = 1044.4577
Water storage loss:												0.0000 (46)
Total storage loss												0.0000 (56)
If cylinder contains dedicated solar storage												0.0000 (57)
Primary loss												0.0000 (59)
Combi loss												0.0000 (61)
Total heat required for water heating calculated for each month	91.3442	79.8307	83.5289	73.5473	69.8878	60.0083	56.4891	62.8443	64.0509	74.1660	81.0003	91.0912 (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	91.3442	79.8307	83.5289	73.5473	69.8878	60.0083	56.4891	62.8443	64.0509	74.1660	81.0003	91.0912 (64)
12Total per year (kWh/year)												Total per year (kWh/year) = Sum(64)m = 887.7891 (64)
Electric shower(s)												888 (64)
Heat gains from water heating, kWh/month	56.7205	50.5385	55.1861	52.6634	53.6516	51.1784	52.8844	53.6516	52.6634	55.1861	54.1484	56.7205 (64a)
												Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 645.1928 (64a)
	37.0162	32.5923	34.6788	31.5527	30.8849	27.7967	27.3434	29.1240	29.1786	32.3380	33.7872	36.9529 (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	138.9870	138.9870	138.9870	138.9870	138.9870	138.9870	138.9870	138.9870	138.9870	138.9870	138.9870	138.9870 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	133.0882	147.3477	133.0882	137.5245	133.0882	137.5245	133.0882	133.0882	137.5245	133.0882	137.5245	133.0882 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	263.8623	266.6004	259.7005	245.0116	226.4694	209.0425	197.4001	194.6621	201.5619	216.2509	234.7930	252.2200 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												

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Pumps, fans	36.8987	36.8987	36.8987	36.8987	36.8987	36.8987	36.8987	36.8987	36.8987	36.8987	36.8987	36.8987 (69)
Losses e.g. evaporation	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)												
Water heating gains (Table 5)	-111.1896	-111.1896	-111.1896	-111.1896	-111.1896	-111.1896	-111.1896	-111.1896	-111.1896	-111.1896	-111.1896	-111.1896 (71)
49.7529	48.5004	46.6112	43.8231	41.5119	38.6065	36.7518	39.1451	40.5258	43.4651	46.9266	49.6679	(72)
Total internal gains	511.3995	527.1446	504.0961	491.0553	465.7657	449.8695	431.9363	431.5915	444.3083	457.5003	483.9402	499.6722 (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	8.3200	10.6334	0.6300	0.7000	0.7700	27.0375 (74)						
East	4.6400	19.6403	0.6300	0.7000	0.7700	27.8508 (76)						
South	15.7800	46.7521	0.6300	0.7000	0.7700	225.4653 (78)						
Solar gains	280.3535	475.4061	647.8883	803.5003	904.3243	900.6714	867.0699	790.7618	701.2679	524.4291	335.3341	240.2657 (83)
Total gains	791.7531	1002.5507	1151.9844	1294.5556	1370.0900	1350.5409	1299.0062	1222.3533	1145.5762	981.9293	819.2743	739.9379 (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	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
alpha	35.1039	35.2167	35.3280	35.8603	35.9617	36.4413	36.4413	36.5316	36.2551	35.9617	35.7572	35.5459
util living area	3.3403	3.3478	3.3552	3.3907	3.3974	3.4294	3.4294	3.4354	3.4170	3.3974	3.3838	3.3697
MIT	0.9810	0.9596	0.9247	0.8510	0.7344	0.5725	0.4315	0.4726	0.6810	0.8854	0.9647	0.9846 (86)
MIT 2	18.9660	19.3333	19.7734	20.2925	20.6763	20.9013	20.9715	20.9609	20.8149	20.2918	19.5387	18.9132 (87)
Th 2	19.8337	19.8370	19.8402	19.8554	19.8582	19.8715	19.8715	19.8740	19.8664	19.8582	19.8525	19.8465 (88)
util rest of house	0.9767	0.9508	0.9082	0.8189	0.6787	0.4886	0.3277	0.3665	0.6012	0.8532	0.9555	0.9811 (89)
MIT 2	18.0100	18.3723	18.8009	19.2995	19.6381	19.8215	19.8624	19.8604	19.7617	19.3141	18.5898	17.9669 (90)
Living area fraction	18.3187	18.6826	19.1149	19.6202	19.9733	20.1702	20.2205	20.2158	20.1017	19.6298	18.8962	18.2725 (92)
MIT	18.3187	18.6826	19.1149	19.6202	19.9733	20.1702	20.2205	20.2158	20.1017	19.6298	18.8962	18.2725 (93)
Temperature adjustment												0.0000
adjusted MIT	18.3187	18.6826	19.1149	19.6202	19.9733	20.1702	20.2205	20.2158	20.1017	19.6298	18.8962	18.2725 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9690	0.9396	0.8957	0.8114	0.6848	0.5119	0.3607	0.3998	0.6191	0.8455	0.9455	0.9744 (94)
Useful gains	767.2028	941.9502	1031.8443	1050.4182	938.2003	691.2843	468.5148	488.7313	709.2485	830.2333	774.6279	720.9835 (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	1923.2230	1884.7690	1719.6529	1439.6702	1107.9401	736.1222	478.4698	503.0247	797.2325	1209.2432	1588.7535	1906.5933 (97)
Space heating kWh	860.0790	633.5743	511.7296	280.2614	126.2865	0.0000	0.0000	0.0000	0.0000	281.9834	586.1705	882.0937 (98a)
Space heating requirement - total per year (kWh/year)												4162.1784
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	860.0790	633.5743	511.7296	280.2614	126.2865	0.0000	0.0000	0.0000	0.0000	281.9834	586.1705	882.0937 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4162.1784
Space heating per m2												(98c) / (4) = 39.7154 (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	1242.2530	977.9439	1001.8943	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8462	0.9006	0.8798	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1051.2414	880.7282	881.4669	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1525.0406	1467.4727	1380.3608	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	341.1354	436.5379	371.1770	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction												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	85.2838	109.1345	92.7943	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement												287.2126 (107)
Energy for space heating												39.7154 (99)
Energy for space cooling												2.7406 (108)
Total												42.4560 (109)
Fabric Energy Efficiency (DFEE)												42.5 (109)

# Full SAP Calculation Printout



## 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	104.8000	2.4300	254.6640
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	104.8000		
Dwelling volume			254.6640

## 2. Ventilation rate

	m <sup>3</sup> per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	4 * 10 = 40.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000	Air changes per hour	0.1571 (8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.4071	(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) =		0.4071 (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
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
Adj infilt rate	0.5190	0.5088	0.4987	0.4478	0.4376	0.3867	0.3867	0.3765	0.4071	0.4376	0.4580	0.4783
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.0000
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												0.0000
Effective ac	0.6347	0.6295	0.6243	0.6003	0.5957	0.5748	0.5748	0.5709	0.5829	0.5957	0.6049	0.6144

## 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
TER Opening Type (Uw = 1.20)			26.2000	1.1450	30.0000		
Heatloss Floor 1			104.8000	0.1300	13.6240		(27)
External Wall 1	109.8400	26.2000	83.6400	0.1800	15.0552		(28a)
External Roof 1	104.8000		104.8000	0.1100	11.5280		(29a)
Total net area of external elements Aum(A, m <sup>2</sup> )			319.4400				(30)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	70.2072	(31)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							(33)
List of Thermal Bridges							165.4313 (35)

Element	Length	Psi-value	Total
K1 Element	15.8100	0.0500	0.7905
E1 Steel lintel with perforated steel base plate	4.9500	0.0500	0.2475
E3 Sill	41.4000	0.0500	2.0700
E4 Jamb	45.2000	0.1600	7.2320
E5 Ground floor (normal)	45.2000	0.0600	2.7120
E10 Eaves (insulation at ceiling level)	12.1500	0.0900	1.0935
E16 Corner (normal)	2.4300	-0.0900	-0.2187
E17 Corner (inverted - internal area greater than external area)			
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			13.9268 (36)
Point Thermal bridges			(36a) = 0.0000
Total fabric heat loss			(33) + (36) + (36a) = 84.1340 (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	53.3386	52.8991	52.4682	50.4446	50.0660	48.3036	48.3036	47.9772	48.9824	50.0660	50.8320	51.6327
Heat transfer coeff	137.4726	137.0331	136.6022	134.5786	134.2000	132.4376	132.4376	132.1112	133.1164	134.2000	134.9660	135.7667
Average = Sum(39)m / 12 =												134.5768
HLP	1.3118	1.3076	1.3035	1.2841	1.2805	1.2637	1.2637	1.2606	1.2702	1.2805	1.2878	1.2955
HLP (average)												1.2841
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Assumed occupancy												2.7797 (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	30.5811	30.1269	29.4874	28.3081	27.4251	26.4460	25.9171	26.5522	27.2437	28.2914	29.4949	30.4777
Hot water usage for other uses	43.0973	41.5301	39.9630	38.3958	36.8286	35.2614	35.2614	36.8286	38.3958	39.9630	41.5301	43.0973
Average daily hot water use (litres/day)												67.5329 (43)
Daily hot water use	73.6784	71.6571	69.4503	66.7039	64.2537	61.7074	61.1786	63.3808	65.6395	68.2544	71.0251	73.5750
Energy conte	116.6886	102.0387	106.7426	91.3143	86.4979	75.8765	73.9902	78.4787	80.9401	92.6205	101.1882	115.2007
Energy content (annual)												1121.5769
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

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Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Total heat required for water heating calculated for each month													
WWHRS	99.1853	86.7329	90.7312	77.6172	73.5232	64.4950	62.8916	66.7069	68.7991	78.7275	86.0100	97.9206	(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	99.1853	86.7329	90.7312	77.6172	73.5232	64.4950	62.8916	66.7069	68.7991	78.7275	86.0100	97.9206	(64)
12Total per year (kWh/year)													
Electric shower(s)	56.7205	50.5385	55.1861	52.6634	53.6516	51.1784	52.8844	53.6516	52.6634	55.1861	54.1484	56.7205	(64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												645.1928	(64a)
Heat gains from water heating, kWh/month	38.9765	34.3178	36.4793	32.5701	31.7937	28.9184	28.9440	30.0896	30.3656	33.4784	35.0396	38.6603	(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	138.9870	138.9870	138.9870	138.9870	138.9870	138.9870	138.9870	138.9870	138.9870	138.9870	138.9870	138.9870	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	133.0882	147.3477	133.0882	137.5245	133.0882	137.5245	133.0882	133.0882	137.5245	133.0882	137.5245	133.0882	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	263.8623	266.6004	259.7005	245.0116	226.4694	209.0425	197.4001	194.6621	201.5619	216.2509	234.7930	252.2200	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.8987	36.8987	36.8987	36.8987	36.8987	36.8987	36.8987	36.8987	36.8987	36.8987	36.8987	36.8987	(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)	-111.1896	-111.1896	-111.1896	-111.1896	-111.1896	-111.1896	-111.1896	-111.1896	-111.1896	-111.1896	-111.1896	-111.1896	(71)
Water heating gains (Table 5)	52.3877	51.0682	49.0313	45.2363	42.7335	40.1644	38.9032	40.4430	42.1745	44.9978	48.6661	51.9628	(72)
Total internal gains	514.0343	529.7123	506.5162	492.4685	466.9872	451.4274	434.0877	432.8894	445.9570	459.0330	485.6797	501.9671	(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		7.5800	10.6334	0.6300	0.7000	0.7700	24.6327 (74)						
East		4.2300	19.6403	0.6300	0.7000	0.7700	25.3898 (76)						
South		14.3900	46.7521	0.6300	0.7000	0.7700	205.6049 (78)						
Solar gains	255.6274	433.4701	590.7184	732.5662	824.4589	821.1152	790.4873	720.9406	639.3767	478.1636	305.7577	219.0760	(83)
Total gains	769.6618	963.1825	1097.2345	1225.0347	1291.4462	1272.5427	1224.5750	1153.8300	1085.3337	937.1966	791.4374	721.0430	(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	35.0316	35.1440	35.2548	35.7849	35.8859	36.3635	36.3635	36.4533	36.1780	35.8859	35.6822	35.4718	
alpha	3.3354	3.3429	3.3503	3.3857	3.3924	3.4242	3.4242	3.4302	3.4119	3.3924	3.3788	3.3648	
util living area	0.9825	0.9637	0.9332	0.8675	0.7590	0.5998	0.4555	0.4973	0.7050	0.8970	0.9680	0.9857	(86)
MIT	18.9334	19.2829	19.7132	20.2356	20.6377	20.8854	20.9661	20.9540	20.7922	20.2494	19.5016	18.8842	(87)
Th 2	19.8316	19.8349	19.8381	19.8533	19.8561	19.8694	19.8694	19.8718	19.8643	19.8561	19.8504	19.8444	(88)
util rest of house	0.9785	0.9557	0.9183	0.8376	0.7048	0.5144	0.3470	0.3872	0.6260	0.8670	0.9595	0.9824	(89)
MIT 2	17.9765	18.3219	18.7427	19.2479	19.6068	19.8105	19.8584	19.8557	19.7451	19.2751	18.5524	17.9368	(90)
Living area fraction	18.2855	18.6322	19.0561	19.5668	19.9397	20.1576	20.2161	20.2103	20.0832	19.5897	18.8589	18.2427	(91)
MIT	18.2855	18.6322	19.0561	19.5668	19.9397	20.1576	20.2161	20.2103	20.0832	19.5897	18.8589	18.2427	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2855	18.6322	19.0561	19.5668	19.9397	20.1576	20.2161	20.2103	20.0832	19.5897	18.8589	18.2427	(93)

## 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	747.4618	910.1784	993.9427	1015.4890	915.8007	683.8029	467.0102	486.4660	697.4274	804.6936	751.7474	703.7847	(94)
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	(95)
Heat loss rate W	1922.6212	1881.7665	1715.1905	1435.5271	1105.7644	736.0383	478.9094	503.3868	796.4583	1206.4208	1587.0483	1906.5335	(96)
Space heating kWh	874.3186	652.9072	536.6083	302.4275	141.3330	0.0000	0.0000	0.0000	0.0000	298.8851	601.4166	894.8451	(98a)
Space heating requirement - total per year (kWh/year)												4302.7414	
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	874.3186	652.9072	536.6083	302.4275	141.3330	0.0000	0.0000	0.0000	0.0000	298.8851	601.4166	894.8451	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4302.7414	
Space heating per m2												41.0567	(99)

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## 8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	1244.9131	980.0380	1004.0449	0.0000	0.0000	0.0000	0.0000 (100)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.8252	0.8849	0.8623	0.0000	0.0000	0.0000	0.0000 (101)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1027.2975	867.2563	865.8049	0.0000	0.0000	0.0000	0.0000 (102)
Space cooling kWh						1433.6108	1380.1120	1300.0495	0.0000	0.0000	0.0000	0.0000 (103)
Cooled fraction	0.0000	0.0000	0.0000	0.0000	0.0000	292.5456	381.5646	323.0780	0.0000	0.0000	0.0000	0.0000 (104)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500 (105)
Space cooling kWh						73.1364	95.3912	80.7695	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement												249.2971 (107)
Energy for space heating												41.0567 (99)
Energy for space cooling												2.3788 (108)
Total												43.4355 (109)
Fabric Energy Efficiency (TFEE)												43.4 (109)

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

## 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	104.8000 (1b)	2.4300 (2b)	254.6640 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	104.8000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	254.6640 (5)

## 2. Ventilation rate

	m <sup>3</sup> per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	0 * 10 = 0.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) = 0.0000 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.2500 (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) = 0.2500 (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	0.3187	0.3125	0.3063	0.2750	0.2687	0.2375	0.2375	0.2313	0.2500	0.2687	0.2812	0.2938 (22b)
Effective ac	0.5508	0.5488	0.5469	0.5378	0.5361	0.5282	0.5282	0.5267	0.5312	0.5361	0.5396	0.5431 (25)

## 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
Opening Type 1 (Uw = 1.20)			28.7400	1.1450	32.9084		(27)
Heatloss Floor 1			104.8000	0.1000	10.4800	110.0000	11528.0000 (28a)
External Wall 1	109.8400	28.7400	81.1000	0.1700	13.7870	60.0000	4866.0000 (29a)
External Roof 1	104.8000		104.8000	0.1000	10.4800	9.0000	943.2000 (30)
Total net area of external elements Aum(A, m <sup>2</sup> )			319.4400				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		67.6554		(33)
Heat capacity Cm = Sum(A x K)						(28)...(30) + (32) + (32a)...(32e) =	17337.2000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							165.4313 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value	Total	
E1 Steel lintel with perforated steel base plate				15.8100	0.4000	6.3240	
E3 Sill				4.9500	0.0420	0.2079	
E4 Jamb				41.4000	0.0460	1.9044	
E5 Ground floor (normal)				45.2000	0.0570	2.5764	
E10 Eaves (insulation at ceiling level)				45.2000	0.1080	4.8816	
E16 Corner (normal)				12.1500	0.0370	0.4496	
E17 Corner (inverted - internal area greater than external area)				2.4300	-0.0610	-0.1482	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							16.1956 (36)
Point Thermal bridges						(36a) =	0.0000
Total fabric heat loss						(33) + (36) + (36a) =	83.8510 (37)

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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	46.2888	46.1230	45.9605	45.1973	45.0545	44.3897	44.3897	44.2666	44.6458	45.0545	45.3434	45.6454	(38)
Heat transfer coeff	130.1398	129.9740	129.8116	129.0483	128.9055	128.2407	128.2407	128.1176	128.4968	128.9055	129.1944	129.4964	(39)
Average = Sum(39)m / 12 =													129.0476
HLP	1.2418	1.2402	1.2387	1.2314	1.2300	1.2237	1.2237	1.2225	1.2261	1.2300	1.2328	1.2357	(40)
HLP (average)													1.2314
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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

Assumed occupancy													2.7797	(42)
Hot water usage for mixer showers														(42a)
Hot water usage for baths														(42b)
Hot water usage for other uses														(42c)
Average daily hot water use (litres/day)														(43)
Daily hot water use	122.9699	120.1970	116.9146	112.7787	108.8965	104.1425	101.7247	106.2484	109.3672	114.0920	118.9422	122.9066	(44)	
Energy conte	181.0330	159.0450	167.0685	147.3171	140.3241	120.4373	112.4088	125.0563	126.8605	147.0191	160.7544	180.4973	(45)	
Energy content (annual)													Total = Sum(45)m =	1767.8214
Distribution loss (46)m = 0.15 x (45)m	27.1549	23.8567	25.0603	22.0976	21.0486	18.0656	16.8613	18.7584	19.0291	22.0529	24.1132	27.0746	(46)	
Water storage loss:													210.0000	(47)
Store volume													1.7700	(48)
a) If manufacturer declared loss factor is known (kWh/day):													0.5400	(49)
Temperature factor from Table 2b													0.9558	(55)
Enter (49) or (54) in (55)														
Total storage loss	29.6298	26.7624	29.6298	28.6740	29.6298	28.6740	29.6298	29.6298	28.6740	29.6298	28.6740	29.6298	(56)	
If cylinder contains dedicated solar storage	29.6298	26.7624	29.6298	28.6740	29.6298	28.6740	29.6298	29.6298	28.6740	29.6298	28.6740	29.6298	(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	233.9252	206.8186	219.9607	198.5031	193.2163	171.6233	165.3010	177.9485	178.0465	199.9113	211.9404	233.3895	(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	-9.9290	-21.5193	-44.1203	-68.4112	-92.3831	-93.7995	-92.7712	-76.8580	-54.9833	-31.1710	-13.3587	-7.7742	(63b)	
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)	
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)	
Output from w/h	223.9961	185.2993	175.8404	130.0919	100.8333	77.8238	72.5298	101.0904	123.0631	168.7403	198.5817	225.6153	(64)	
													Total per year (kWh/year) = Sum(64)m =	1783.5054
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
Heat gains from water heating, kWh/month	102.5072	91.1013	97.8640	89.9318	88.9715	80.9942	79.6897	83.8950	83.1299	91.1976	94.3996	102.3291	(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	166.7844	166.7844	166.7844	166.7844	166.7844	166.7844	166.7844	166.7844	166.7844	166.7844	166.7844	166.7844	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	41.9487	37.2585	30.3006	22.9395	17.1476	14.4767	15.6426	20.3328	27.2907	34.6518	40.4438	43.1146	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	393.8243	397.9110	387.6127	365.6889	338.0141	312.0037	294.6271	290.5404	300.8387	322.7625	350.4373	376.4477	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.4582	54.4582	54.4582	54.4582	54.4582	54.4582	54.4582	54.4582	54.4582	54.4582	54.4582	54.4582	(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)	-111.1896	-111.1896	-111.1896	-111.1896	-111.1896	-111.1896	-111.1896	-111.1896	-111.1896	-111.1896	-111.1896	-111.1896	(71)
Water heating gains (Table 5)	137.7785	135.5675	131.5377	124.9052	119.5854	112.4919	107.1098	112.7621	115.4582	122.5774	131.1106	137.5391	(72)
Total internal gains	683.6046	680.7899	659.5040	623.5867	584.8000	549.0253	527.4324	533.6883	553.6405	590.0447	632.0446	667.1545	(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	8.3200	10.6334	0.6300	0.7000	0.7700	27.0375							
East	4.6400	19.6403	0.6300	0.7000	0.7700	27.8508							
South	15.7800	46.7521	0.6300	0.7000	0.7700	225.4653							
Solar gains	280.3535	475.4061	647.8883	803.5003	904.3243	900.6714	867.0699	790.7618	701.2679	524.4291	335.3341	240.2657	(83)
Total gains	963.9581	1156.1960	1307.3923	1427.0869	1489.1244	1449.6966	1394.5023	1324.4501	1254.9084	1114.4737	967.3788	907.4201	(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	37.0055	37.0527	37.0991	37.3185	37.3598	37.5535	37.5535	37.5896	37.4787	37.3598	37.2763	37.1894		
alpha	3.4670	3.4702	3.4733	3.4879	3.4907	3.5036	3.5036	3.5060	3.4986	3.4907	3.4851	3.4793		
util living area														



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	0.9659	0.9386	0.8929	0.8108	0.6868	0.5299	0.3943	0.4301	0.6287	0.8430	0.9430	0.9716 (86)
Living	19.3042	19.6242	20.0233	20.4465	20.7588	20.9279	20.9803	20.9731	20.8662	20.4509	19.7912	19.2311
Non living	17.9524	18.3511	18.8409	19.3453	19.6890	19.8548	19.8931	19.8902	19.8041	19.3663	18.5707	17.8639
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10
MIT	20.1325	19.6242	20.0233	20.4465	20.7588	20.9279	20.9803	20.9731	20.8662	20.4509	19.7912	19.4785 (87)
Th 2	19.8867	19.8880	19.8892	19.8950	19.8961	19.9011	19.9011	19.9020	19.8992	19.8961	19.8939	19.8916 (88)
util rest of house												
	0.9587	0.9264	0.8720	0.7749	0.6303	0.4508	0.3003	0.3337	0.5507	0.8046	0.9295	0.9656 (89)
MIT 2	19.1156	18.3511	18.8409	19.3453	19.6890	19.8548	19.8931	19.8902	19.8041	19.3663	18.5707	18.2293 (90)
Living area fraction									FLA = Living area / (4) =			0.3229 (91)
MIT	19.4439	18.7622	19.2227	19.7009	20.0345	20.2013	20.2442	20.2399	20.1471	19.7165	18.9648	18.6327 (92)
Temperature adjustment												0.0000
adjusted MIT	19.4439	18.7622	19.2227	19.7009	20.0345	20.2013	20.2442	20.2399	20.1471	19.7165	18.9648	18.6327 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9554	0.9109	0.8573	0.7679	0.6379	0.4732	0.3303	0.3641	0.5693	0.7975	0.9151	0.9566	(94)
Useful gains	920.9324	1053.1527	1120.7862	1095.9026	949.8800	685.9965	460.5381	482.2417	714.4752	888.7420	885.2027	868.0829	(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	1970.8272	1801.7296	1651.5551	1393.8377	1074.3574	718.3201	467.3311	491.9547	777.0285	1175.1643	1532.8673	1868.9809	(97)
Space heating kWh	781.1217	503.0437	394.8921	214.5132	92.6112	0.0000	0.0000	0.0000	0.0000	213.0982	466.3185	744.6681	(98a)
Space heating requirement - total per year (kWh/year)													3410.2668
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	781.1217	503.0437	394.8921	214.5132	92.6112	0.0000	0.0000	0.0000	0.0000	213.0982	466.3185	744.6681	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)													3410.2668
Space heating per m2										(98c) / (4) =			32.5407 (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 %)														271.1944	(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	781.1217	503.0437	394.8921	214.5132	92.6112	0.0000	0.0000	0.0000	0.0000	213.0982	466.3185	744.6681	(98)		
Space heating efficiency (main heating system 1)	271.1944	271.1944	271.1944	271.1944	271.1944	0.0000	0.0000	0.0000	0.0000	271.1944	271.1944	271.1944	(210)		
Space heating fuel (main heating system)	288.0302	185.4919	145.6122	79.0994	34.1494	0.0000	0.0000	0.0000	0.0000	78.5777	171.9499	274.5883	(211)		
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)		
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)		
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)		
Water heating															
Water heating requirement	223.9961	185.2993	175.8404	130.0919	100.8333	77.8238	72.5298	101.0904	123.0631	168.7403	198.5817	225.6153	(64)		
Efficiency of water heater (217)m	171.1358	171.1358	171.1358	171.1358	171.1358	171.1358	171.1358	171.1358	171.1358	171.1358	171.1358	171.1358	(216)		
Fuel for water heating, kWh/month	130.8879	108.2761	102.7490	76.0168	58.9200	45.4749	42.3814	59.0703	71.9096	98.6002	116.0375	131.8341	(219)		
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)		
Pumps and Fa	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(231)		
Lighting	36.7175	29.4561	26.5220	19.4311	15.0092	12.2626	13.6919	17.7972	23.1168	30.3305	34.2582	37.7380	(232)		
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-38.8233	-57.5656	-86.3060	-98.7626	-105.1605	-94.2080	-92.5937	-88.0944	-77.5271	-65.8531	-43.2617	-33.0881	(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	-0.2310	-2.1040	-7.0177	-15.9969	-27.8744	-33.2840	-32.9787	-26.2818	-17.8434	-6.3583	-1.3051	-0.1878	(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														1257.4990	(211)
Space heating fuel - main system 2														0.0000	(213)
Space heating fuel - secondary														0.0000	(215)
Efficiency of water heater														171.1358	(217)
Water heating fuel used														1042.1578	(219)
Space cooling fuel														0.0000	(221)
Electricity for pumps and fans:															
Total electricity for the above, kWh/year														0.0000	(231)
Electricity for lighting (calculated in Appendix L)														296.3311	(232)
Energy saving/generation technologies (Appendices M ,N and Q)															
PV generation														-1052.7072	(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 1543.2808 (238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	1257.4990	16.4900	207.3616 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1042.1578	16.4900	171.8518 (247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000 (247a)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (249)
Energy for lighting	296.3311	16.4900	48.8650 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-881.2439	16.4900	-145.3171
PV Unit electricity exported	-171.4632	5.5900	-9.5848
Total			-154.9019 (252)
Total energy cost			273.1765 (255)

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

Energy cost deflator (Table 12):		0.3600 (256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	0.6565 (257)
SAP value		89.3582
SAP rating (Section 12)		89 (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	1257.4990	0.1560	196.1341 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1042.1578	0.1449	150.9978 (264)
Space and water heating			347.1319 (265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (267)
Energy for lighting	296.3311	0.1443	42.7697 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-881.2439	0.1345	-118.5374
PV Unit electricity exported	-171.4632	0.1156	-19.8206
Total			-138.3580 (269)
Total CO2, kg/year			251.5437 (272)
CO2 emissions per m2			2.4000 (273)
EI value			97.7499
EI rating			98 (274)
EI band			A

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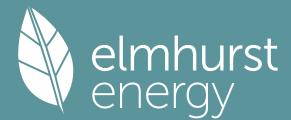
-----  
 1. Overall dwelling characteristics  
 -----

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	104.8000 (1b)	x 2.4300 (2b)	= 254.6640 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	104.8000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	254.6640 (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)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000 (8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000 (17)	
Infiltration rate		0.2500 (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) =	0.2500 (21)	

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.5000	4.5000	4.4000	3.9000	3.8000	3.4000	3.3000	3.3000	3.5000	3.8000	3.9000	4.1000	(22)
Wind factor	1.1250	1.1250	1.1000	0.9750	0.9500	0.8500	0.8250	0.8250	0.8750	0.9500	0.9750	1.0250	(22a)
Adj infilt rate													
Effective ac	0.2812	0.2812	0.2750	0.2437	0.2375	0.2125	0.2062	0.2062	0.2188	0.2375	0.2437	0.2562	(22b)
	0.5396	0.5396	0.5378	0.5297	0.5282	0.5226	0.5213	0.5213	0.5239	0.5282	0.5297	0.5328	(25)

### 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K	
Opening Type 1 (Uw = 1.20)			28.7400	1.1450	32.9084			(27)
Heatloss Floor 1			104.8000	0.1000	10.4800	110.0000	11528.0000	(28a)
External Wall 1	109.8400	28.7400	81.1000	0.1700	13.7870	60.0000	4866.0000	(29a)
External Roof 1	104.8000		104.8000	0.1000	10.4800	9.0000	943.2000	(30)
Total net area of external elements Aum(A, m <sup>2</sup> )			319.4400					(31)
Fabric heat loss, W/K = Sum (A x U)					(26) ... (30) + (32) =	67.6554		(33)

Heat capacity Cm = Sum(A x k) (28) ... (30) + (32) + (32a) ... (32e) = 17337.2000 (34)  
 Thermal mass parameter (TMP = Cm / TFA) in kJ/m<sup>2</sup>K 165.4313 (35)

#### List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	15.8100	0.4000	6.3240
E3 Sill	4.9500	0.0420	0.2079
E4 Jamb	41.4000	0.0460	1.9044
E5 Ground floor (normal)	45.2000	0.0570	2.5764
E10 Eaves (insulation at ceiling level)	45.2000	0.1080	4.8816
E16 Corner (normal)	12.1500	0.0370	0.4496
E17 Corner (inverted - internal area greater than external area)	2.4300	-0.0610	-0.1482

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 16.1956 (36)  
 Point Thermal bridges (36a) = 0.0000  
 Total fabric heat loss (33) + (36) + (36a) = 83.8510 (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	45.3434	45.3434	45.1973	44.5161	44.3897	43.9170	43.8070	43.8070	44.0303	44.3897	44.5161	44.7787	(38)
Average = Sum(39)m / 12 =	129.1944	129.1944	129.0483	128.3671	128.2407	127.7680	127.6580	127.6580	127.8813	128.2407	128.3671	128.6298	(39)
												128.3540	

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP (average)	1.2328	1.2328	1.2314	1.2249	1.2237	1.2192	1.2181	1.2181	1.2202	1.2237	1.2249	1.2274	(40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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

Assumed occupancy													2.7797	(42)
Hot water usage for mixer showers														(42a)
Hot water usage for baths	79.8726	78.6669	76.9516	74.3829	72.0679	68.8810	66.4633	69.4198	70.9714	74.1291	77.4121	79.8093	(42b)	
Hot water usage for other uses	43.0973	41.5301	39.9630	38.3958	36.8286	35.2614	35.2614	36.8286	38.3958	39.9630	41.5301	43.0973	(42c)	
Average daily hot water use (litres/day)													113.2402	(43)

Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy conte	122.9699	120.1970	116.9146	112.7787	108.8965	104.1425	101.7247	106.2484	109.3672	114.0920	118.9422	122.9066	(44)
Energy content (annual)	181.0330	159.0450	167.0685	147.3171	140.3241	120.4373	112.4088	125.0563	126.8605	147.0191	160.7544	180.4973	(45)
Distribution loss (46)m = 0.15 x (45)m													1767.8214

Water storage loss: 27.1549 23.8567 25.0603 22.0976 21.0486 18.0656 16.8613 18.7584 19.0291 22.0529 24.1132 27.0746 (46)

Store volume 210.0000 (47)

a) If manufacturer declared loss factor is known (kWh/day): 1.7700 (48)

Temperature factor from Table 2b 0.5400 (49)

Enter (49) or (54) in (55) 0.9558 (55)

Total storage loss 29.6298 26.7624 29.6298 28.6740 29.6298 28.6740 29.6298 29.6298 28.6740 29.6298 28.6740 29.6298 (56)

If cylinder contains dedicated solar storage 29.6298 26.7624 29.6298 28.6740 29.6298 28.6740 29.6298 29.6298 28.6740 29.6298 28.6740 29.6298 (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 233.9252 206.8186 219.9607 198.5031 193.2163 171.6233 165.3010 177.9485 178.0465 199.9113 211.9404 233.3895 (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 -10.8256 -23.9365 -49.1937 -78.2605 -97.4723 -109.5966 -103.2878 -88.0457 -64.0860 -35.9251 -17.2135 -9.7878 (63b)

Solar input 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (63c)

FGHRS 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (63d)

Output from w/h 223.0996 182.8821 170.7671 120.2426 95.7441 62.0267 62.0132 89.9028 113.9605 163.9862 194.7269 223.6017 (64)

Total per year (kWh/year) = Sum(64)m = 1702.9534 (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)

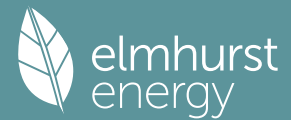
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)

Heat gains from water heating, kWh/month 102.5072 91.1013 97.8640 89.9318 88.9715 80.9942 79.6897 83.8950 83.1299 91.1976 94.3996 102.3291 (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	166.7844	166.7844	166.7844	166.7844	166.7844	166.7844	166.7844	166.7844	166.7844	166.7844	166.7844	166.7844	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	41.9487	37.2585	30.3006	22.9395	17.1476	14.4767	15.6426	20.3328	27.2907	34.6518	40.4438	43.1146	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	393.8243	397.9110	387.6127	365.6889	338.0141	312.0037	294.6271	290.5404	300.8387	322.7625	350.4373	376.4477	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.4582	54.4582	54.4582	54.4582	54.4582	54.4582	54.4582	54.4582	54.4582	54.4582	54.4582	54.4582	(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)

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Losses e.g. evaporation (negative values) (Table 5)	-111.1896	-111.1896	-111.1896	-111.1896	-111.1896	-111.1896	-111.1896	-111.1896	-111.1896	-111.1896	-111.1896	-111.1896	(71)
Water heating gains (Table 5)	137.7785	135.5675	131.5377	124.9052	119.5854	112.4919	107.1098	112.7621	115.4582	122.5774	131.1106	137.5391	(72)
Total internal gains	683.6046	680.7899	659.5040	623.5867	584.8000	549.0253	527.4324	533.6883	553.6405	590.0447	632.0446	667.1545	(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	8.3200	11.3201	0.6300	0.7000	0.7700	28.7837 (74)							
East	4.6400	21.0039	0.6300	0.7000	0.7700	29.7845 (76)							
South	15.7800	49.0238	0.6300	0.7000	0.7700	236.4209 (78)							
Solar gains	294.9891	507.7411	694.5054	881.2493	937.0554	1009.5434	936.5615	870.0830	778.3678	575.1685	397.1473	279.4790	(83)
Total gains	978.5936	1188.5310	1354.0094	1504.8360	1521.8555	1558.5686	1463.9939	1403.7713	1332.0084	1165.2131	1029.1919	946.6335	(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	37.2763	37.2763	37.3185	37.5165	37.5535	37.6924	37.7249	37.7249	37.6591	37.5535	37.5165	37.4399		
alpha	3.4851	3.4851	3.4879	3.5011	3.5036	3.5128	3.5150	3.5150	3.5106	3.5036	3.5011	3.4960		
util living area	0.9642	0.9347	0.8814	0.7868	0.6706	0.4839	0.3754	0.3986	0.6065	0.8305	0.9327	0.9678	(86)	
Living	19.3392	19.6565	20.0901	20.5115	20.7816	20.9479	20.9834	20.9795	20.8802	20.4806	19.8700	19.2948		
Non living	18.0008	18.3943	18.9244	19.4208	19.7156	19.8728	19.8988	19.8969	19.8188	19.4016	18.6706	17.9480		
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0		
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0		
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10		
MIT	20.1504	19.6565	20.0901	20.5115	20.7816	20.9479	20.9834	20.9795	20.8802	20.4806	19.8700	19.5333	(87)	
Th 2	19.8939	19.8939	19.8950	19.9001	19.9011	19.9047	19.9055	19.9055	19.9038	19.9011	19.9001	19.8982	(88)	
util rest of house	0.9568	0.9220	0.8589	0.7487	0.6134	0.4068	0.2856	0.3062	0.5305	0.7910	0.9173	0.9611	(89)	
MIT 2	19.1392	18.3943	18.9244	19.4208	19.7156	19.8728	19.8988	19.8969	19.8188	19.4016	18.6706	18.2994	(90)	
Living area fraction												FLA = Living area / (4) =	0.3229	(91)
MIT	19.4657	18.8018	19.3008	19.7730	20.0598	20.2199	20.2490	20.2465	20.1615	19.7500	19.0579	18.6978	(92)	
Temperature adjustment													0.0000	
adjusted MIT	19.4657	18.8018	19.3008	19.7730	20.0598	20.2199	20.2490	20.2465	20.1615	19.7500	19.0579	18.6978	(93)	

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisation	0.9534	0.9064	0.8449	0.7439	0.6221	0.4297	0.3143	0.3356	0.5493	0.7849	0.9026	0.9517	(94)	
Useful gains	932.9879	1077.3236	1143.9516	1119.4218	946.7959	669.6403	460.1235	471.0490	731.7249	914.5224	928.9461	900.9089	(95)	
Ext temp.	4.3000	4.8000	6.6000	9.0000	11.8000	14.8000	16.6000	16.5000	14.0000	10.5000	7.1000	4.2000	(96)	
Heat loss rate W	1959.3227	1808.9579	1639.0159	1382.8992	1059.2445	692.4937	465.8292	478.2672	787.9445	1186.2284	1534.9993	1864.8515	(97)	
Space heating kWh	763.5931	491.6582	368.3278	189.7037	83.6618	0.0000	0.0000	0.0000	0.0000	202.1493	436.3583	717.1733	(98a)	
Space heating requirement - total per year (kWh/year)												3252.6255		
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	763.5931	491.6582	368.3278	189.7037	83.6618	0.0000	0.0000	0.0000	0.0000	202.1493	436.3583	717.1733	(98c)	
Space heating requirement after solar contribution - total per year (kWh/year)												3252.6255		
Space heating per m2												(98c) / (4) =	31.0365	(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 %)												271.0087	(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	763.5931	491.6582	368.3278	189.7037	83.6618	0.0000	0.0000	0.0000	0.0000	202.1493	436.3583	717.1733	(98)
Space heating efficiency (main heating system 1)	271.0087	271.0087	271.0087	271.0087	271.0087	0.0000	0.0000	0.0000	0.0000	271.0087	271.0087	271.0087	(210)
Space heating fuel (main heating system)	281.7597	181.4179	135.9100	69.9991	30.8705	0.0000	0.0000	0.0000	0.0000	74.5914	161.0127	264.6311	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	223.0996	182.8821	170.7671	120.2426	95.7441	62.0267	62.0132	89.9028	113.9605	163.9862	194.7269	223.6017	(64)
Efficiency of water heater (217)m	171.1243	171.1243	171.1243	171.1243	171.1243	171.1243	171.1243	171.1243	171.1243	171.1243	171.1243	171.1243	(216)
Fuel for water heating, kWh/month	130.3728	106.8709	99.7913	70.2663	55.9500	36.2466	36.2387	52.5366	66.5951	95.8287	113.7927	130.6662	(219)
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(231)
Lighting	36.7175	29.4561	26.5220	19.4311	15.0092	12.2626	13.6919	17.7972	23.1168	30.3305	34.2582	37.7380	(232)

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Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-40.8628	-61.0812	-90.9564	-104.1747	-106.8986	-98.6886	-95.6612	-92.4832	-82.7413	-70.8085	-49.9871	-37.9935	(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	-0.3125	-2.4849	-8.4288	-19.6062	-30.1451	-40.1583	-37.5312	-30.8449	-21.2450	-7.6369	-1.9334	-0.3386	(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												1200.1924	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												171.1243	
Water heating fuel used												995.1559	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
Total electricity for the above, kWh/year												0.0000	(231)
Electricity for lighting (calculated in Appendix L)												296.3311	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-1133.0029	(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												1358.6766	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1200.1924	25.1600	301.9684	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	995.1559	25.1600	250.3812	(247)
Energy for instantaneous electric shower(s)	0.0000	25.1600	0.0000	(247a)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(249)
Energy for lighting	296.3311	25.1600	74.5569	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-932.3371	25.1600	-234.5760	
PV Unit electricity exported	-200.6658	5.8100	-11.6587	
Total			-246.2347	(252)
Total energy cost			380.6719	(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	1200.1924	0.1562	187.4249	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	995.1559	0.1457	144.9464	(264)
Space and water heating			332.3714	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	296.3311	0.1443	42.7697	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-932.3371	0.1348	-125.6421	
PV Unit electricity exported	-200.6658	0.1159	-23.2594	
Total			-148.9015	(269)
Total CO2, kg/year			226.2396	(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	1200.1924	1.5781	1893.9992	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	995.1559	1.5388	1531.3429	(278)
Space and water heating			3425.3421	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	296.3311	1.5338	454.5226	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-932.3371	1.4981	-1396.7106	
PV Unit electricity exported	-200.6658	0.4249	-85.2584	
Total			-1481.9690	(283)
Total Primary energy kWh/year			2397.8957	(286)

## SAP 10 EPC IMPROVEMENTS

Adjacent To 7 Foster Close

Current energy efficiency rating: B 89  
Current environmental impact rating: A 98

# Full SAP Calculation Printout



N Solar water heating			Recommended
U Solar photovoltaic panels			Already installed
V2 Wind turbine			Not applicable
Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.0	-£ 27	-85 kg (37.5%)

Recommended measures	Typical annual savings		Energy efficiency	Environmental impact
Solar water heating	£27	0.81 kg/m <sup>2</sup>	B 90	A 98
<b>Total Savings</b>	<b>£27</b>	<b>0.81 kg/m<sup>2</sup></b>		
Potential energy efficiency rating:			B 90	
Potential environmental impact rating:				A 98

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

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

	Current	Potential	Saving
Electricity	£627	£645	-£18
Space heating	£302	£322	-£21
Water heating	£250	£248	£3
Lighting	£75	£75	£0
Generated (PV)	-£246	-£291	£45
<b>Total cost of fuels</b>	<b>£381</b>	<b>£354</b>	<b>£27</b>
<b>Total cost of uses</b>	<b>£381</b>	<b>£354</b>	<b>£27</b>
Delivered energy	13 kWh/m <sup>2</sup>	6 kWh/m <sup>2</sup>	7 kWh/m <sup>2</sup>
Carbon dioxide emissions	0.2 tonnes	0.1 tonnes	0.1 tonnes
CO2 emissions per m <sup>2</sup>	2 kg/m <sup>2</sup>	1 kg/m <sup>2</sup>	1 kg/m <sup>2</sup>
Primary energy	23 kWh/m <sup>2</sup>	21 kWh/m <sup>2</sup>	2 kWh/m <sup>2</sup>

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

### 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	104.8000 (1b)	x 2.4300 (2b)	= 254.6640 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	104.8000		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 254.6640 (5)

### 2. Ventilation rate

	Value	Reference
m3 per hour		
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	0 * 10 =	0.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)
Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000 (8)
Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design AP50	5.0000	(17)
Infiltration rate	0.2500	(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) =	0.2500 (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	0.3187	0.3125	0.3063	0.2750	0.2687	0.2375	0.2375	0.2313	0.2500	0.2687	0.2812	0.2938 (22b)
Effective ac	0.5508	0.5488	0.5469	0.5378	0.5361	0.5282	0.5282	0.5267	0.5312	0.5361	0.5396	0.5431 (25)

### 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
Opening Type 1 (Uw = 1.20)			28.7400	1.1450	32.9084		(27)
Heatloss Floor 1			104.8000	0.1000	10.4800	110.0000	11528.0000 (28a)
External Wall 1	109.8400	28.7400	81.1000	0.1700	13.7870	60.0000	4866.0000 (29a)
External Roof 1	104.8000		104.8000	0.1000	10.4800	9.0000	943.2000 (30)
Total net area of external elements Aum(A, m <sup>2</sup> )			319.4400				(31)

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Fabric heat loss, W/K = Sum (A x U) (26)...(30) + (32) = 67.6554 (33)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 17337.2000 (34)  
 Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 165.4313 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	15.8100	0.4000	6.3240
E3 Sill	4.9500	0.0420	0.2079
E4 Jamb	41.4000	0.0460	1.9044
E5 Ground floor (normal)	45.2000	0.0570	2.5764
E10 Eaves (insulation at ceiling level)	45.2000	0.1080	4.8816
E16 Corner (normal)	12.1500	0.0370	0.4496
E17 Corner (inverted - internal area greater than external area)	2.4300	-0.0610	-0.1482

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 16.1956 (36)  
 Point Thermal bridges 0.0000 (36a) =  
 Total fabric heat loss (33) + (36) + (36a) = 83.8510 (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	46.2888	46.1230	45.9605	45.1973	45.0545	44.3897	44.3897	44.2666	44.6458	45.0545	45.3434	45.6454 (38)
Average = Sum(39)m / 12 =	130.1398	129.9740	129.8116	129.0483	128.9055	128.2407	128.2407	128.1176	128.4968	128.9055	129.1944	129.4964 (39)

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.2418	1.2402	1.2387	1.2314	1.2300	1.2237	1.2237	1.2225	1.2261	1.2300	1.2328	1.2357 (40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

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

Assumed occupancy 2.7797 (42)

Hot water usage for mixer showers	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hot water usage for mixer showers	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	79.8726	78.6669	76.9516	74.3829	72.0679	68.8810	66.4633	69.4198	70.9714	74.1291	77.4121	79.8093 (42b)
Hot water usage for other uses	43.0973	41.5301	39.9630	38.3958	36.8286	35.2614	35.2614	36.8286	38.3958	39.9630	41.5301	43.0973 (42c)
Average daily hot water use (litres/day)	130.1398	129.9740	129.8116	129.0483	128.9055	128.2407	128.2407	128.1176	128.4968	128.9055	129.1944	129.4964 (43)

Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	122.9699	120.1970	116.9146	112.7787	108.8965	104.1425	101.7247	106.2484	109.3672	114.0920	118.9422	122.9066 (44)
Energy conte	181.0330	159.0450	167.0685	147.3171	140.3241	120.4373	112.4088	125.0563	126.8605	147.0191	160.7544	180.4973 (45)
Energy content (annual)	27.1549	23.8567	25.0603	22.0976	21.0486	18.0656	16.8613	18.7584	19.0291	22.0529	24.1132	27.0746 (46)

Water storage loss:  
 Store volume 210.0000 (47)  
 a) If manufacturer declared loss factor is known (kWh/day): 1.7700 (48)  
 Temperature factor from Table 2b 0.5400 (49)  
 Enter (49) or (54) in (55) 0.9558 (55)  
 Total storage loss 29.6298 26.7624 29.6298 28.6740 29.6298 28.6740 29.6298 29.6298 28.6740 29.6298 28.6740 29.6298 (56)

If cylinder contains dedicated solar storage 29.6298 26.7624 29.6298 28.6740 29.6298 28.6740 29.6298 29.6298 28.6740 29.6298 28.6740 29.6298 (57)

Primary loss	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624 (59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)

Total heat required for water heating calculated for each month 233.9252 206.8186 218.5650 191.7495 180.4220 159.0166 152.2740 165.8520 172.6436 198.5156 211.9404 233.3895 (62)

WWHRS	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000 (63b)

Aperture area of solar collector 3.0000 (H1)  
 Zero-loss collector efficiency 0.8000 (H2)  
 Collector linear heat loss coefficient 1.8000 (H3)  
 Collector 2nd order heat loss coefficient 0.0000 (H4)  
 Collector loop efficiency 0.9000 (H5)  
 Incidence angle modifier 1.0000 (H6)  
 Overshading factor 0.8000 (H8)  
 Overall heat loss coefficient of system 6.5000 (H10)  
 Heat loss coefficient of collector loop 3.9667 (H11)  
 Dedicated solar storage volume 75.0000 (H12)  
 Effective solar volume 75.0000 (H14)  
 Reference volume 225.0000 (H15)  
 Storage tank correction coefficient 1.3161 (H16)  
 Heat delivered to hot water 564.4576 (H24)  
 Heat delivered to space heating 0.0000 (H29)  
 Solar input 564.4576  
 Solar input -0.0000 -10.3979 -51.0477 -74.7441 -98.0054 -88.7878 -85.8776 -77.9919 -52.7525 -24.8527 -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 233.9252 196.4207 167.5173 117.0055 82.4167 70.2287 66.3965 87.8601 119.8910 173.6629 211.9404 233.3895 (64)  
 Total per year (kWh/year) = Sum(64)m = 1760.6544 (64)

Electric shower(s)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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 102.5072 91.1013 96.7475 84.5289 78.7361 70.9088 69.2681 74.2178 78.8076 90.0810 94.3996 102.3291 (65)

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

Metabolic gains (Table 5), Watts

(66)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	166.7844	166.7844	166.7844	166.7844	166.7844	166.7844	166.7844	166.7844	166.7844	166.7844	166.7844	166.7844 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	41.9487	37.2585	30.3006	22.9395	17.1476	14.4767	15.6426	20.3328	27.2907	34.6518	40.4438	43.1146 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	393.8243	397.9110	387.6127	365.6889	338.0141	312.0037	294.6271	290.5404	300.8387	322.7625	350.4373	376.4477 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.4582	54.4582	54.4582	54.4582	54.4582	54.4582	54.4582	54.4582	54.4582	54.4582	54.4582	54.4582 (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)	-111.1896	-111.1896	-111.1896	-111.1896	-111.1896	-111.1896	-111.1896	-111.1896	-111.1896	-111.1896	-111.1896	-111.1896 (71)
Water heating gains (Table 5)	137.7785	135.5675	130.0369	117.4012	105.8281	98.4845	93.1023	99.7551	109.4550	121.0766	131.1106	137.5391 (72)

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Total internal gains  
683.6046 680.7899 658.0032 616.0827 571.0427 535.0178 513.4250 520.6814 547.6373 588.5439 632.0446 667.1545 (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	8.3200	10.6334	0.6300	0.6300	0.7000	0.7700	27.0375 (74)					
East	4.6400	19.6403	0.6300	0.6300	0.7000	0.7700	27.8508 (76)					
South	15.7800	46.7521	0.6300	0.6300	0.7000	0.7700	225.4653 (78)					
Solar gains	280.3535	475.4061	647.8883	803.5003	904.3243	900.6714	867.0699	790.7618	701.2679	524.4291	335.3341	240.2657 (83)
Total gains	963.9581	1156.1960	1305.8915	1419.5829	1475.3670	1435.6892	1380.4948	1311.4431	1248.9052	1112.9729	967.3788	907.4201 (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	37.0055	37.0527	37.0991	37.3185	37.3598	37.5535	37.5535	37.5896	37.4787	37.3598	37.2763	37.1894
alpha	3.4670	3.4702	3.4733	3.4879	3.4907	3.5036	3.5036	3.5060	3.4986	3.4907	3.4851	3.4793
util living area	0.9659	0.9386	0.8932	0.8126	0.6908	0.5341	0.3980	0.4340	0.6309	0.8434	0.9430	0.9716 (86)
Living	19.3042	19.6242	20.0220	20.4418	20.7541	20.9261	20.9797	20.9723	20.8647	20.4498	19.7912	19.2311
Non living	17.9524	18.3511	18.8393	19.3402	19.6846	19.8536	19.8929	19.8899	19.8030	19.3651	18.5707	17.8639
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10
MIT	20.1325	19.6242	20.0220	20.4418	20.7541	20.9261	20.9797	20.9723	20.8647	20.4498	19.7912	19.4785 (87)
Th 2	19.8867	19.8880	19.8892	19.8950	19.8961	19.9011	19.9011	19.9020	19.8992	19.8961	19.8939	19.8916 (88)
util rest of house	0.9587	0.9264	0.8723	0.7770	0.6345	0.4547	0.3033	0.3368	0.5529	0.8051	0.9295	0.9656 (89)
MIT 2	19.1156	18.3511	18.8393	19.3402	19.6846	19.8536	19.8929	19.8899	19.8030	19.3651	18.5707	18.2293 (90)
Living area fraction	19.4439	18.7622	19.2212	19.6959	20.0300	20.1999	20.2438	20.2394	20.1458	19.7153	18.9648	18.6327 (92)
MIT	19.4439	18.7622	19.2212	19.6959	20.0300	20.1999	20.2438	20.2394	20.1458	19.7153	18.9648	0.0000
Temperature adjustment												0.0000
adjusted MIT	19.4439	18.7622	19.2212	19.6959	20.0300	20.1999	20.2438	20.2394	20.1458	19.7153	18.9648	18.6327 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9554	0.9109	0.8576	0.7698	0.6418	0.4771	0.3334	0.3675	0.5714	0.7979	0.9151	0.9566 (94)
Useful gains	920.9324	1053.1527	1119.9031	1092.8406	946.9053	684.9797	460.2837	481.8959	713.6176	888.0494	885.2027	868.0829 (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	1970.8272	1801.7296	1651.3621	1393.1978	1073.7778	718.1352	467.2849	491.8922	776.8673	1175.0179	1532.8673	1868.9809 (97)
Space heating kWh	781.1217	503.0437	395.4054	216.2572	94.3931	0.0000	0.0000	0.0000	0.0000	213.5046	466.3185	744.6681 (98a)
Space heating requirement - total per year (kWh/year)												3414.7125
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	781.1217	503.0437	395.4054	216.2572	94.3931	0.0000	0.0000	0.0000	0.0000	213.5046	466.3185	744.6681 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3414.7125
Space heating per m2										(98c) / (4) =		32.5831 (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 %) 271.1944 (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	781.1217	503.0437	395.4054	216.2572	94.3931	0.0000	0.0000	0.0000	0.0000	213.5046	466.3185	744.6681 (98)
Space heating efficiency (main heating system 1)	271.1944	271.1944	271.1944	271.1944	271.1944	0.0000	0.0000	0.0000	0.0000	271.1944	271.1944	271.1944 (210)
Space heating fuel (main heating system)	288.0302	185.4919	145.8015	79.7425	34.8065	0.0000	0.0000	0.0000	0.0000	78.7275	171.9499	274.5883 (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	233.9252	196.4207	167.5173	117.0055	82.4167	70.2287	66.3965	87.8601	119.8910	173.6629	211.9404	233.3895 (64)
Efficiency of water heater (217)m	171.1358	171.1358	171.1358	171.1358	171.1358	171.1358	171.1358	171.1358	171.1358	171.1358	171.1358	171.1358 (216)
Fuel for water heating, kWh/month	136.6898	114.7747	97.8856	68.3700	48.1586	41.0368	38.7975	51.3394	70.0561	101.4767	123.8434	136.3768 (219)
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	6.7945	6.1370	6.7945	6.5753	6.7945	6.5753	6.7945	6.7945	6.5753	6.7945	6.5753	6.7945 (231)
Lighting	36.7175	29.4561	26.5220	19.4311	15.0092	12.2626	13.6919	17.7972	23.1168	30.3305	34.2582	37.7380 (232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-38.9053	-57.7907	-86.3862	-98.7314	-104.7788	-94.5154	-93.0587	-87.9833	-77.9226	-66.1918	-43.4292	-33.1485 (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)



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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	-11.1812	-25.7892	-55.9600	-92.0407	-130.9040	-137.1983	-135.5928	-111.7906	-78.5405	-40.6541	-15.9806	-8.7654	(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													1259.1383 (211)
Space heating fuel - main system 2													0.0000 (213)
Space heating fuel - secondary													0.0000 (215)
Efficiency of water heater													171.1358
Water heating fuel used													1028.8053 (219)
Space cooling fuel													0.0000 (221)
Electricity for pumps and fans: pump for solar water heating													80.0000 (230g)
Total electricity for the above, kWh/year													80.0000 (231)
Electricity for lighting (calculated in Appendix L)													296.3311 (232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation													-1727.2394 (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													937.0353 (238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1259.1383	16.4900	207.6319	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1028.8053	16.4900	169.6500	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(249)
Pump for solar water heating	80.0000	16.4900	13.1920	(249)
Energy for lighting	296.3311	16.4900	48.8650	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-882.8421	16.4900	-145.5807	
PV Unit electricity exported	-844.3973	5.5900	-47.2018	
Total			-192.7825	(252)
Total energy cost			246.5564	(255)

## 11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600	(256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	0.5925	(257)
SAP value		90.3952	
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	1259.1383	0.1559	196.3622	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1028.8053	0.1458	150.0131	(264)
Space and water heating			346.3753	(265)
Pumps, fans and electric keep-hot	80.0000	0.1387	11.0970	(267)
Energy for lighting	296.3311	0.1443	42.7697	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-882.8421	0.1345	-118.7497	
PV Unit electricity exported	-844.3973	0.1231	-103.9446	
Total			-222.6943	(269)
Total CO2, kg/year			177.5477	(272)
CO2 emissions per m2			1.6900	(273)
EI value			98.4118	
EI rating			98	(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)
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Ground floor  
 Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 104.8000 104.8000 (1b) x 2.4300 (2b) = 254.6640 (1b) - (3b)  
 Dwelling volume (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 254.6640 (4)  
 (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 5.0000 (17)  
 Infiltration rate 0.2500 (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) = 0.2500 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.5000	4.5000	4.4000	3.9000	3.8000	3.4000	3.3000	3.3000	3.5000	3.8000	3.9000	4.1000
Wind factor	1.1250	1.1250	1.1000	0.9750	0.9500	0.8500	0.8250	0.8250	0.8750	0.9500	0.9750	1.0250
Adj infiltr rate	0.2812	0.2812	0.2750	0.2437	0.2375	0.2125	0.2062	0.2062	0.2188	0.2375	0.2437	0.2562
Effective ac	0.5396	0.5396	0.5378	0.5297	0.5282	0.5226	0.5213	0.5213	0.5239	0.5282	0.5297	0.5328

## 3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
Opening Type 1 (Uw = 1.20)			28.7400	1.1450	32.9084		
Heatloss Floor 1			104.8000	0.1000	10.4800	110.0000	11528.0000
External Wall 1	109.8400	28.7400	81.1000	0.1700	13.7870	60.0000	4866.0000
External Roof 1	104.8000		104.8000	0.1000	10.4800	9.0000	943.2000
Total net area of external elements Aum(A, m2)			319.4400				
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 67.6554		

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 17337.2000 (34)  
 Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 165.4313 (35)

### List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	15.8100	0.4000	6.3240
E3 Sill	4.9500	0.0420	0.2079
E4 Jamb	41.4000	0.0460	1.9044
E5 Ground floor (normal)	45.2000	0.0570	2.5764
E10 Eaves (insulation at ceiling level)	45.2000	0.1080	4.8816
E16 Corner (normal)	12.1500	0.0370	0.4496
E17 Corner (inverted - internal area greater than external area)	2.4300	-0.0610	-0.1482

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 16.1956 (36)

Point Thermal bridges (36a) = 0.0000  
 Total fabric heat loss (33) + (36) + (36a) = 83.8510 (37)

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

(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	45.3434	45.3434	45.1973	44.5161	44.3897	43.9170	43.8070	43.8070	44.0303	44.3897	44.5161	44.7787
Heat transfer coeff	129.1944	129.1944	129.0483	128.3671	128.2407	127.7680	127.6580	127.6580	127.8813	128.2407	128.3671	128.6298
Average = Sum(39)m / 12 =												128.3540

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.2328	1.2328	1.2314	1.2249	1.2237	1.2192	1.2181	1.2181	1.2202	1.2237	1.2249	1.2274
HLP (average)												1.2248
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

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

Assumed occupancy 2.7797 (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 79.8726 78.6669 76.9516 74.3829 72.0679 68.8810 66.4633 69.4198 70.9714 74.1291 77.4121 79.8093 (42b)  
 Hot water usage for other uses 43.0973 41.5301 39.9630 38.3958 36.8286 35.2614 35.2614 36.8286 38.3958 39.9630 41.5301 43.0973 (42c)  
 Average daily hot water use (litres/day) 113.2402 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	122.9699	120.1970	116.9146	112.7787	108.8965	104.1425	101.7247	106.2484	109.3672	114.0920	118.9422	122.9066
Energy conte	181.0330	159.0450	167.0685	147.3171	140.3241	120.4373	112.4088	125.0563	126.8605	147.0191	160.7544	180.4973
Energy content (annual)										Total = Sum(45)m =		1767.8214
Distribution loss (46)m = 0.15 x (45)m	27.1549	23.8567	25.0603	22.0976	21.0486	18.0656	16.8613	18.7584	19.0291	22.0529	24.1132	27.0746
Water storage loss:												210.0000
Store volume												1.7700
a) If manufacturer declared loss factor is known (kWh/day):												0.5400
Temperature factor from Table 2b												0.9558
Enter (49) or (54) in (55)												
Total storage loss	29.6298	26.7624	29.6298	28.6740	29.6298	28.6740	29.6298	29.6298	28.6740	29.6298	28.6740	29.6298

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If cylinder contains dedicated solar storage												
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624 (59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)
Total heat required for water heating calculated for each month												
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63a)
FV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000 (63b)
Aperture area of solar collector												
Zero-loss collector efficiency												0.8000 (H1)
Collector linear heat loss coefficient												1.8000 (H2)
Collector 2nd order heat loss coefficient												0.0000 (H3)
Collector loop efficiency												0.9000 (H4)
Incidence angle modifier												1.0000 (H5)
Overshading factor												0.8000 (H6)
Overall heat loss coefficient of system												6.5000 (H7)
Heat loss coefficient of collector loop												3.9667 (H8)
Dedicated solar storage volume												75.0000 (H9)
Effective solar volume												75.0000 (H10)
Reference volume												225.0000 (H11)
Storage tank correction coefficient												1.3161 (H12)
Heat delivered to hot water												640.6421 (H13)
Heat delivered to space heating												0.0000 (H14)
Solar input												640.6421 (H15)
Solar input	-0.0000	-14.5175	-58.5125	-85.3027	-102.6068	-100.9675	-93.8644	-88.3479	-62.8277	-32.3170	-1.3782	-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	233.9252	192.3011	160.0525	106.4468	77.8153	58.0491	58.4096	77.5041	109.8159	166.1986	210.5622	233.3895 (64)
											Total per year (kWh/year) = Sum(64)m =	1684.4699 (64)
Electric shower(s)												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												
	102.5072	91.1013	96.7475	84.5289	78.7361	70.9088	69.2681	74.2178	78.8076	90.0810	94.3996	102.3291 (65)

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

Metabolic gains (Table 5), Watts												
(66)m	166.7844	166.7844	166.7844	166.7844	166.7844	166.7844	166.7844	166.7844	166.7844	166.7844	166.7844	166.7844 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	41.9487	37.2585	30.3006	22.9395	17.1476	14.4767	15.6426	20.3328	27.2907	34.6518	40.4438	43.1146 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	393.8243	397.9110	387.6127	365.6889	338.0141	312.0037	294.6271	290.5404	300.8387	322.7625	350.4373	376.4477 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.4582	54.4582	54.4582	54.4582	54.4582	54.4582	54.4582	54.4582	54.4582	54.4582	54.4582	54.4582 (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)	-111.1896	-111.1896	-111.1896	-111.1896	-111.1896	-111.1896	-111.1896	-111.1896	-111.1896	-111.1896	-111.1896	-111.1896 (71)
Water heating gains (Table 5)	137.7785	135.5675	130.0369	117.4012	105.8281	98.4845	93.1023	99.7551	109.4550	121.0766	131.1106	137.5391 (72)
Total internal gains	683.6046	680.7899	658.0032	616.0827	571.0427	535.0178	513.4250	520.6814	547.6373	588.5439	632.0446	667.1545 (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		8.3200	11.3201	0.6300	0.7000	0.7700	28.7837 (74)					
East		4.6400	21.0039	0.6300	0.7000	0.7700	29.7845 (76)					
South		15.7800	49.0238	0.6300	0.7000	0.7700	236.4209 (78)					
Solar gains	294.9891	507.7411	694.5054	881.2493	937.0554	1009.5434	936.5615	870.0830	778.3678	575.1685	397.1473	279.4790 (83)
Total gains	978.5936	1188.5310	1352.5086	1497.3320	1508.0982	1544.5612	1449.9865	1390.7643	1326.0052	1163.7123	1029.1919	946.6335 (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	37.2763	37.2763	37.3185	37.5165	37.5535	37.6924	37.7249	37.7249	37.6591	37.5535	37.5165	37.4399
alpha	3.4851	3.4851	3.4879	3.5011	3.5036	3.5128	3.5150	3.5150	3.5106	3.5036	3.5011	3.4960
util living area	0.9642	0.9347	0.8817	0.7887	0.6746	0.4877	0.3788	0.4020	0.6086	0.8309	0.9327	0.9678 (86)
Living	19.3392	19.6565	20.0888	20.5073	20.7773	20.9466	20.9829	20.9789	20.8790	20.4796	19.8700	19.2948
Non living	18.0008	18.3943	18.9229	19.4163	19.7116	19.8719	19.8986	19.8967	19.8178	19.4005	18.6706	17.9480
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10
MIT	20.1504	19.6565	20.0888	20.5073	20.7773	20.9466	20.9829	20.9789	20.8790	20.4796	19.8700	19.5333 (87)
Th 2	19.8939	19.8939	19.8950	19.9001	19.9011	19.9047	19.9055	19.9055	19.9038	19.9011	19.9001	19.8982 (88)
util rest of house	0.9568	0.9220	0.8593	0.7508	0.6175	0.4102	0.2883	0.3090	0.5325	0.7915	0.9173	0.9611 (89)
MIT 2	19.1392	18.3943	18.9229	19.4163	19.7116	19.8719	19.8986	19.8967	19.8178	19.4005	18.6706	18.2994 (90)
Living area fraction												fLA = Living area / (4) =
MIT	19.4657	18.8018	19.2994	19.7686	20.0557	20.2189	20.2487	20.2461	20.1604	19.7489	19.0579	18.6978 (92)
Temperature adjustment												0.0000
adjusted MIT	19.4657	18.8018	19.2994	19.7686	20.0557	20.2189	20.2487	20.2461	20.1604	19.7489	19.0579	18.6978 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9534	0.9064	0.8452	0.7458	0.6260	0.4331	0.3172	0.3385	0.5513	0.7853	0.9026	0.9517 (94)
Useful gains	932.9879	1077.3236	1143.1116	1116.6797	944.0845	668.9398	459.9170	470.8004	730.9760	913.8672	928.9461	900.9089 (95)

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Ext temp.	4.3000	4.8000	6.6000	9.0000	11.8000	14.8000	16.6000	16.5000	14.0000	10.5000	7.1000	4.2000 (96)
Heat loss rate W	1959.3227	1808.9579	1638.8339	1382.3356	1058.7223	692.3680	465.7919	478.2223	787.8053	1186.0913	1534.9993	1864.8515 (97)
Space heating kWh	763.5931	491.6582	368.8174	191.2722	85.2905	0.0000	0.0000	0.0000	0.0000	202.5347	436.3583	717.1733 (98a)
Space heating requirement - total per year (kWh/year)												3256.6977
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	763.5931	491.6582	368.8174	191.2722	85.2905	0.0000	0.0000	0.0000	0.0000	202.5347	436.3583	717.1733 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3256.6977
Space heating per m2												(98c) / (4) = 31.0754 (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 %)												271.0087 (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	763.5931	491.6582	368.8174	191.2722	85.2905	0.0000	0.0000	0.0000	0.0000	202.5347	436.3583	717.1733 (98)
Space heating efficiency (main heating system 1)	271.0087	271.0087	271.0087	271.0087	271.0087	0.0000	0.0000	0.0000	0.0000	271.0087	271.0087	271.0087 (210)
Space heating fuel (main heating system)	281.7597	181.4179	136.0906	70.5779	31.4715	0.0000	0.0000	0.0000	0.0000	74.7337	161.0127	264.6311 (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	233.9252	192.3011	160.0525	106.4468	77.8153	58.0491	58.4096	77.5041	109.8159	166.1986	210.5622	233.3895 (64)
Efficiency of water heater (217)m	171.1243	171.1243	171.1243	171.1243	171.1243	171.1243	171.1243	171.1243	171.1243	171.1243	171.1243	171.1243 (216)
Fuel for water heating, kWh/month	136.6990	112.3751	93.5300	62.2044	45.4730	33.9222	34.1329	45.2911	64.1732	97.1216	123.0464	136.3860 (219)
Space cooling fuel requirement												
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	6.7945	6.1370	6.7945	6.5753	6.7945	6.5753	6.7945	6.7945	6.5753	6.7945	6.5753	6.7945 (231)
Lighting	36.7175	29.4561	26.5220	19.4311	15.0092	12.2626	13.6919	17.7972	23.1168	30.3305	34.2582	37.7380 (232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	-40.9568	-61.3134	-90.9871	-104.0974	-106.5206	-99.3990	-96.4143	-92.4222	-83.1449	-71.1379	-50.2282	-38.0784 (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	-12.2470	-28.8488	-63.0577	-106.6396	-138.8256	-161.2218	-151.5423	-128.7344	-92.0480	-47.2242	-20.8184	-11.1291 (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												1201.6950 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												171.1243
Water heating fuel used												984.3548 (219)
Space cooling fuel												0.0000 (221)
Electricity for pumps and fans:												
pump for solar water heating												80.0000 (230g)
Total electricity for the above, kWh/year												80.0000 (231)
Electricity for lighting (calculated in Appendix L)												296.3311 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-1897.0374 (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												665.3435 (238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	1201.6950	25.1600	302.3465 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	984.3548	25.1600	247.6637 (247)
Energy for instantaneous electric shower(s)	0.0000	25.1600	0.0000 (247a)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (249)
Pump for solar water heating	80.0000	25.1600	20.1280 (249)
Energy for lighting	296.3311	25.1600	74.5569 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-934.7002	25.1600	-235.1706
PV Unit electricity exported	-962.3372	5.8100	-55.9118
Total			-291.0824 (252)
Total energy cost			353.6127 (255)

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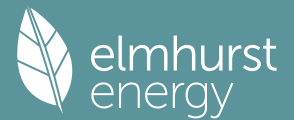
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 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP  
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	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	1201.6950	0.1561	187.6340 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	984.3548	0.1465	144.2503 (264)
Space and water heating			331.8843 (265)
Pumps, fans and electric keep-hot	80.0000	0.1387	11.0970 (267)
Energy for lighting	296.3311	0.1443	42.7697 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-934.7002	0.1347	-125.9446
PV Unit electricity exported	-962.3372	0.1231	-118.4978
Total			-244.4424 (269)
Total CO2, kg/year			141.3086 (272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	1201.6950	1.5780	1896.2756 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	984.3548	1.5421	1517.9841 (278)
Space and water heating			3414.2597 (279)
Pumps, fans and electric keep-hot	80.0000	1.5128	121.0240 (281)
Energy for lighting	296.3311	1.5338	454.5226 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-934.7002	1.4980	-1400.1904
PV Unit electricity exported	-962.3372	0.4518	-434.8049
Total			-1834.9952 (283)
Total Primary energy kWh/year			2154.8111 (286)

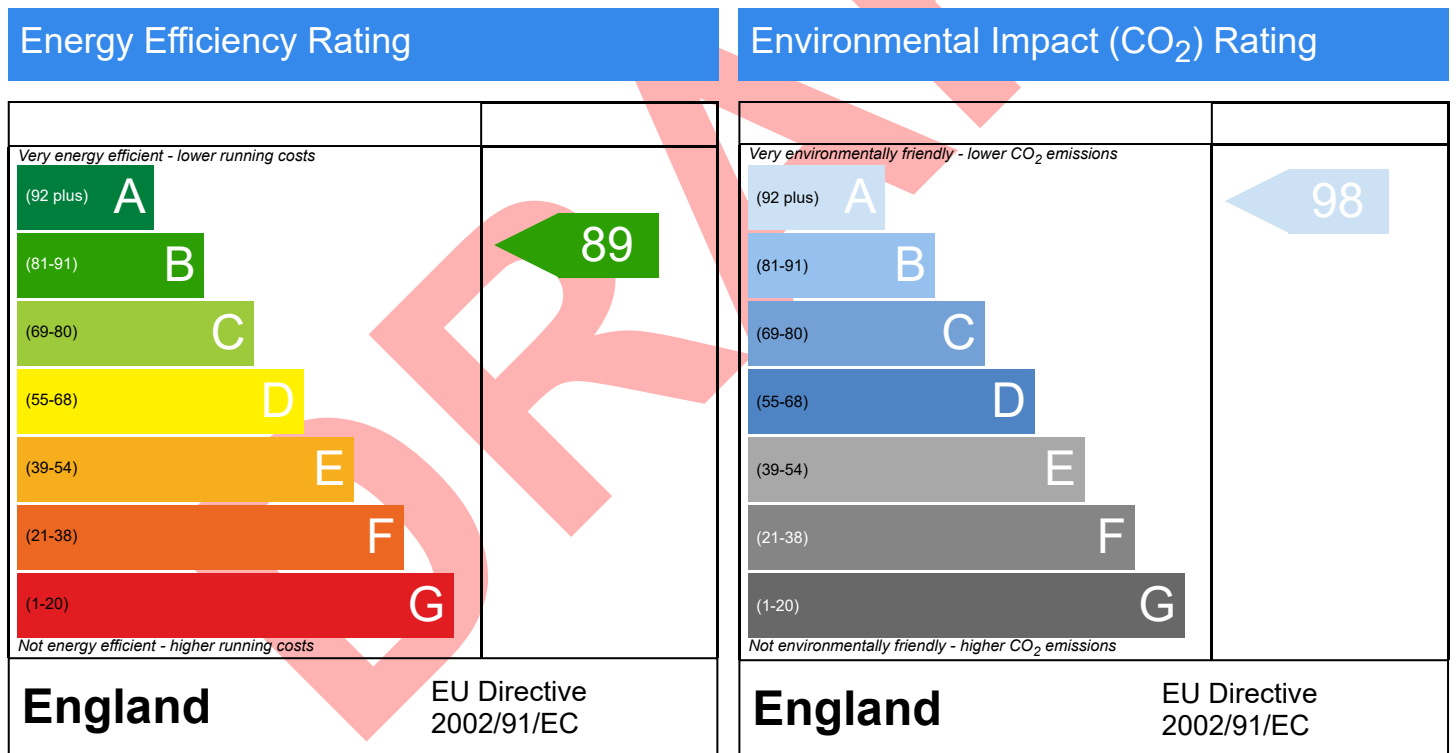
# Predicted Energy Assessment



Dwelling type: Bungalow, Detached  
 Date of assessment: 31/01/2024  
 Produced by: John Ashe  
 Total floor area: 104.8 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	Adjacent To 7 Foster Close	Issued on Date	31/01/2024
Assessment Reference	Adjacent To 7 Foster Close	Prop Type Ref	Adjacent To 7 Foster Close
Property			

SAP Rating	89 B	DER	2.51	TER	8.46
Environmental	98 A	% DER < TER			70.33
CO <sub>2</sub> Emissions (t/year)	0.23	DFEE	42.46	TFEE	43.44
Compliance Check	See BREL	% DFEE < TFEE			2.25
% DPER < TPER	42.56	DPER	26.35	TPER	45.88

Assessor Details	Mr. John Ashe	Assessor ID	AV69-0001
Client	N/A, N/A		

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

Orientation	North
Property Tenture	ND
Transaction Type	6
Terrain Type	Urban
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	Standard
Smart electricity meter fitted	Yes
Smart gas meter fitted	Yes

7.0 Measurements		Heat Loss Perimeter	Internal Floor Area	Average Storey Height
	Ground floor:	45.20 m	104.80 m <sup>2</sup>	2.43 m

8.0 Living Area	33.84	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 Wall 1	Cavity Wall	Cavity wall : plasterboard on dabs, AAC block, filled cavity, any outside structure	0.17	60.00	109.84	81.10	0.00	None	28.74	Enter Gross Area

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 1	External Plane Roof	Plasterboard, insulated at ceiling level	0.10	9.00	104.80	104.80	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 1	Ground Floor - Solid	Lowest occupied	Slab on ground, screed over insulation	0.10	None	0.00	110.00	104.80

Description	Data Source	Type	Glazing	Glazing Gap	Filling Type	G-value	Frame Type	Frame Factor	U Value (W/m <sup>2</sup> K)
Opening Type 1	Manufacturer	Window	Double Low-E Soft 0.05			0.63		0.70	1.20

Name	Opening Type	Location	Orientation	Area (m <sup>2</sup> )	Pitch
Opening	Opening Type 1	External Wall 1	North	8.32	
Opening	Opening Type 1	External Wall 1	South	15.78	
Opening	Opening Type 1	External Wall 1	East	4.64	

14.0 Conservatory	None
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15.0 Draught Proofing	100	%
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16.0 Draught Lobby	No
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# Summary for Input Data



## 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	15.81	0.40	0.40	No
E3 Sill	Independently assessed	4.95	0.04	0.04	No
E4 Jamb	Independently assessed	41.40	0.05	0.05	No
E5 Ground floor (normal)	Independently assessed	45.20	0.06	0.06	No
E10 Eaves (insulation at ceiling level)	Independently assessed	45.20	0.11	0.11	No
E16 Corner (normal)	Independently assessed	12.15	0.04	0.04	No
E17 Corner (inverted – internal area greater than external area)	Independently assessed	2.43	-0.06	-0.06	No

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

## 18.0 Pressure Testing

Designed AP<sub>50</sub>  m<sup>2</sup>/(h.m<sup>2</sup>) @ 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	100.00	1	100	10

### 24.0 Main Heating 1

Percentage of Heat  %

Database Ref. No.

Fuel Type

In Winter

In Summer

Model Name

Manufacturer

System Type

Controls SAP Code

Is MHS Pumped

Heating Pump Age

Heat Emitter

Flow Temperature

Flow Temperature Value

### 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

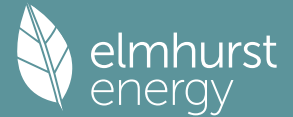
SAP Code

Flue Gas Heat Recovery System

Waste Water Heat Recovery Instantaneous System 1



# Summary for Input Data



Waste Water Heat Recovery Instantaneous System 2	No
Waste Water Heat Recovery Storage System	No
Solar Panel	No
Water use <= 125 litres/person/day	Yes
Cold Water Source	From header tank
Bath Count	1
Immersion Only Heating Hot Water	No

## 28.3 Waste Water Heat Recovery System

### 29.0 Hot Water Cylinder

Hot Water Cylinder	Hot Water Cylinder	
Cylinder Stat	Yes	
Cylinder In Heated Space	Yes	
Independent Time Control	Yes	
Insulation Type	Measured Loss	
Cylinder Volume	210.00	L
Loss	1.77	kWh/day
Pipes insulation	Fully insulated primary pipework	
In Airing Cupboard	No	

### 31.0 Thermal Store

None

### 32.0 Photovoltaic Unit

One Dwelling	
Export Capable Meter?	Yes
Connected To Dwelling	Yes
Diverter	Yes
Battery Capacity [kWh]	0.00

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

### 34.0 Small-scale Hydro

None

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

### Recommendations

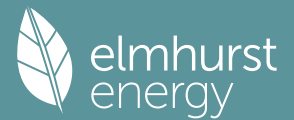
Lower cost measures

None

Further measures to achieve even higher standards

Typical Cost	Typical savings per year	Ratings after improvement	
		SAP rating	Environmental Impact
£4,000 - £6,000	£27	B 90	A 98
		0	0
		0	0

# Thermal Bridging



Property Reference	Adjacent To 7 Foster Close		Issued on Date	31/01/2024
Assessment Reference	Adjacent To 7 Foster Close	Prop Type Ref	Detached Bungalow	
Property				

SAP Rating	89 B	DER	2.51	TER	8.46
Environmental	98 A	% DER < TER			70.33
CO <sub>2</sub> Emissions (t/year)	0.23	DFEE	42.46	TFEE	43.44
Compliance Check	See BREL	% DFEE < TFEE			2.25
% DPER < TPER	42.56	DPER	26.35	TPER	45.88

Assessor Details	Mr. John Ashe	Assessor ID	AV69-0001
Client	N/A, N/A		

	Junction details	Source Type	Psi (W/mK)	Length (m)	Result	Reference
External wall	E1 Steel lintel with perforated steel base plate	Independently assessed	0.400	15.81	6.32	
External wall	E3 Sill	Independently assessed	0.042	4.95	0.21	
External wall	E4 Jamb	Independently assessed	0.046	41.40	1.90	
External wall	E5 Ground floor (normal)	Independently assessed	0.057	45.20	2.58	
External wall	E10 Eaves (insulation at ceiling level)	Independently assessed	0.108	45.20	4.88	
External wall	E16 Corner (normal)	Independently assessed	0.037	12.15	0.45	
External wall	E17 Corner (inverted – internal area greater than external area)	Independently assessed	-0.061	2.43	-0.15	

Total: 167.14 W/mK:  
 Y-Value: 0.05 W/m<sup>2</sup>K:

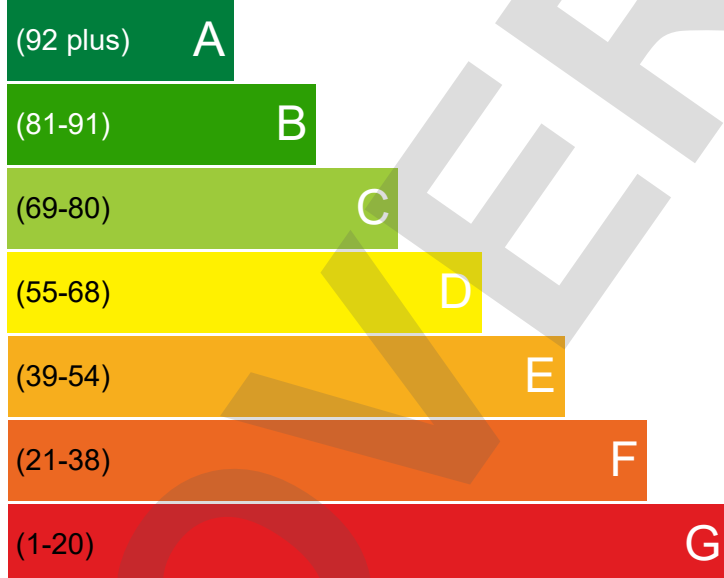
Dwelling Address	
Report Date	31/01/2024
Property Type	Bungalow, Detached
Floor Area [m <sup>2</sup> ]	105

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

POTENTIAL

89

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 0.17 W/m <sup>2</sup> K	Very Good
Roof	Average thermal transmittance 0.1 W/m <sup>2</sup> K	Very Good
Floor	Average thermal transmittance 0.1 W/m <sup>2</sup> K	Very Good
Windows	High performance glazing	Very Good
Main heating	Air source heat pump, radiators, electric	Good
Main heating controls	Time and temperature zone control	Very Good
Secondary heating	None	
Hot water	From main system	Average
Lighting	Excellent lighting efficiency	Very Good
Air tightness	Air permeability [AP50] = 5.0 m <sup>3</sup> /h.m <sup>2</sup> (assumed)	Good

## Primary Energy use

The primary energy use for this property per year is 23 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: **0.2** per year

With the recommended measures the potential CO emissions could be: **0.0** 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	£27	 1	£27	 B 90
Photovoltaic		 -90	£381	 G 0

## Estimated energy use and potential savings

Estimated energy cost for this property over a year

**£381**

Over a year you could save

**£27**

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	Mr. John Ashe
Assessor's accreditation number	
Email Address	

## Accreditation scheme contact details

Accreditation scheme	
Telephone	
Email Address	

## Assessment details

Related party disclosure	
Date of assessment	26/01/2024
Date of certificate	26/01/2024
Type of assessment	SAP, new dwelling